

**THE INFLUENCE OF EDUCATIONAL LEADERSHIP ON  
QUALITY TEACHING AND LEARNING OF HIGH SCHOOL  
MATHEMATICS**

**A thesis submitted in fulfilment of the requirement for the degree  
Doctor of Philosophy  
in  
Mathematics Education**

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December 2019**

**Abstract**

I address the relevance of quality learning and teaching in South African high schools' as it relates to the strategic direction provided by high school leadership for the benefit of knowledge economies and higher learning institutions. The main research question is: "How does educational leadership influence the quality of learning and teaching of high school mathematics?" The research was framed within a confirmatory study viewing quality learning and teaching from a doing mathematics perspective, within the context of a community of practice acknowledging that school leadership can also be situated within the same practice, i.e. doing mathematics. The research was qualitatively designed to employ unstructured, semi-structured and focus group discussion interviews with the school leaders, teachers and students respectively. These enquiries were conducted within six high schools' representatives of all previously South African demographical perspectives. The analysis was conducted through interpretive phenomenological analysis for sensemaking of situational leadership within a mathematical practice. The findings of the research lacked "doing mathematical" depth, beyond students and teachers. Explanatory findings of a grounded theoretical analysis yielded a school leadership's silence on quality learning and teaching of mathematics contrary to the literature review's expectation. The significance of the study lies in the possibilities associated with an under-research stakeholder to the development of quality learning and teaching of mathematics and meeting the expectations of knowledge economies and higher educational institutions.

**Keywords:** Mathematics education; quality teaching of mathematics; quality learning of mathematics; doing mathematics; situated leadership; principles of learning; the learning walk; nested learning community; high school leadership; communities of practices.

**Declaration**

I declare that “Educational Leadership’s Influence on Quality Teaching and Learning of High School Mathematics” is my own work; that all sources I have used or quoted have been indicated and acknowledged by means of complete references; and that this work has not been submitted previously in its entirety, or in any other higher education institution for degree purposes.

.....

Ronald A. Fortune

November 2019

## **Dedication**

This thesis is dedicated to:

- My wife, Avril Fortune, who inspires me to focus and balance my life,
- My daughter, Tatum Fortune, whose musical talent helped me to realise that there is aesthetical value even in teaching high school mathematics.
- My son, Timothy Fortune who shows much promise, academically.
- My late parents, Neville and Dorothy Fortune who, I know, would have been very proud of this achievement in my life.

**Acknowledgements**

My very first acknowledgement is to the Almighty God, to whom all honour is due!

This was not an easy research to undertake and could not have been possible without the help and support of a range of people. This is my opportunity to honour them and thank them for helping me in making this thesis a reality.

Firstly, I would like to thank the participating schools' principals, teachers and students who availed themselves to be part of this research. Their cooperation is appreciated. I would also like to thank the Western Cape education Department (WCED) for giving me the permission to conduct the research in their schools.

Secondly, I would like to thank Christel DeHaan, who inspired me to be innovative and taught me to look at mathematics education from a completely different vantage point. I would like to thank her for her wisdom which motivated me to take on this venture. Thanks also to all my work colleagues for their inspiration and motivation to persevere.

Finally, I would like to thank my supervisors, Professor Cyril Julie and Prof Monde Mbekwa who inspired me with their knowledge, wisdom and recognition of potential in me.

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**List of Acronyms**

OBE	Outcomes Based Education
CoP	Communities of practice
LPP	Legitimate Peripheral Participation
TIMSS	Trends in International Mathematics and Science Study
CAPS	Curriculum and Assessment Policy Statements
NSC	National Senior Certificate
UCT	University of Cape Town
UWC	University of the Western Cape
IPA	Interpretive Phenomenological Assessment
Ex-HOA	Ex - House of Assembly
Ex-HOD	Ex – House of Delegates
Ex-HOR	Ex – House of Representatives
Ex-DET	Ex – Department Education and Training

## Chapter 1

### A case for Leadership in Mathematics

#### 1.1. Introduction

This study investigated high school leaders' influence on the quality of teaching and learning of mathematics in the school. The main goal was to investigate the actions of school leaders and their influences on the quality of learning and teaching of mathematics for high school teachers and students. The research is a confirmatory enquiry into high school leadership's presence into the quality aspects of mathematics taught and learnt within a high school. I based my investigation on the premise that quality learning and teaching of mathematics is the practice of 'doing mathematics' (Lave & Wenger, 1998). Mimicking doing mathematics thus represents quality mathematical learning and should be an objective for high school educators and learners of mathematics to aspire to.

The proponents of "doing mathematics" (Schoenfeld, 1989; Julie, 1992, 2004) propose a list of standards for quality learning and teaching in the broader mathematical fraternity that I used in a previous study (Fortune, 1996). This list refers to indicators of quality learning and teaching for South African high school mathematics. In line with this list of doing mathematics, students and teachers model their activities against the broader mathematical communities of practice. The research primarily focuses on whether the school leaders can influence the extent to which students and teachers meet these quality standards set out by the practice of "doing mathematics".

#### 1.2. Background and Motivation

Quality learning of high school mathematics deals predominantly with mathematics activities which students engage in especially the types of activities mathematicians in the real mathematical communities of practice deal with (Julie, 1992; Schoenfeld, 1992). The aspects which determine quality mathematics are to a certain extent determined by the broader mathematical community of practice and the knowledge economies that benefits from these skills (Lesch & Zawojewski, 2007). It is thus not an unfair expectation that high school students

should have the necessary skills which knowledge economies or the broader mathematical community of practices can benefit from. The reality, however, is that school mathematics does not meet the need of these relevant knowledge economies. Furthermore, the broader mathematical community of practice has always been dissatisfied with the calibre of mathematics students produced by high schools in South Africa. Normally, classroom innovations should be implemented by mathematics teachers to improve the quality of learning and teaching. However, this is generally not sustained (Giles & Hargreaves, 2006; Sindelar, Shearer, Yendol-Hoppey & Liebert, 2006). According to Chan (2011) the non-sustainable attempts by teachers to implement quality learning and teaching innovations, are not new issues.

This research therefore acknowledges other potential role-players (Owstan, 2006) in the lives of students as potential candidates to resolve the issue of sustaining innovations of quality learning and teaching of high school mathematics. In this study, I particularly investigated the impact of South African educational leadership on the quality of teaching and learning in high school mathematics.

The key motivation for this study is therefore the non-sustainability of quality learning and teaching of mathematics innovations in the high school; acknowledging the viability that solutions to sustain the innovations may lie beyond the mathematics teacher and the realization that school leaders have a far greater likelihood of influence over others beyond the classroom than the teachers and students.

### **1.3. Research Questions**

The main research question to this study is: “How does educational leadership influence the quality of performance of the teaching and learning of mathematics in South African high schools?” I sought answers to the following research questions:

- How do we define quality learning and teaching of mathematics in high schools?
- How should quality learning and teaching of mathematics in high schools be conceptualised for optimal alternative high school improvement?
- What are those leadership relations that would optimise quality learning and teaching of mathematics performance, in high-stakes examinations in South African schools?

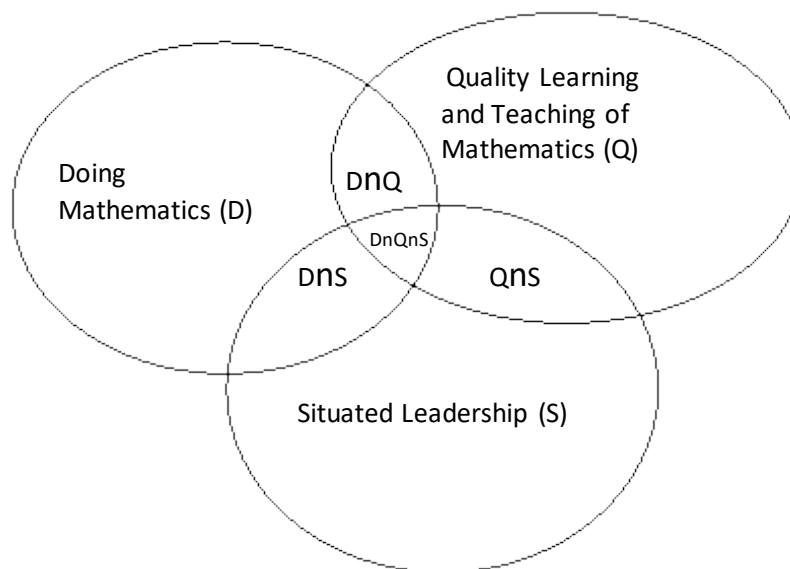
In the following subsection, an overview of the key constructs used throughout this study is provided.

#### 1.4. Key Constructs in the Research Question

The study into the influence of educational leadership on the quality of teaching and the learning of mathematics at high school level outlines three broad theoretical positions, namely:

- “Quality” of teaching and learning of high school mathematics (Q)
- “Doing” mathematics, predominantly accepted by mathematics education scholars as the broader notions of quality learning and teaching of mathematics (D)
- Situated leadership as a community of practice orientated leadership (S).

As stand-alone domains, these three theoretical positions are well-documented. However, as inter-related constructs, these three broad, theoretical positions are not well-researched at all.



**Figure 1.1:** Mapping of the interrelated theoretical perspectives for literature review

South African scholarly research and writing on two-dimensional concepts materialising from Figure 1.1, is scanty. These two-dimensional concepts are:

- The extent to which leadership influences the quality of mathematical teaching and learning ( $Q \cap S$ )
- ‘Doing mathematics’ as indicators of quality mathematical learning in a high school ( $D \cap Q$ )
- Situating high school leadership in a ‘doing mathematics practice’ ( $D \cap S$ )

The Venn-diagram (figure 1.1), above represents inter-related constructs and shows the intersection of the three individual theoretical positions (as a three-dimensional niche in mathematics education). It is within this niche that I am addressing the research question: “How does educational leadership influence the quality of performance of the teaching and learning of mathematics in South African high schools?” The research links the three theoretical perspectives as one concept ( $D \cap Q \cap S$  in the schematic presentation, Figure 1.1). The figure represents the inter-related construct arising from their interaction. Thus, the research questions are formulated around the broad focus of quality teaching and learning of mathematics, ‘doing mathematics’ as a quality teaching and learning practice and situated leadership in high school mathematics.

#### **1.4.1. Quality Learning and Teaching**

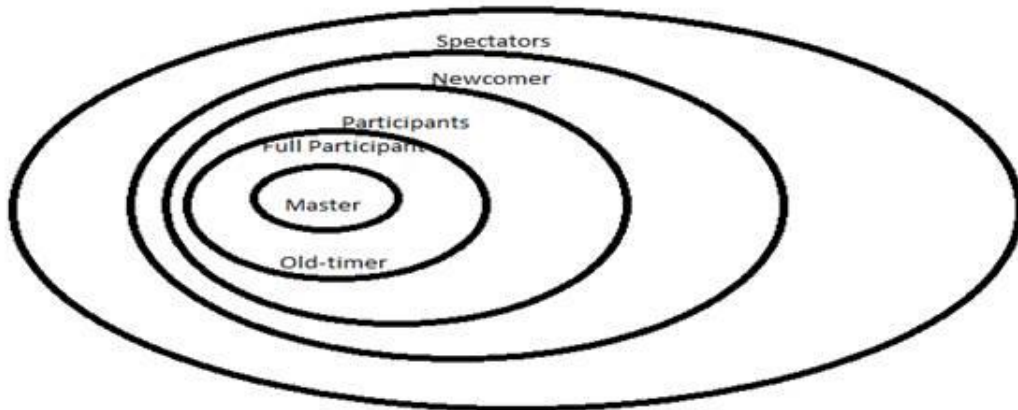
Lave & Wenger (1998) describe learning, not as a process of socially shared cognition that results in the internalisation of knowledge by individuals, but as a process of becoming a member of a sustained Community of Practice (CoP). This process of becoming a member is captured in the context of Lave’s concept of legitimate peripheral participation (LPP). Moreover, it is looking at learning as the acquisition of certain forms of knowledge, that she places it in social relationships, i.e. situations of co-participation.

Participation in a CoP is, according to Lave (1989), a two-way bridge between the development of knowledgeable skill and identity (production of persons), and the production and reproduction of the CoP. Lave introduces the concept of ‘newcomers’ to a practice becoming ‘old-timers’ through a social process of increasingly centripetal participation. This process depends on legitimate access to an ongoing CoP.

The concepts of ‘old-timers’ and ‘newcomers’ are used by Lave (1989) in the same context as she uses concepts such as ‘full participants’ and ‘legitimate peripheral participants’ (but not educators and learners, or experts and novices). In other words, these concepts result from the notion of social relations whereby persons and practices reproduce and transform one another. Other concepts used by Lave are the terms ‘master’ and ‘apprentice’. ‘Masters’ do not usually have a direct, didactic impact on the learning activity of ‘apprentices’, although they are often



crucial in providing newcomers to a community with legitimate access to its practices. Fortune (1996) suggests the following view to visualise a CoP in a mathematics classroom:



**Figure 1.2:** Representation of a CoP participation in a mathematics classroom.

In the figure above, the master, old-timer and full participant are those students who practise mathematics within a CoP classroom. In the realm of mathematics (outside a classroom set-up), where the practice of mathematics is the community of mathematical practitioners, the master, full participant and the old-timer all make contributions to the practice of mathematics. The masters, however, have some additional roles in that they are involved with the participants at the newcomer and spectator levels to the extent that the masters want to involve them with the ultimate purpose of making them full participants. The master does this by giving the newcomer and participants access in a way described by Fortune (1996) and depicted in Figure 1.3, below:

Practitioners in the community of practice	
Becoming a Participant	Being A Participant
	Continuity      Practicing

**Figure 1.3:** Representation of the three relevant CoP components.

The three components of this figure are identified by Lave & Wenger (1998) as being necessary to qualify an activity as a CoP. Firstly, there needs to be a domain. A CoP has an identity determined by a shared domain of interest which for the purposes of this study was high school mathematics teaching. Membership therefore implies a commitment to the domain of high school mathematics. Secondly, there needs to be a community. A necessary component is that members of a specific domain interact and engage in shared activities to help one another and share information with one another. They build relationships that enable them to learn from one another. There needs to be people who interact and learn together for a CoP to be formed. In

the example of high school mathematics teaching, there are members who interact and engage in shared activities (such as teaching specific types of lessons). The intention of this engagement is to provide a basis for entering discourse. Through this process, much relationship building, and cooperative and interactive learning occur. Thirdly, there needs to be a practice. A CoP does not just comprise people who share an interest in something. The members are practitioners. They develop a shared repertoire of resources which can include stories, helpful tools, experiences, and ways of handling typical problems. This kind of interaction needs to be developed over time.

The notions of community and relationship building, as well as the cooperative and interactive nature of learning, as described above make the prevalence of the influence of leadership a significant consideration in the context of this investigation. Furthermore, in the context of this study, a shortcoming outlined by Kerno (2008) where the co-existence of organisational hierarchy is seen as a challenge to a CoP can be addressed from the perspective of the situated nature of leadership. In other words, the situated nature of leadership is a viable option for the practice of the mathematical CoP, i.e. 'doing Mathematics'.

#### **1.4.2. Doing Mathematics as a Quality Learning and Teaching practice**

As was mentioned earlier on, Schoenfeld (1989) sees research as what most mathematicians call 'doing mathematics', which consists of actively making contributions to the mathematical knowledge store of the community. Learning in this context would imply that 'doing mathematics' should reach the stage where mathematics is being 'produced'. Research implies discovery. In other words, participants in the CoP should reach a stage where they produce mathematics.

Julie (1992) proposes aspects that are characteristic of the practice of 'doing mathematics' by full participants and that can also be used by newcomers to the practice. The notion of a hierarchy within the mathematical CoP implies leadership. According to Schoenfeld (1989), classroom practice in the context of a whole school practice, also adopts and reflects the values of the mathematical community. In the context of a school, the school leaders including the mathematics head of department, as well as teachers in the classroom and students all impact on

the values and activities of the mathematical community. It is with consideration of this influence that I chose to investigate an appropriate leadership movement also rooted in a CoP (Blanchard, 2010).

### 1.4.3. Situated Leadership

For this study, I have employed the concept of situated leadership as developed by Blanchard (2010) to link up with the ‘quality’ perspective of the ‘doing’ of mathematics described above. Blanchard believes that a leader should be able to move back and forth between four styles of leadership, based on the leader's perception as to the needs of the follower and the situation itself:

- When students or teachers are virtually dormant and just require to be moved, Blanchard recommends a step-by-step instruction. This requires a **directing leadership style**.
- Teachers and students, who err on the side of effort related contributions, whilst still making contributions, but clearly not fully committed to the fraternity of doing mathematics, can be supported by a style of leadership referred to by Blanchard as a **supporting leadership style**.
- When students and teachers have a lack of depth component of their mathematical knowledge whilst making sufficient contributions, are seen by Blanchard as requiring coaching referred to as a **coaching leadership style**.
- When students and teachers are predominantly capable of making independent regular quality contributions to the practice of doing mathematics, Blanchard suggests an appropriate leadership to meet such individuals is a **delegatory leadership style**.

Blanchard (2010), states that these styles are appropriate and necessary under particular conditions. Situated leaders will use all these styles appropriately, depending on the need of the teachers and students. The outcome of ‘quality’ teaching and learning in most South African high schools are seen in the context of improved ‘quality’ of teaching and learning which is predominantly an indication of how well students do in high-stakes examinations and benchmark tests. In turn, this means supplying higher education and the knowledge economy with sufficiently skilled mathematics users; hence the concept is worthy of further expansion.

## 1.5. Conclusion

In this research I set out to confirm that the school leader can influence the quality of teaching and the learning of mathematics at high school level. I collected qualitative data through an evaluative means to achieve the objective of this research. Three different instruments were employed to collect the data: semi-structured interviews, unstructured interviews and focus group discussions. The use of these three sources of data enabled me to get a more holistic picture of the answers to the research questions, as well as to gain a deeper insight into the nature of the intentions of the respondents. Mason (2006) supports my method of using of integrated sources of data, because she argues that such an approach allows strengths to be combined to correct the deficiencies of any single source or method.

The following groups of people participated in the interviews and discussions I conducted to collect qualitative data:

- school principals who used to be mathematics teachers
- school principals who were not qualified mathematics teachers
- mathematics heads of department
- mathematics teachers
- mathematics students.

These research instruments are described in full in the next section.

For this study, I adopted the use of an evaluation research to describe and evaluate the performance of leaders in their natural settings, focusing on the influence leadership wields on the quality of learning and teaching of mathematics. The use of confirmatory evaluation is the use of evaluation concepts, techniques and findings to foster improvement and self-determination. According to Mouton (2005), the researcher can evaluate and describe, for instance, both a social impact assessment and an environmental impact assessment. Mouton identifies one of the strengths attributed to this type of research as being its capacity to establish rapport and trust with the research subjects, affording high construct validity, and an insider perspective. For this reason, in conducting interviews and focus group discussions, the collaborative and participatory nature of this design minimises suspicion and distrust of research with a concomitant increase in trust and credibility.

Below I give a brief outline of the outcomes and activities I conducted in the various stages of this study.

### **Chapter 1: Introduction.**

In this chapter, I have covered the idea for the thesis and motivation for the study, the justification for the research topic from a preliminary literature review vantage point, the research questions, definitions used in the study, the initial conceptual framework underpinning the study, and a brief overview of the research design and methodology.

### **Chapter 2 and 3: Literature review**

I present the theoretical background (literature review) used for exploring the impact of leadership on the quality of teaching and learning of mathematics in various settings. Earmarked definitions and relevant key concepts are covered here.

### **Chapter 4: The research methodology**

This chapter focuses on sample design and techniques I used, including choice of sample size for the research. There is a discussion of fieldwork practices used to carry out the study, key variables, data collection methods, and measurements used in the research instruments. Data editing, data analysis procedures and rationale along with shortcomings and the sources of errors also form part of this chapter.

### **Chapter 5 to 7: Presentation of results**

I present the results of the fieldwork in tabulated form with specific mention of the sample profiles. The findings are discussed in the light of the extant literature review and the conceptual framework underpinning this study. These chapters conclude with an interpretation of the main findings as well as highlighting both negative and positive aspects.

### **Chapter 8: Conclusion and recommendations for further study**

This is a summary and discussion of the salient points of the research where I interpret the results in terms of the literature discussions, the gaps, anomalies and deviations in the data, revealing the larger significance of the results, and make recommendations for further study.

## Chapter 2

### Literature Review

#### 2.1. Introduction

In the previous chapter the research statement was contextualised as falling within the domain of quality learning and teaching of Mathematics and situating school leadership within a school mathematical practice. This chapter expounds on definitions and scholarly views to orientate the research statement as it relates to the quality teaching and learning of Mathematics in high schools. Defining quality of Mathematics learning and teaching is presented in this chapter from prominent perspectives as to the purpose of Mathematics in the broader Mathematical communities of practice.

#### 2.2. Defining ‘Quality’ Teaching and Learning of Mathematics

Unpacking the notion of “quality” in teaching and learning of Mathematics, presupposes a common understanding and action by interest groups. In other words, the establishment and sustainability of innovations for the improvement of quality learning and teaching are subject to influences by students, parents, teachers and school leaders. The difficulty in defining “quality” in this context lies with the decision as to whose empirically based definitions are eventually accepted or discarded.

Parents and students do not normally have ulterior motives (beyond what is important for the child) to influence the concept of ‘quality’ in teaching and learning. It is for this reason that their impact on the definition of the quality of teaching and learning of Mathematics is not included in this literature review. The highest likelihood of potential ulterior benefit (other than for the purpose of learning) derived from the notion of sustaining innovations towards ‘quality’ teaching and learning of Mathematics in high schools for the purpose of this literature review will be focused on teachers and the school leadership.

One would expect teachers to be the obvious custodians of non-compromising quality teaching and learning of Mathematics in high schools, because one expects them to have the wellbeing of their students at heart. According to Krainer (2011), teachers are expected to be innovative in teaching for the purpose of students exposure to a consistent quality learning

experience. The consistency of sustaining innovations in quality teaching and learning by teachers is, however, found wanting (Giles & Hargreaves, 2006; Sindelar, Shearer, Yendol-Hoppey & Liebert, 2006). When teachers introduce innovative quality teaching and learning practices into mathematics classrooms it is initially very exciting to them. The challenge is, however, that they tend to resist long and laborious initiatives, even if these have value for the practice of quality teaching and learning of Mathematics (Fullan, 2009). Non-sustainable innovations of quality teaching and learning in the mathematics classroom is a problem that has been around for some time (Chan, 2011). The urge by many business-minded, profit driven individuals is to enforce an improvement in quality (Collins, 2006). Bottom-up innovative practices, do not hold well for classroom Mathematics if the responsibility is mostly that of the teacher to ensure quality teaching and learning of Mathematics (Wenger, 2004). Innovative and creative teachers require support at every stage of implementation (and beyond) in order to sustain the innovation (Banaji, Cranmer & Perrotta, 2010). Bottom-up attempts at sustaining quality teaching and learning of Mathematics innovations are widely acceptable but seldom viable, as the only quality assurance directional drive.

School leadership is however not widely seen as an integral option to sustain innovations in quality learning and teaching of Mathematics. Supportive conditions in sustaining pedagogical innovations by school leaders are cited by Zhang, Hong, Scardamalia, Teo, & Morley (2011) as viable options worthy of investigation. Even though it is not usual for school leadership to make contributions to the quality of teaching and learning of Mathematics in the classroom, Wheatley (2011) places aspects of quality controls of teaching and learning fully within the scope of school leadership. There are even suggestions that leadership should be excluded entirely from a design science such as Mathematics education. Fullan (2005), however, sees the consistent presence of school leadership as inevitable in sustaining quality learning and teaching of Mathematics. Fullan's position comes as no surprise when we consider Collins' (2006) claim around leadership's scope encompassed by the resolve and intention to bring about a desired performance in the teaching and learning of Mathematics. In other words, the leadership is expected to involve itself with the final product and the improvement of school results.

It is my opinion that the responsibility of “quality” teaching and learning should not be limited to teachers and students only, but that leadership should form an integral part of the sustainability of innovations to this end. The argument that schools cannot be run like other disciplines (including businesses) where leadership is prominent in the improvement of quality of teaching and learning, should be reconsidered (Collins, 2001). Lesh & Sriraman (2005) also express the opinion that it is in fact desirable for leadership to be involved in Mathematics education as an integral part of such a design science. It is within this context that this research has investigated the extent of school leadership’s influence on the quality of Mathematics teaching and learning. This notion of quality is not necessarily limited to the achievement of results in curriculum-based mathematics testing (Pegg & Panizzon, 2007). This section of the literature review set out to interrogate the notion of ‘quality’ teaching and learning of Mathematics. The notion of ‘quality’ implies much more than mere testing of curriculum-based skills. It also includes notions of problem solving and other skills required by the broader knowledge economies. In what follows, I pursue the definition of ‘quality’ from two predominantly recognised perspectives, i.e. a curriculum-based perspective (where testing of curriculum-based skills are the predominant motivator of activities) and a knowledge-economy perspective (where the required skills in the knowledge economy are the prevalent foci).

### **2.2.1. Curriculum-based views on Quality Learning and Teaching of Mathematics**

The curriculum-based perspective of quality Mathematics teaching and learning refers to a mathematics classroom focussing on the predominant testing of curriculum-based skills. In this view quality (Glennan & Resnick, 2004) is related to the studious nature of learners and examination orientated teachers as predominant indicators in the learning and teaching of Mathematics. Quality teachers according to this view, possesses an inert “quality”, which allows them to sustain students’ good results in curriculum-based tests and examinations. The reality is that high-achieving, curriculum-based Mathematics schools have far greater clout in making community-acceptable utterances as to what constitutes ‘quality’ than their less successful counterparts. This is despite the fact that (Heck & Hallinger, 2009; Lesch & Zawojewski, 2007)



there is no substance to claims that individual learners are better at Mathematics as a result of the specific school attended.

Highly “successful”, experienced and qualified educators in Mathematics classrooms can easily feed off the energy of learners who are inertly orientated to achieve. Kennedy (2010) challenges the curriculum-based notion that quality teaching depends on the quality of the educator. He feels strongly that it is the educator’s use of the studious traits of the learner that attributes to the extent of the quality of the learning experience of the learner. It is no surprise that Heck & Hallinger (2009) support the notion that learners do not necessarily benefit by attending better schools. The notion that learners will learn if they really want to, irrespective of the school or educator, is also supported by Zimmerman (2002). The implication is thus that high achieving Mathematics schools claiming to have “quality” learning and teaching of Mathematics tend to propagate ulterior motives to “engineer” a false value-proposition (Bauer & Gaskell, 1999) for quality learning and teaching of Mathematics. The rest of this section expands on the two notions referred to earlier, i.e. the “engineering” of “quality” and innovations to sustain the “engineered quality” in learning and teaching of Mathematics.

#### **A. Engineering curriculum-based quality learning and teaching**

Defining quality of teaching and learning of high school Mathematics is especially complicated when quality is defined only in terms of good results in high-stakes curriculum-based examinations. Jensen (2009), expects schools, specifically school leadership to tackle shortcomings in Mathematics learning and teaching. In other words if curriculum-based examinations do not meet the real intentions behind school Mathematics, then schools should take responsibility. Howie (2004) cites the lack of problem solving exposure (which should be an intention of school Mathematics) as a shortcoming in some South African high school Mathematics classrooms. It is no surprise that the South African National Senior Certificate examination (NSC) has very few problem solving items as it tries to “engineer” quality of Mathematics of the South African curriculum to meet its systemic justification.

Greer & Mukhopadhyay (2003) identify seven intentions or objectives for school Mathematics. The seven objectives are: the production of mathematicians; the training of a workforce to compete in the global knowledge economy; the development of creative problem

solvers; the development of youth who can reason, objectively and rationally; the preparation of learners for the practicalities of future living; the honing of learners' Mathematical ideas and skills relevant to their lives; the preparation of learners to shape (model) and reshape (re-model) the realities of their world. The examination orientated curriculum-based innovations might add value towards teaching and learning. However, they are hugely deficient in meeting full-on, the demands outlined above.

### **B. Sustaining “engineered quality” learning and teaching of Mathematics**

The intentions behind a typical school leadership's mathematical innovations are not obvious nor are necessarily sustainable for the purpose of the broader Mathematical community. Hogan & Hogan (2001) are of the opinion that school leadership's intentions are primarily determined by employers and / or school boards to drive their institutional agenda at all cost. Riddle & Drenth (2002) note that some school leaders can even be relentless and in their pursuit to meet the goals of their employers. McNair (2000) observes that, in the case of state schools, the agenda of state departments, as well as politicians often determines a Mathematics Department's strategy, i.e. the direction of the enterprise includes the conceptualisation of what constitutes quality Mathematics.

A leadership strategy for school Mathematics which maintains a distorted sense of “quality” is susceptible to harshly directed leadership influences. Collins (2001) sees such practices as being based on non-developmental manoeuvring that leans on getting the right people employed with business-like objectives to meet higher profits and increased market share at the expense of the sustainability of an enterprise. The implication of such leadership objectives, specifically for high schools, can be two-fold and as described and implied by Attewell (2001); Cook & Frank(1993); Trompenaars & Hampden-Turner (2003). Firstly, it encourages a process of “laying-off” (also referred to as “culling”) of weak students and the conscious admission of learners known for their high performance at their previous schools. Heck & Hallinger (2009) maintain that such admission practices of taking on high-performing learners (who incidentally would be high-performing irrespective of the school they attend), have a distorted sense of quality learning and teaching of mathematics. These schools should be questioning claims that they are responsible for high performance as a result of the

implementation of their mathematics programs and efforts. The bigger picture is that schools which cannot attract the better junior school learners end up with learners who perform weakly, thus starting a vicious cycle of low performance for the have-nots in South African schools. In some cases one even has a poor school ‘brain-drain’ as wealthier schools attract better mathematics learners with promises of bursaries and “superior” school resources. The unfortunate consequence of these practices is that many schools in poor communities do not perform very well in Mathematics, unless leadership follows the same engineering of quality geared at excluding the undesirables and the admission of the high inert-quality students. Secondly, it also implies that schools attract and employ educators who meet the strategic intention of curriculum-based schools, and hence to get learners to produce good results in high-stakes curriculum-based-examinations (Collins, 2006). Teaching and learning should essentially be developmental by nature and free from manoeuvring to meet the whims of a privileged few, with their own ulterior motives and agendas.

### **2.2.2. Knowledge-based views on Quality Learning and Teaching of Mathematics**

Quality is about sustaining the supply of teachers and learners, and the attainment of value in the lives of the learners. For Mathematics to have meaning in the lives of the learners, it must bring value to their future careers. It is the responsibility of school leadership to do more than just look after the needs of governing bodies, state enterprises or interest groups with various ulterior motives (Riddle & Drenth, 2002). It is to the advantage of the school community to develop a perception of growth which has long-term value as a goal (Collins & Poras, 2002). The value of Mathematics needs to be understood by educators and learners for quality teaching and learning to be truly appreciated (White, 2014).

Quality should be appreciated in the minds of the individuals experiencing it for it to stand the test of time (Hektner, Schmidt, & Csikszentmihalyi, 2007). When educators and learners truly understand the academic purpose in their own lives, the quality of the academic enterprise will be appreciated and prolonged. Sustaining quality mathematics practices for knowledge economies as an aspect of quality teaching and learning of Mathematics implies that the value of the practice needs to be understood by all involved.

A popular notion expressed by Clarke (2007) is that school principals should be held more accountable for quality teaching and learning in schools. In fact it is professed that high achievement is automatic if the school leader secures good quality teaching and learning (Dobbie & Fryer, 2009). Smith (2002) explains that knowledge economy learning relies on apprenticeship methodology to enhance the quality of learning. It is no surprise that Lampert (1988) proposes a mathematical community that engages learners along the lines of apprenticeship methodologies to enhance the quality of their learning experience in Mathematics.

Sustaining methodologies to enhance the quality of the learning experience within a school is the essence of this research. School leadership is the focus of this research. The fact that leadership might hold the key to sustain the quality of teaching and learning of Mathematics seems to be a proposition worthy of further investigation. The concept of teaching and learning of Mathematics is thus grounded in the leadership's value proposition dependent on "the clarity of quality learning and teaching indicators" and "the continuity of the quality practices".

#### **A. Leadership clarifying "quality" indicators of mathematics teaching and learning**

Clarifying a set of quality descriptors to measure performance of teaching and learning of mathematics is a quality assurance priority for school leadership. Senge (2006) is clear that performance has to do with sustainable results. Sustainable results, however, depend on the value proposition of the mathematics practice, i.e. the usefulness of the practice for the participants. In other words, the purpose behind the results people are trying to achieve is in essence the basis for sustainability of a practice. Senge challenges mathematics teachers in a profound way when he asks whether they really understand the "products" they are creating. Zevenbergen (2001) takes the discussion further with the claim that there exists a mismatch between school Mathematics and beyond-school Mathematics. She suggests a strategy to bring about quality in the mathematics classroom is to embed mathematical concepts in context, making the mathematics appear more useful and purposeful. This is the notion of clarifying the strategic quality indicators, which lies at the heart of the leadership's influence in the mathematical teaching and learning practice. Stein, Remillard & Smith (2007) define the space which teachers create for learning as located beyond the intended curriculum.

Curriculum is roughly defined as the content of teaching and learning. Within this dimension much “misinterpretation” can occur because educators incorporate their prior understanding, along with their own beliefs and objectives about the formal curriculum, into the execution of the curriculum (Stein *et al.*, 2007).

A set of nine indicators which can easily be adapted to clarify the establishment of quality teaching and learning of Mathematics, is proposed by Resnick (1989). The set of principles of learning and teaching was introduced as an alternative to Lave’s (1998), Communities of Practice (CoP) (Goldman *et al.*, 2004). Lave is of the opinion that a CoP is not entirely applicable in a school set-up because of the limitations of school periods, the organisational hierarchy of the school and the misalignment between schools and the broader mathematical community. Kerns (2008) agrees with this. Goldman *et al.* (2004) argue for an alternative notion of Nested Communities of Practices in which a set of principles suffices in identifying the practice. In the case of a learning environment such as a school where lessons are organised, the nine indicators were identified to bring validity to these assumptions (Goldman *et al.*). The broader mathematical CoP has rules and clarity regarding what is expected, allowed and disallowed in a LPP (Lave, 1989). The set of indicators which facilitate quality teaching and learning of mathematics proposed by Resnick & Hall (2000), Goldman, Resnick, Bill, Johnston, Micheaux & Seitz (2004) and Boothe (2013) are as follows: organising and supporting to encourage effort from the participants; setting targets and goals at various stages of the learning; establishing sustained effort over time so that participants experience assessment as fair and credible; recognising participants for authentic accomplishment; engaging the participants in reasoning activities; developing accountable conversation skills; socialising participants to think intellectually; assisting participants to self-manage learning; allowing transition from learning to work through an apprenticeship process. The clarification of indicators of quality teaching and learning of Mathematics in high schools are definitely functions of school leadership, especially where educators are not driving these innovations and sustaining these valuable practices.

**B. The continuity of quality teaching and learning of Mathematics practices**

Quality assurance is about a rigorous and continuous inquiry against specific quality descriptors which measure the prevalence, extent and consistency of teaching and learning practice. A simple question to mathematics educators regarding how they know that learners have learnt anything elicits different responses from them, according to Wiliam (2007). Standardising assessment is normally the response offered as an explanation of how to gauge learning. Wiliam endorses the value of assessment as a tool to improve Mathematics learning. He goes further to link a good assessment tool to a good teaching activity. To achieve this, it is incumbent upon educators to design an interactive process to assess whether what was taught was in fact learnt. In a rigorously systemised school, the responsibility to secure consistency of this level of quality assurance rests with school leadership. The challenge for leadership is thus, to measure the teaching and learning against and how to determine the most appropriate method to sustain such a culture of quality improvement.

A consistent and rigorous quality-controlling mechanism to provide regular and consistent feedback for the teaching and learning of Mathematics is required to ensure and sustain quality. Goldman, Bill, Johnston & McConachie (2005) propose a strategy by leadership to sustain and improve the quality of teaching and learning within a school, named “the learning walk”. According to Goldman and his co-authors, “the learning walk” is an organised literal walk through a school’s halls and classrooms using a set of learning principles as described above, to focus on the instructional core. Elmore (1996) defines the instructional core as how teachers teach, how students learn, and what teachers teach learners. The hallmark of the learning walk is observation of the instructional core through the eyes of a leader (Goldman *et al.*). Such leadership could examine learners’ work and question learners about their work and teachers about on their classroom practices. Through this observations, leaders collect evidence about teaching as well as learning. Learning walks are short in duration, usually 5 – 10 minutes per class, to make it possible for an entire school (depending on size) to be observed within a few hours (Goldman *et al.*). During these visits, leaders obtain a snapshot (Goldman *et al.*, 2005) of the learning at the school. The leaders on such learning walks have to be strategic about their observations based on the brief period of time it occurs because the evidence gathered during this

time is of a valid but limited nature. Rather than drawing conclusions from the evidence, these leaders should formulate reflections or thought-provoking questions designed to encourage new practices that can potentially lead to increasingly higher quality teaching in an individual classroom or in the school as a whole. The power of the snapshot views, according to Goldman (*et al.*), is that they are of a recursive nature, i.e. they are part of a professional development cycle of a school. As such, professional development can occur following the learning walk in terms of the principles of learning previously outlined (Goldman *et al.*, 2004). The learning walk is an example of a rigorous and consistent process that can be put in place in a school to ensure sustainability in quality and in so doing improve teaching and learning consistently.

### **2.3. Conclusion**

In this chapter the concept of “quality” as it relates to two predominant orientations was clarified as depending on the motives of the school’s leadership. Both orientations’ foci are necessary dimensions of the definition. The concept of quality should include the high-stakes examination drive as well as meeting of the needs of the knowledge economies as the users of high school mathematics. Furthermore it has also been established that high school Mathematics quality practices require leadership to be sustained through quality management practices (like the learning walk) measured against a clear set of principles (like the nine principles of learning) against which to measure what constitutes quality. In the next chapter the role of leadership in sustaining the production of quality learning and teaching practices in Mathematics classrooms, will be further expounded on.

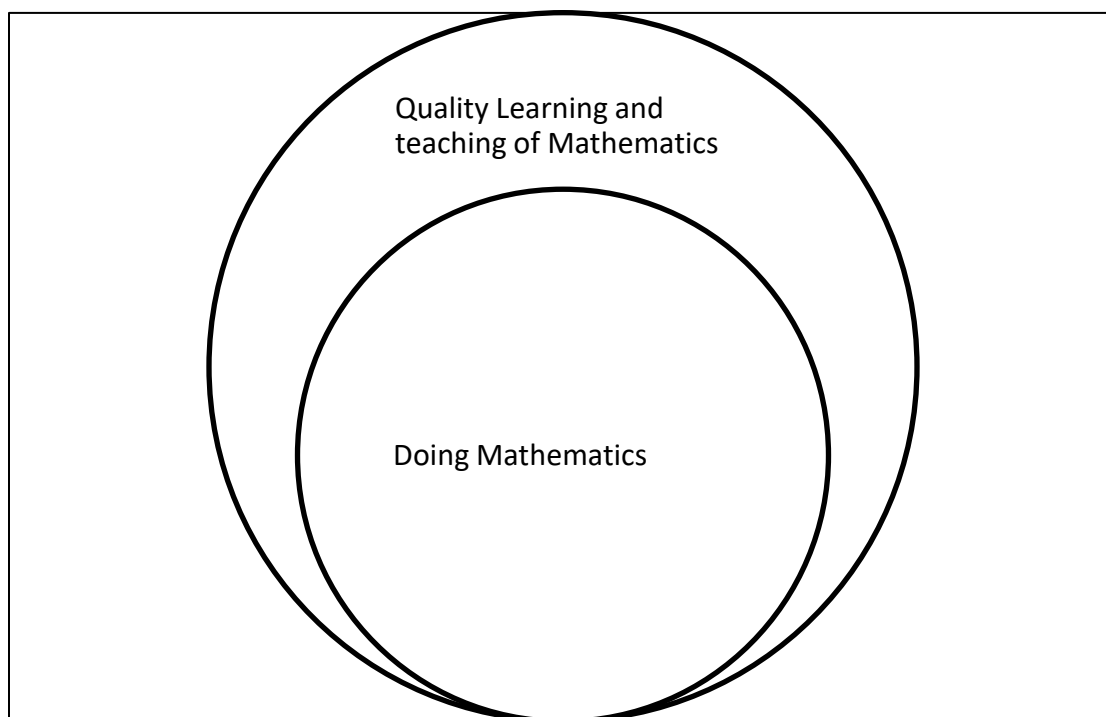
## Chapter 3

### Leadership Sustaining Quality Learning and Teaching of Mathematics

#### 3.1 Introduction

In the previous chapter quality learning and teaching of mathematics was defined and shown to be subject to influence by various interest groups. The gap which exists between the establishment of quality learning and teaching innovations in mathematics and the sustainability of such innovations have been acknowledged as a major challenge. The value of leadership as an option for consideration to sustain quality learning and teaching innovations are thus the starting point of this chapter. Known quality learning and teaching of mathematics constructs like “doing mathematics” professed by Schoenfeld (1989) and Julie (1992) are seen within the context of this research as a subset of the broader quality learning and teaching of mathematics practice, which are conceptualised diagrammatically as follows:

**Figure 3.1:** “Doing Mathematics” as Quality Learning and Teaching of Mathematics



The sustainability of quality learning and teaching of mathematics innovations, where school leadership support is lacking, is addressed by writers like Printy (2010) and Baxter & Williams (2010). Fortune (1996) also recognised the lack of school leadership support in addressing the apparent gap in sustaining quality learning and teaching of mathematics in high



schools. In the latter case the passion for innovation in quality mathematics teaching was dampened by the lack of enthusiasm by the school leadership which was possibly the reason for the retardation of sustainability of such innovations. It seems as if something is amiss when it comes to sustaining quality practices in the mathematics classroom. Meyer & Slechta (2002) attribute the dilemma to sustain practices like “doing Mathematics” to “a gap in leadership”.

Organizational leadership (including school leadership) and a CoP (of which “doing Mathematics” is an example) have similarities related to the establishment and sustainability of innovations. Doing Mathematics encompasses two CoP components as proposed by Lave & Wenger (1998), outlined in Figure 3.1 below, i.e. (i) becoming a participant to the mathematical community of practitioners and (ii) sustaining the practice of “doing Mathematics”. A leadership type which is closely related to “Doing Mathematics” is “situated leadership” (Blanchard, 2010). Blanchard’s notion of “situated leadership” is about an orientation within a practice where the leadership supports established innovations and sustain actions which are beneficial to the practice. In Table 3.1 below, it is far easier to recognise the corresponding notions:

**Table 3.1:** Comparison between Doing mathematics and Situated Leadership

	<b>Becoming / Establishing</b>	<b>Sustaining</b>
<b>Doing Mathematics</b>	Becoming a participant	Secure the survival of the practice
<b>Situated Leadership</b>	Establishing a culture to become a participant	Sustain the culture for survival of practice

Table 3.1, highlights a comparison between “doing Mathematics” and “Situated Leadership”, in terms of “becoming” and “sustaining”. In terms of the above table, the research question is thus about school leadership influencing the establishment and sustainability of “doing Mathematics” innovations in a high school. Discussions on establishing and sustaining quality learning and teaching of mathematics practices are thus the crux of the rest of this chapter.

### **3.2 Establishing quality learning and teaching of mathematics through leadership**

Leadership is known to play a role in establishing a conducive learning “tension” (Trompenaars & Hampden-Turner, 2002) between teaching and learning of mathematics (Harkness & Portwood, 2007). The value of the leadership’s influence lies in the establishment of such a tension for learning and teaching (Trompenaars & Hampden-Turner, 2002), which

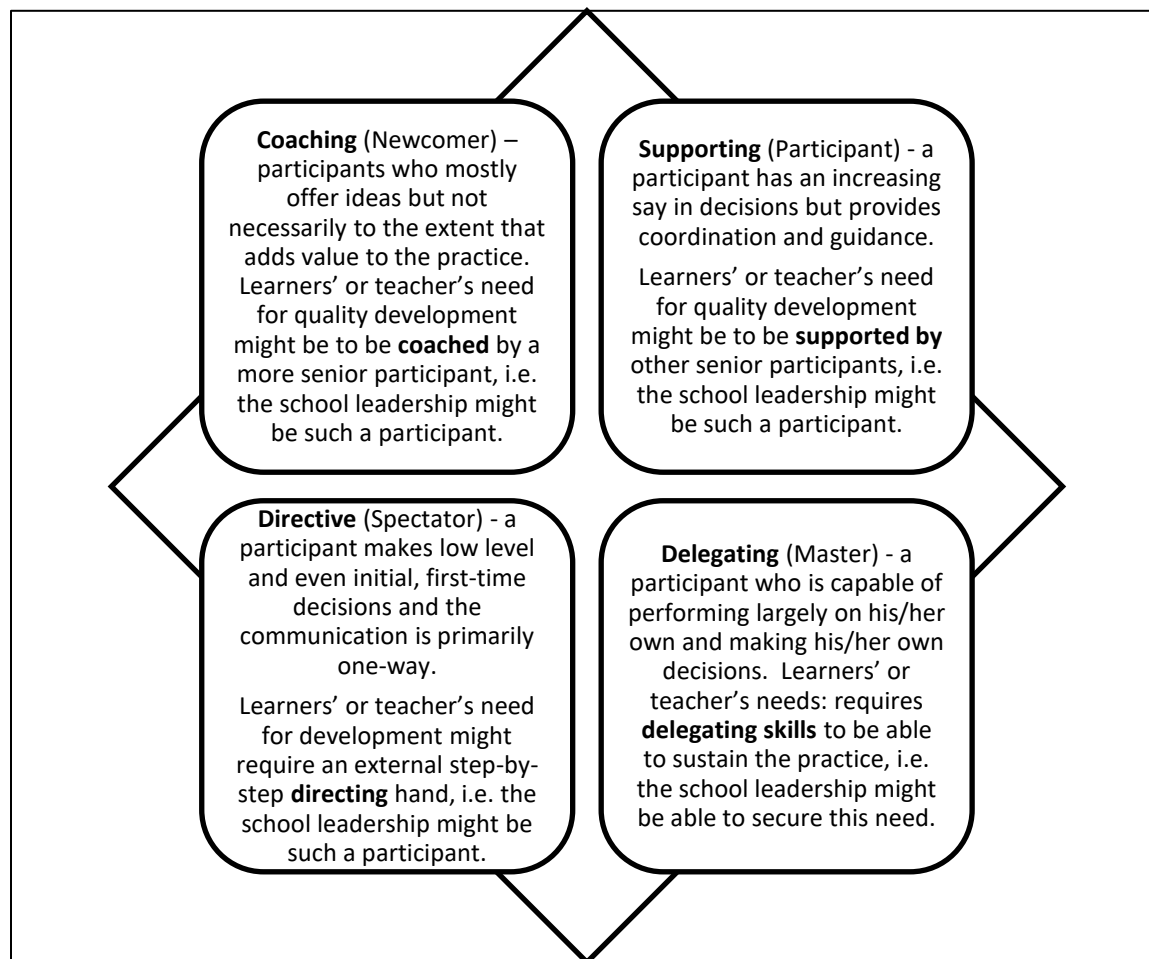
makes leadership necessarily worthy of inclusion as a quality learning and teaching innovator. Quality learning and teaching of mathematics are often stifled by educators in the classrooms. This occurs through some careless actions by educators according to Walls (2007). Quality learning and teaching in mathematics classrooms (with CoP features) acknowledge a need for a Legitimate Peripheral Participation (LPP) consciousness (Lave, 1989) which Trompenaars & Hampden-Turner (2002) calls a “learning tension for development”. This learning tension can be harnessed to establish the practice of quality learning and teaching of mathematics. It is the intention of this study to investigate factors bringing about such tensions for quality teaching and learning of mathematics by focusing on similarities between LPP of “doing Mathematics” and the developmental levels of “situated leadership” (Blanchard, 2010). In “doing Mathematics” (as in any CoP), LPP has essential levels of participation where participants have an objective (or it is the objective of the system within which they operate) to sustain the practice, where the participants can strive to become ‘experts’ within the practice. In Table 3.3 below, I simplified a representation of Lave and Wenger’s (1998) LPP structure for easier contextualisation.

**Table 3.3:** Distinction of Roles in a CoP

Spectator	Newcomer	Participant	Master / Full Participant
<ul style="list-style-type: none"> <li>An individual who is not necessarily involved, however he/she observes and is definitely present.</li> </ul>	<ul style="list-style-type: none"> <li>A newcomer is the individual who makes the initial contributions.</li> <li>This might not imply that he/she is making value-added contributions; however there is a move to get involved.</li> </ul>	<ul style="list-style-type: none"> <li>A participant functions on the level whereby the individual begins to make value-added contributions to the knowledge store of the practice</li> </ul>	<ul style="list-style-type: none"> <li>A full-on participant who consistently makes a high degree of contributions to the practice.</li> <li>This individual also has the sustainability of the practice at heart.</li> </ul>

In a CoP orientated mathematics classroom the learning tension between the students and teachers is expected to be non-traditional. Lave and Wenger (1998) did not necessarily intend that the participants in a CoP fulfil the roles of leaders in relation to each other. The LPP roles do not even make distinctions between student and teacher participants. In other words, all

participants are seen to be a part of the learning milieu. However, to sustain a practice, as well as making things better for peers, is in line with Sanborn's (2006) definition of a leader. The role of the expert is thus essentially that of a leader. "Situated leadership", according to Blanchard (2010), is a generic attempt at formalising the development of leaders in the context of a practice. This developmental nature, coupled with the hierarchical progression within "doing Mathematics", makes situated leadership a very good proposition in addressing the shortcomings related to sustainability of innovations towards "doing Mathematics" in the classroom. Figure 3.4 below, represents my simplified representation of Blanchard's (2010) leadership development model within an organisational setting, based on the needs of mathematics students and teachers.

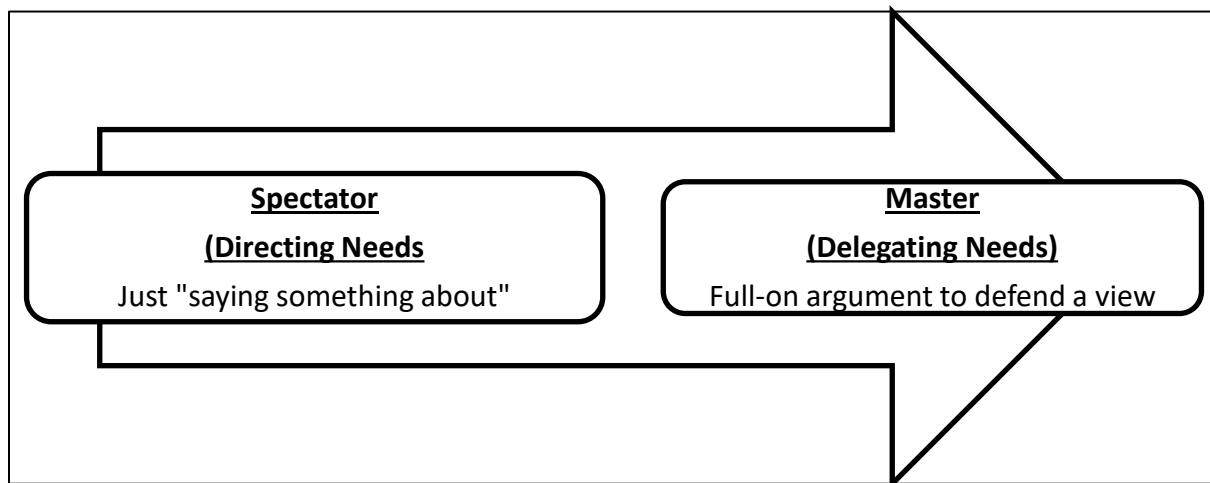


**Figure 3.2:** Learning and teaching development based on "learner" needs Spectrum

The innovation of a "doing Mathematics" classroom tension nurtured by a school's leadership within the context of situated leadership is a crucial point of research for the establishment of quality learning and teaching of mathematics in a high school (Blanchard, 2010).

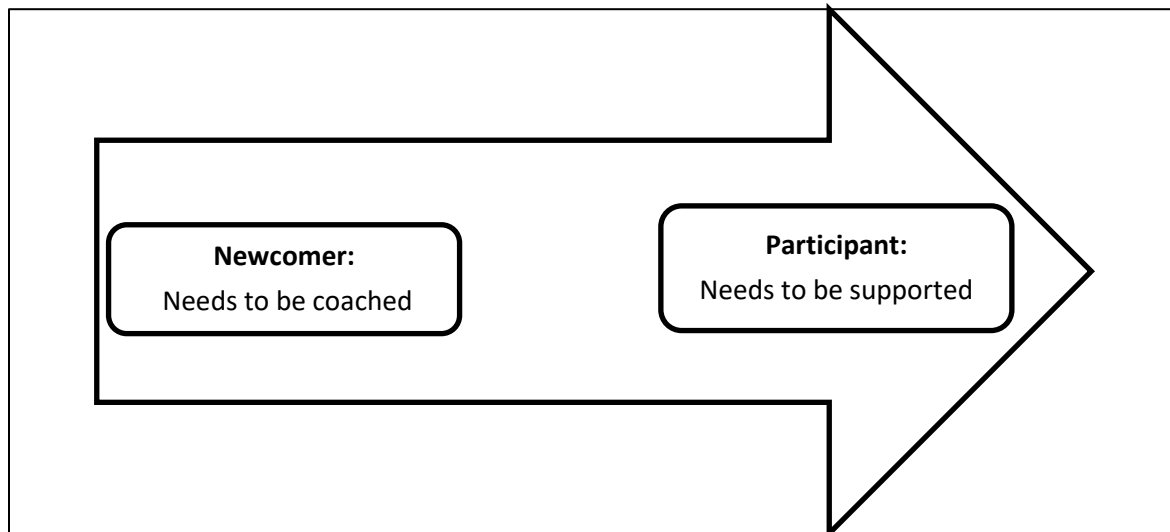
The role of situated leadership (Blanchard, 2010) is to encourage and nurture quality learning and teaching of mathematics practices between mathematics teachers and their learners'

so that the quality of mathematics students' and their teachers' contributions are acceptable to some or other "school-levelled" mathematical community of practitioners' standards. Student contributions on a school level is according to Michaels & O'connor (2012) and Kumpulainen & Lipponen (2010) necessary in order to develop the quality of learner contributions. Figure 3.5 below, shows my schematic representation of two extremes of learner contribution development on a discourse spectrum: i.e. "simply say something about" to a "full-on argument to defend a view".



**Figure 3.3:** Student contributions on a discourse spectrum

Two types of general contribution can be easily influenced by school leadership through the establishment of special grouping of students throughout the school, which acknowledges Lave & Wenger's (1998) LPP and Blanchard's (2010) developmental needs of learners. The first type of contribution is accommodated in group settings, where students are encouraged to just say something - anything. In this group setting initiated classroom, students can be coached or supported to become "full participants" by virtue of the extent of their participation. The second type of contribution which is also viably accommodated in a group setting is where the quality of contributions is paramount. In other words, the group arrangements of students within the school has the capacity to accommodate a CoP-like milieu where the extent and quality of contributions are developed by running like a local mathematical community of practice. In the figure 3.6 below, I represent my expectation of the school leadership role if it were to accommodate mathematics students' decisive contribution in developing full participants.



**Figure 3.4:** Scope of decisive mathematical contribution

According to Lave (1989), these two spectrums (discursing contributions and decisive mathematical contributions) illustrate the general types of contributions made by practitioners in their respective practices. In a doing Mathematics classroom context, learners are expected to make contributions to the class in a way that brings the practice in line with the practice of mathematicians in the broader Mathematics CoP. On the other hand, learners also develop and hone some skills which reflect them as practitioners.

Leadership can sustain a viable tension between teaching and learning in a mathematics classroom derived from the contributions learners make to the classroom activities. The maintenance of established quality learning and teaching of mathematics innovations is the responsibility of the school leadership (Trompenaars & Hampden-Turner, 2003). The school leader can establish viable systems to ensure that these established learning tensions are sustained throughout the school or even in the classroom through enforcing his leadership practice (Blanchard, 2010) within “doing Mathematics” (Lave & Wenger, 1998).

The extent of the school leader’s nurturing of the learning tension systems also depends on the contributions of the participants. As has been discussed, Blanchard's (2010) “situated leadership” intervention can be viewed in line with Lave and Wenger's (1998) LPP classification and doing Mathematics, based on the extent of the participants’ contributions. Investigating leadership’s influence on the two dimensions of contributions (i.e. discursing contributions and

discoursing contributions) as it impacts on the quality of teaching and learning of mathematics in the classroom, seems a logical progression for the next section.

### **3.2.1 Leadership innovating a discursive mathematics classroom**

Educators of mathematics want their learners to be make substantial contributions. Sometimes it does not matter as long as they just make contributions, which is the reasoning behind discursive contributions. According to the Oxford Dictionary (2008), discursive means communication of thoughts through words. These words might even be lengthy to include additional material not relevant to the topic of conversation. In the context of this study, a discursive contribution corresponds with Julie's (1992) notion of a quality mathematics, i.e. a contribution that can be added even though it might not have the depth required in the broader knowledge store. Leadership's role in ensuring educators and learners develop their discursive capacity is exemplified through an existing model that has predominantly discursive attributes.

Goldman, Resnick, Bill, Johnson, Micheax & Seitz (2004) have developed the nine principles of learning tensions five of which apply comfortably to the discursive dimension of a “doing mathematics” activity. These five principles are in line with Mason’s (2006) ontological perspective. The five principles are about:

- Regular questioning by and to learners
- Substantiating through evidence and what others said to reinforce positions
- Accounting to meet the practice requirements of mathematicians
- Self-monitoring and regulation of learning
- Reflecting on the experts who model thinking and learning strategies from which others can learn.

These five principles of quality learning are appropriate as viable discursive contributions and their introduction into the classroom context rests in the realm of school leadership. Julie (1992, 2004) identified a set of discursive attributes which can also be seen as typical South African high school attributes. These include:

- Completion of academic work, especially if it is specified
- Involvement in a group set-up to assist low functioning learners in the mathematics class

- Educators giving special assignments to learners who are willing to do the work
- Responsibility and willingness to be held accountable for facts negotiated.

These attributes of quality learning contributions are the prerequisites of a quality teaching and learning system and hence of an effective of school leadership

For leadership to be able to influence the quality of teaching and learning, the five principles of learning mentioned above from Goldman's nine principles (Goldman *et al.*, 2004) need to be applied consistently. Goldman *et al.* (2004; 2005) and Julie (1992, 2004), have produced excellent work in identifying these principles and classroom attributes but have not elaborated on how such discursive attributes in teaching and learning can be inculcated or developed. It is my objective in this study to investigate the capacity of those in leadership to bring about and further sustain and improve these discursive attributes in the mathematics classroom.

I am of the opinion that it should be mathematics educators' objective to have their learners make discursive contributions in the mathematics classroom and develop their skills in doing. The leader according to Sanborn (2006) should prioritise seeing learners develop and improve the quality of their contributions. This is in line with Jensen's (2009) resolve for leadership to see all learning and teaching shortcomings addressed by the school's leadership. What is quite important is that school leadership should be viewed as a vital component in sustaining the quality attributes of learning and teaching described by Julie (1992, 2004) and Goldman, Resnick, Bill, Johnston, Micheaux & Seitz (2004). A discursive contribution is about making contributions to the classroom, which does not necessarily have a quality dimension acceptable to the broader knowledge store. However, in the next section I pursue the option of a contribution which is far more acceptable to the standards of the broader doing mathematics community, i.e. a "decisive" contribution. The Oxford Dictionary (2008) defines "decisive" as the act of settling a discourse.

### **3.2.2 Leadership in innovating decisive Mathematics classroom contributions**

The concept of learners making quality contributions which are acceptable by the broader "Doing Mathematics" fraternity is not always acknowledged as a valuable as part of a school

leader's influence. Ross & Gray (2006) acknowledge school leaders' impact on mathematics learners' contributions in the classroom and even in the development of the quality of these contributions. Heck & Hallinger (2009) have found that a specific type of focused leadership brings about a far better improvement in mathematics learning than other types of leadership. Matthews (2009) feels strongly that school principals, as well as educators, have a role to play in establishing and improving the quality of contributions made by learners in the mathematics class. The sensitivity of the school leadership towards the type of contributions learners make in the mathematics classroom were investigated further based on how leadership can innovate a culture of making contributions in the classroom and how to inculcate a sustainable culture of making these contributions.

The school leader's most obvious tool is the appraisal of teachers intended to encourage educators to innovate practices that will develop learner contributions in the classroom. There are however factors other than teachers aligning themselves with an appraisal system led by school leadership which needs to be recognised for encouraging teachers to develop decisive contributions from students. This notion of educators as an imperative role player to improve student contributions in the mathematics classroom is supported by Civil & Planas (2004) who see the role of the educator as paramount in this endeavour. Liskala, Vauras & Lehtinen (2004) however, do not acknowledge the presence of the teacher in the higher order contributions of learners as an imperative in bringing about quality learning. Turner & Patrick (2004) find a middle road between the two extreme roles of educators in development of student learning in mathematics. They see educator instructions however, as key in establishing a desire within learners to make quality contributions. Unfortunately South African educators are not well known for sustainable innovations, even though leadership uses appraisal tools intended for teacher development.

Establishing a culture of making contributions in the classroom is easily created but unfortunately not necessarily sustained unless the learners involved realise the value of being placed at the centre of the learning practice. Rohrbeck, Ginsburg-Block, Fanuzza & Miller (2003) emphasise that peer learning is an example of how students can learn to value their role in socializing as part of a Mathematical practice. Topping (2005) links peer learning as an aspect



of a classroom practice which could influence the quality of learning. In fact Topping is of the opinion that it can also be implemented on a school-wide level and not just at a classroom level. Goos (2004) mentions peer learning as being the responsibility of the educator in a classroom, and by implication, whole-school organisation of this will reside with whoever has influence on such a level, i.e. the head of department or even the school principal. Sustaining an innovation requires the impact of leadership in order to make the innovation a cultural tool, within a school.

As was mentioned previously, the essence of quality learning and teaching of mathematics in a classroom context is about making contributions in the mathematics classroom (Walls, 2007). Davies & Davies (2008) argue that the school leader who has the intention to establish quality learning and teaching of mathematics practices in the classroom, should be situated in the Mathematics practice. School leadership's involvement is essential to initiate learning such that the all participants are situated in the mathematical practice. The one thing that needs to be added to this discussion is that the decisive contribution that is being discussed here does not necessarily imply a higher order quality contribution (Liskala, Vauras & Lehtinen, 2004).

The establishment of a system which acknowledges learner contributions with the intention to develop them, is a function of school leadership. According to Walls (2007), the context of making contributions in the mathematics classroom is the essence of school mathematics. Jensens (2009) posits that if a school comes short in any area of development, it is incumbent upon the school leadership to find solutions for these shortcomings.

### **3.3 Leadership inspires sustainable quality learning and teaching of Mathematics**

School leadership has a vested interest in prioritising those aspects of teaching and learning that promote quality (Higgins & McAllistair, 2004). Bereiter (2002) questions the sustainability of innovations such as doing Mathematics in a high school. Jamrock, Vickers & Bear (2006) however indicate that the sustainability of innovations of quality learning and teaching of mathematics are viable if it becomes part of the culture of an organisation. For leadership to develop such a culture, the following two aspects are vital and will form the basis of this section of this literature review:

- Leadership should promote quality learning and teaching of mathematics practices in the school, and
- Leadership should cultivate a school-wide quality learning and teaching culture.

### **3.3.1 Leadership promotes quality learning and teaching of mathematics practices**

Innovating quality learning and teaching tools in line with Schoenfeld's (1992) notion of doing Mathematics is, according to Knuth (2002), a possibility within mathematics classrooms in secondary schools. Julie (1992) sees "doing Mathematics" as a practice within the context of the learner's world. He sees "doing Mathematics" as solving puzzles, working with classical problems, calculation procedures, and using the activities learners experience in their daily lives as vehicles for concept formulation. These four teaching attributes are not necessarily always found together in the normal classroom setting. Julie (1992) and Handley, Sturdley & Clark (2006) speak of the separation of Mathematical tools into distinct types as being viable options. That is why I investigated activities within schools that make up quality learning and teaching of mathematics in additional school programmes, as well as in the classroom itself.

Some of the stand-alone and extramural programmes include opportunities for quality learning and teaching of mathematics but however require school leadership's sensitivity (Greiffenhagen & Sharock, 2008). The successful operation of mathematics clubs or societies in schools are typical examples of sustainable activities within South African schools. The doing of mathematics should not be restricted to the implemented mathematics curriculum in the classroom. Out of classroom or extramural mathematics activities like mathematics clubs, societies and the solving of puzzles, riddles and mathematics olympiads are the various ways through which the doing of mathematics can be supported by school leaders (Julie, 2004; Koich & Berman, 2005; Douglas, 2009; Deng, Li & Li, 2013).

Knuth (2002) raises the place of proofs in secondary schools as scarce classroom activities despite these being very much part of classical problem solving and the curriculum-based classroom. These quality learning and teaching aspects, through traditional quality assurance processes can be promoted by school leadership showing a preference towards cooperative learning practices. Pape (2004) sees problem solving as a very important aspect of improved

comprehension which is of significance in mathematics learning. Gillies (2004), as well as Cobb, Stephan, McClain & Gravemeijer (2001), sees small cooperative groups as very important aspects of improving problem solving amongst learners. Scarlatos (2006), and Stahl Zhou & Toledo (2006) are of the opinion that group work is effective when learners solve puzzles. Furthermore, the group brings about a sense of belonging which fits well for “doing Mathematics” as well as the necessary identity aspects that go with being part of a CoP (Gere & Macdonald, 2010). Jensen (2009) proposes that the school leaders could secure a CoP in a school, whereas Kerns (2008) sees Lave & Wenger’s (1998) notion of a CoP in the classroom as being problematic because of bureaucratic limitations and time-sensitivity to curriculum related work. These issues can be circumvented through schools which are dedicated to expose learners to these artefacts in the interest of quality teaching and learning.

Co-curricular or extracurricular mathematical experiences are appropriate innovations to facilitate quality learning. Julie’s (2004) description of artefact production to include calculation procedures is actually an everyday classroom activity in mathematics. One of the big challenges according to Duval (2006), however, is that the classroom activities go hand in hand with notions of procedural understanding. According to Leung (2005), Eastern countries do very well in TIMSS testing because their educators and learners have a keen conceptual understanding, procedural understanding and procedural fluency which play a role in test performance. Mulligan & Mitchelmore (2009) see the value in calculation procedures as being foundational to other very important aspects of mathematics: generalisation, patterns and algebra. Julie’s (2004) notion of doing Mathematics through incorporating activities based on learners’ experiences in their daily lives as being the vehicle for concept formulation is a viable option in the classroom. The decline in performance quality in mathematics has much to do with lack of interest according to Swarat (2008). Differentiated groups are seen by Kirkey (2005) as an opportunity to develop conceptual understanding in mathematics. Innovations involving tutorial programmes have helped to create interest according to Moursund & Albrecht (2011); Strong, Thomas, Perini & Silver (2004). Innovating Julie’s artefact production aspects as minimum requirements for doing Mathematics in secondary school classrooms are indeed possibilities because these are viable as individual classroom practices. Scarlatos & Scarlatos (2006) recognise the value of a learning

environment in classrooms where learners do mathematical manipulations, mathematical puzzles and physical mathematical activities in the classrooms. Julie states that artefact production and doing mathematics, do not necessarily always occur together. Gresalfi, Martin, Hand & Greeno (2009), McNair (2000), Forman & Ansell (2001) remind us that the quality of discussions, as well as the opportunities created for discourse are important considerations for viable production of mathematical artefacts and hence a “doing Mathematics” practice in high schools.

Sustaining quality learning and teaching of mathematics innovations require some or other external attribute such as leadership, to ensure rigorous practices are applied. According to Bereiter (2002) and Julie (1992), the innovation around these educational aspects are not necessarily a problem compared to other more traditional procedures. The issue with quality does, however, lie with the sustainability there-of. The issue of quality learning and teaching of mathematics innovations can however be cultivated in a sustained culture, which will be discussed, next.

### **3.3.2 Cultivating school-wide quality learning of teaching of Mathematics culture**

Lubienski (2003) is of the opinion that innovations of quality learning and teaching of mathematics hold much value for learners in the classroom, but proposes it to be part of the school's culture to secure its sustainability. Walshaw & Anthony (2008) raise the inevitability of such educational reform for learning in high school mathematics. Julie (2004) reminds us that doing Mathematics practices might not be prevalent in the mathematics classrooms. However innovation does take place. In this section of the literature review, I investigate the viability of sustaining innovations using a strategy that normally works well in a non-hierarchical ‘real’ doing Mathematics fraternity, but which, in a mathematics class, might require the input of leadership practices.

When educators fail to sustain quality learning and teaching of mathematics practices in the classroom, it is incumbent on school leadership to find innovative solutions to the problem. Jamrog, Vickers, & Bear (2006) are of the opinion that innovation is vital, in fact a prerequisite for success and needs to be incorporated into any aspect of an organisation including teaching

and learning. Knapp (1997) sees innovation as imperative for improvement of instruction in mathematics. Edwards (2000), however, raises a concern that whilst innovation can revolutionise the teaching of mathematics, it has failed miserably because it was not sustainable in quality learning and teaching mathematics. Bereiter (2002) is of the opinion that classroom innovation does not always lead to sustainable practice. Looking beyond the educator to find a solution for the promotion of quality teaching and learning of mathematics requires a resolve to make things better through innovative means, hence the leaning towards the school leadership (Sanborn, 2006).

Success in sustaining innovations of quality learning and teaching of mathematics in the classroom has to do with the school leadership's sensitivity and resolve. Fortune (1996) found that a systemic manoeuvring of the high school classroom design can in fact bring about a local CoP functioning as a local doing Mathematics practice. Zhang, Hong, Teo & Morley (2011) show that innovation related to community knowledge building is sustainable in a junior school mathematics classroom. In order to sustain an innovative practice such as "doing Mathematics" in a high school classroom requires a school-wide culture which can make the practice an acceptable school practice. Chan (2011) admits that innovation integrated with normal classroom activities poses challenges, whereas a knowledge-building model which includes contextual and systemic changes, as well as community building aspects to the school, can help to sustain the innovation.

The lack of school leadership support in the production of quality practices is the essence of the non-sustainability of quality learning and teaching of mathematics. The real issue transcends the school leader but is really to do with the function of the leader which involves galvanising the entire school community to be accepting of the drive to develop school-wide quality of learning and teaching of mathematics. Owston (2006) agrees that the greatest requirement of successful innovation is the support provided to an educator by the school's leadership. Higgins & Mcallaster (2004) are of the opinion that some of the main reasons innovation cannot be sustained, are that strategic changes cannot be done in isolation. What is required is that the cultural artefacts need to change as well. Kavanagh (2006) confirms the notion that leadership impacts in a huge way on the culture of an organisation, such as a school.

Zien & Buckler (1997) see the culture of an organisation as the sustainable factor of any innovation introduced. Squire, Makinster, Barnett, Luehmann & Barab (2003) highlight the importance of leadership functions, such as cultural design adjustments in a school, in order to implement curriculum innovation of the likes described by Julie (1992). Parry & Proctor-Thompson (2003) see leadership as the contributor to an organisational culture which could successfully sustain innovation. The value of leadership as a viable option to support educators in sustaining their “doing Mathematics” innovations in their classrooms is worthy of further study and research.

Sawayer (2006) uses the concept of sustaining a classroom innovation involving the entire school community as a cultural solution. Situating the school leader into the quality of learning and teaching of mathematics will imply a school culture designed for that purpose. Whilst Julie (1992) agrees with Kerno (2008) that it is a difficult proposition to create a mathematics CoP in a classroom set-up, it is beginning to appear that a viable option to sustain such an innovation revolves around creating a culture that has the capacity to situate a leadership practice within the “doing Mathematics” practice (Blanchard, 2010). This literature review shows that it is indeed a viable option to sustain “doing Mathematics” aspects in a classroom set-up. All that remains now is to embark on a research to validate the theoretical research within practice (Mason, 2006).

### **3.4 Conclusion**

The development of appropriate quality learning and teaching of Mathematics practices combined with the notion of situating the leadership practices within the practice was discussed in this chapter. Establishing quality learning and teaching of Mathematics is done against a set of quality indicators which brings about a measure other than mere testing in high-stakes examinations. Furthermore, the sustainability of innovations in the established quality Mathematics practices are reviewed according to literature, viable through school leadership situated in the practice. In the next chapter, the research to investigate the prevalent measures of situated leadership in schools where there exists a sense of quality learning and teaching of mathematics, will be embarked upon.

## Chapter 4

### Research and Methodological Design and Implementation

#### 4.1 Introduction

In this chapter, I describe the design of the study as it relates to high school leaders' influence on the quality of teaching and learning of mathematics in their respective schools. The study sets out to evaluate phenomena where high school leaders influence the quality of the learning and teaching of mathematics practices at their schools. The research design outlines the specifications of the research plan for the research participants and the selected research methods to collect and analyse data. (Welman, Kruger & Mitchell, 2008).

#### 4.2 Research Design

The two primary research designs (i.e. quantitative and qualitative research designs) were both considered for this research in exploring high school leaders' influence on the quality of learning and teaching of mathematics. According to Mouton (2005) these research designs may be used in combination if the nature of the inquiry requires it. Quantitative research however involves random selected samples and does not allow for participants to provide reasons for their actions (Mason, 2006). The absence of social dimensions in quantitative evaluation is contrary to the purpose of this research to investigate school leaders' ways of influencing the quality of learning and teaching of mathematics at their schools. This research requires an inquiry with a strong quality element, researched from a social dimension perspective.

The case for a qualitative approach to this research provides the value component to the social inquiry. The nature of this inquiry is impacted by its social research dimension (Leedy & Ormrod, 2005), which can be mapped out in terms of its purpose (to improve mathematics learning in the school) but also its use (to produce mathematics participants in higher learning and knowledge economies), the timing (within the school and not after school programs) and the viable data collection techniques (to approach a sample of role-players representative of the entire school population). The nature of social research thus necessitates a qualitative approach if

it is purposed in exploring the phenomenon of the school leader's influence on mathematics learning and teaching (Mason, 2006).

Qualitative investigations develop from needs within the research community (Mouton, 2005) as is the case for this investigation. This qualitative design explores the phenomenon of school leaders' influence on quality learning and teaching of mathematics. The research design comprises predominantly a phenomenological approach. The generation of textual data is according to Mouton (2005) indicative of this type of research, where unstructured interviews, semi-structured interviews and focus group discussions can be implemented. In the next section the data collection methods used in this research, will now be further motivated and the procedure for data analysis outlined.

### **4.3 Data Collection methods**

The data collection methods to extract phenomenological qualitative data from school leaders may include according to Mouton (2005), unstructured interviews, semi-structured interviews and focus group discussions. In this research, unstructured interviews were conducted with school leaders and semi-structured interviews with mathematics teachers. Focus group discussions were conducted with small groups of mathematics students. Below, I expound on my motivation for unstructured interviews, semi-structured interviews and focus group discussions as the most appropriate research methods to extract data for investigation of the phenomenon of school leaders' influence on quality learning and teaching of mathematics. Further I will also clarify the procedures around the application of the three methods of data collection.

#### **4.3.1 Unstructured in-depth interviews**

An unstructured interview is essentially a relatively informal interactional exchange of a topic-centred aspect. The one-on-one in-depth probing viability of an unstructured interview is according to Mason (2006) an investigation into the social reality of participating individuals. The school leaders were interviewed to investigate whether they believe they influence the quality of mathematics being taught and learnt in their schools.

An advantage of the unstructured interview in this research is that it allowed for penetrating follow-up questions and the generation of hypotheses based on the accounts of the



school leaders. It needs to be considered that the data sought are not obtainable in any form other than the accounts of the school leaders. The idea behind unstructured interview questioning in this study was to determine whether school leaders influence the quality teaching and learning practices within the mathematics classroom (see chapter 2 and 3).

A single core question (Appendix 7) was posed to all the participating school leaders at the start of the unstructured interview. The core question captures the main research question: "Please tell me how you influence quality learning and teaching of mathematics in your school?" The notion of asking this single core question is in line with Interpretive Phenomenological Analysis (IPA), which forms the basis of this study (Smith, Floweres & Larkin, 2009).

The reasons for the single question in terms of an IPA as asserted by Smith *et.al.* (2009) are manifold. Firstly, it allowed for an IPA inductive epistemology. Secondly, issues were not structured around the researcher's assumptions. Thirdly, the school leaders' priorities and what they deem to be important became the focal point of the interview. Fourthly, it reduced the likelihood of the researcher directing the interview. Fifthly, it limited the danger of only the key topics being reflected in the analysis. Finally, it increased the likelihood of new and unexpected findings. The reasoning behind a choice of unstructured interviewing in this study is to open new and potentially uncharted theory.

#### **4.3.2 Semi-structured in-depth interviews**

A semi-structured interview is different from the unstructured interview only to the extent of its pre-determined structure and questions which inform the semi-structured interviews. The semi-structured interview for this study is thus a follow-up of the unstructured interview. The variables and hypotheses derived from the unstructured interviews with school leaders about their practices were further pursued for consistency and corroboration, in the semi-structured interview with the mathematics teachers. The list of research questions (Appendix 8) were pitched at an abstract level (Smith *et.al.*, 2009) to allow for interpretation and curtail directing the interviewee. The same questions (Appendix 8) were posed to all the participating mathematics teachers, to bring about consistency in the data from interview to interview. The semi-structured interview questions were used to facilitate the discussions of relevant themed

topics used in the unstructured interviews with the school leaders. The idea behind asking these themed questions was to avoid directed responses. Further, the interview list of questions allowed for deviation from the absolute structured nature, to accommodate in-depth reflection by the interviewees for the sake of in-depth data. The intention behind a list of pre-determined questions is intended to keep the sense of a loose agenda, to allow for a measure of new postulates in line with the objective of the research. The semi-structured interviews with the mathematics teachers were intended to validate the unstructured interview data derived from the school leaders and most importantly to also allow for the addition of new uncharted data, i.e. data not predicted in the literature review nor derived from the unstructured interview.

IPA continues to be appropriate for semi-structured interviews by starting with the level of detail derived in the unstructured interview and then progress to a more meticulous analysis of subsequent data sources (Larkin, Watts & Clifton, 2006). The same procedure as in the unstructured interview is applicable in the development of grounded theory through analysis of semi-structured interview data, whilst still corroborating the themes with the literature review (see chapter 2 and 3). This level of analysis (IPA) continues into the next section, i.e. the focus group discussion data collection.

### **4.3.3 Focus group discussions**

The six focus groups consisted of between three to eight mathematics learners who were roughly representative of all the high school demographics (Caucasian, Indian, Coloured and Black) in the Western Cape Province of South Africa. The groups comprised of all high school year age groups across a typical South African high school. The composition of the specific groups was predominantly from the same age groups, but allowances were made for follow-on years where the group numbers necessitated it. The intended diversification of the student cluster sample was influenced by the students the school allowed to be interviewed on the day, which is why the interview groups were not all optimally diversified as was originally intended. The intention with the focus group discussions was to have like-grades (or at least follow-on-grades) in the same discussion groups, to allow for learners to express their opinions openly and to reach some sort of consensus on open-ended questions.

The focus group discussion questions (Appendix 9) were designed to investigate the students' experiences on aspects of quality learning and teaching of mathematics in the classrooms. Students' perceptions as to how learning was impacted upon by role-players within the school: the school principal, mathematics educators and even other learners formed part of this investigation. Focus group discussions are recommended by Welman, Kruger and Mitchell (2008) as a viable research method to corroborate the phenomena highlighted in the previous interviews. The usefulness of the focus group discussion as the last method of data extraction in this research is because of the flexibility in follow-up questions in the focus groups. The flexibility in IPA application of a focus group discussion is not necessarily unheard of (Larkin, Watts & Clifton, 2006).

IPA can be a very complicated analysis strategy in the context of focus group discussions especially with high school students, where so many factors not related to the school leaders' influence on quality learning and teaching are applicable. The notion of the unpredictability of students as viable commentators makes IPA appropriate for focus group discussion data. According to Palmer, Fadden, Larkin & Visser (2010) IPA can be used across all the methods for data analysis. IPA is about moving from descriptive data to interpretive data, but it can be applied flexibly.

Palmer et.al., (2010) suggested a few adaptations to the IPA process, to make the focus group discussions with high school students as participants relevant for this research: the researcher should be identifying the students' experiential claims and concerns very early in the focus group discussion sessions; the researcher should be investigating the role which the school leader plays in the life of the students in the focus groups in the course of the session; the researcher could investigate the particular relationships between the school leader and the students. This data will be relevant for IPA when the researcher: examines the students' references about their school and opinions about school systems; examines the students' stories and carefully noting the underlying imagery; monitors the language usage and paying special attention to metaphors and euphemisms which are used and finally cross reference the data from focus group to focus group in the study. Through the adaptation of IPA, credibility is accomplished with the focus group discussion source data.

In this section I set out and clarified the data collection methods and how the data analysis (IPA) guided the data collection methods. The IPA process in this research which were conducted on the three data collection methods chosen (unstructured interviews, semi-structured interviews and focus group discussions) was intended to bring a level of rigour to the research approach (Larkin, Watts & Clifton, 2006) where the validity and reliability of a grounded theory is often deemed to be questionable. The responsibility was on the researcher to acknowledge the limitations and sources of error accompanying this qualitative research. In the next section these limitations and sources of error will be acknowledged.

#### **4.4 Limitations and Sources of Error**

Validity of data collection is about the limitations of the data sources and errors which cannot be controlled. According to Mouton (2005), the most relevant limitations of a qualitative study are the issues related to inherent limitations of the data and issues around naturalistic studies. What follows now is a very brief acknowledgement of the most salient limitations and possible sources of error.

##### **4.4.1 Limitations**

The emphasis on the school leaders' systematic and rigorous influence on programme outcomes is difficult to investigate. The result is that strong causal inferences regarding programme benefits and impact are problematic, if not impossible, to make. This research study was eventually confined to in-depth interviews (unstructured and semi-structured) and focus group discussions. This limitation restricted the justifications of findings to inductive reasoning, and does not allow sufficient triangulation opportunity, beyond qualitatively acquired sources. The purposeful sampling procedure decreased the generalisation of findings. The findings of this study cannot be said to extend to all areas of school leadership's influence on the mathematics classroom.

##### **4.4.2 Main sources of error**

The main sources of errors were those typically associated with naturalistic studies (Mouton, 2005). Some examples include interview bias as well as lack of rigorous control. Further shortcomings associated with the focus groups' sample compilation was in some cases

enforced by the predominance of certain student demographics. An example of such a shortcoming was where a school group consisted of students who may have been representative of the school but was eventually a full Caucasian focus group. In the same vein one of the focus groups consisted of only “black” students, because the school had predominantly black students.

It must be mentioned however, that every attempt has been made to negate shortcomings and sources of error as far as possible. In the event where this was not possible it was acknowledged as in the paragraph above. The only other considerations which might also be sources of error depending on the readers’ vantage point, is the ethical considerations which will be discussed next.

#### **4.5 Ethical Issues**

From inception, the work done in this study was performed with the highest possible level of ethical considerations. I was guided by the ethical standards required by the University of the Western Cape (2005). I had to be sensitive to issues of a personal nature, as the research topic itself poses major challenges to the school leaders, the educators and the learners who participated as research subjects. Several ethical documents were generated at various levels of the research process.

Permission was requested from various sources to conduct the research within the schools. Firstly, the Western Cape Education Department (WCED) was approached to grant permission for me to conduct research at schools falling under its jurisdiction. Permission was obtained and is attached as Appendix 2. Secondly, the University of the Western Cape (UWC) had to grant permission at the level of the proposal by its ethics committee (Appendix 4). Finally, the parents of students had to provide permission for students to participate in focus group discussions (Appendix 3). Fortunately, all the requests made for permission to conduct the research were approved.

The school leaders, who were under scrutiny in terms of their leadership’s influence, had to agree to the research as well (Appendix 1). These leaders did not have to accept simply because the WCED gave permission, which is why I also had to run the questions (Appendix 9) to be posed past the six school principals. The principals all agreed without concern.

Based on the requirements of the research methods, I also had to meet the requirements of what constitute an acceptable research sample size. The focus group discussions consisting of learners from which I had to get consent from enough parents or guardians to have a big enough sample size. A rigorous process of gaining permission from parents (Appendix 3) had to be adhered to by both the students and their parents. Fortunately, the positive respondents were enough to constitute an amply sized sample for focus group discussions (Richie & Lewis, 2003).

It was important to guarantee the anonymity of all the participants and institutions. The ethical guidelines for students, from the University of the Western Cape (2006), supplied the model for confidentiality and relevant consent forms. A sample of a consent form is attached as Appendix 3. In the next section, sampling and sampling sizes will be discussed in far greater detail.

#### **4.6 Sampling and sample size**

Sampling of a population is about a representative slice of the broader population where the phenomenon under review will be investigated. Two types of groups can be considered when sampling takes place within the Western Cape Province. Firstly, the high school grouping is based on the students' year of schooling. Secondly, the consideration that South African high schools are still loosely arranged in line with the previous apartheid education departments in the Western Cape Province. The sample from where the data will be extracted will thus have to be drawn from this representative slice of the Cape Peninsula urban area of high school leaders, mathematics teachers and students.

The South African National Education system works more-or-less on an age cohort allocation of students' year of schooling, with the 8<sup>th</sup> to 12<sup>th</sup> year of schooling basically coinciding with 14 to 18-year-old students. In terms of the WCED school policies, mathematics (as a subject) is compulsory in the 8<sup>th</sup> and 9<sup>th</sup> school years in a normal secondary school, whilst 10<sup>th</sup> to 12<sup>th</sup> school year students have a choice between mathematics and mathematical literacy. WCED sources reported in 2015 that roughly 40% of all 10<sup>th</sup> to 12<sup>th</sup> year students did mathematics with the top achieving schools having an average above 60% of the students doing mathematics instead of the less "complicated" mathematical literacy. In the Western Cape

quality learning and teaching of high school mathematics are loosely measured by the systemic tests in the WCED's 9<sup>th</sup> year of school and the achievements of the high-stakes examination towards the annual senior certificate examination for 12<sup>th</sup> year of school students. A purposeful sample which took all these high school grading aspects into account was eventually agreed upon.

The sample in this study comes from six Western Cape high schools, representative of all ex-apartheid department schools, ranging from previously advantaged to previously disadvantaged, public to independent schools. Western Cape public schools are still basically grouped in line with the previous demographical dispensation as the Ex-House of Assembly schools (Ex-HOA), Ex-House of Representatives (Ex-HOR), Ex-House of Delegates (Ex-HOD) and the Ex-Department Education and Training (Ex-DET). The diversity of participating schools in this research is outlined in Table 4.1, below.

**Table 4.1:** Sample representative of the Western Cape's high school population

School Orientation	Previously advantaged Schools			Previously disadvantaged Schools		
	Historical Demographics	Ex-HOA	Maths and Science Specialised Schools	Independent Schools	Ex-HOR	Ex-HOD
Number of Schools	1	1	1	1	1	1

The Western Cape's historical demographics were considered in compiling the sample size (Table 4.1).

A simple random sampling method was eventually decided upon. The sampling includes notions of a random sampling representative of the diverse groupings within the entire local population (Mouton, 2005). The sample (Table 4.1) had to be carefully considered because of the richness in diversity within the Western Cape Province, South Africa.

The sample represented by Table 4.1 above is a diverse sample intended to represent the various Western Cape Province groupings. The groupings will now be further clarified as the sample size and sampling is expounded on per number of school leaders, mathematics teachers and mathematics students as they respectively participated in the unstructured interviews, semi-structured interviews and focus group discussions.

#### 4.6.1 Unstructured interview sample size and sampling

The notion of big sample sizes in qualitative studies is almost a contradiction in terms. Qualitative research is concerned with meaning and not geared at making generalised statements. Phenomenological studies (i.e. the study of a phenomenon) is according to Mason (2006) thus not necessarily concerned with big sample sizes, however in a study on PhD research projects which Mason conducted, she found that sample sizes between 5 to 25 respondents are more than acceptable. The size eventually depends on when a sense of saturation has been achieved. In the case of this research the decision was taken to heed the advice of Mason (2006), which specifically influenced the decision to focus on a sample size of six schools.

As was mentioned earlier the group of school leaders come from diverse historical background schools, however school leaders' exposure to mathematics as a teacher differ from leader to leader as was captured in Table 4.2, below.

**Table 4.2:** School leader cluster sample

	Previously Advantaged Schools			Previously Disadvantaged Schools		
	Ex-HOA	Maths and Science Specialised Schools	Independent Schools	Ex-HOR	Ex-HOD	Ex-DET
<b>Historical Demographics</b>						
<b>School Leaders</b>	1	1	1	1	1	1
<b>Mathematics-teacher-turned-leader</b>	1	1	1	0	0	1

Table 4.2 represents cluster sampling with six school leaders from diverse Western Province's previous demographic groupings. Further the school leaders' experience as high school mathematics teacher has also been captured in Table 4.2. The same format from this section was carried over to the semi-structured interview section, below.

#### 4.6.2 Semi-structured interview sample size and sampling

The second sample category is the semi-structured interviews of high school mathematics teachers comprising of 11 teachers. The number of teachers who participated in the research were at average 2 per school. The WCED had approximately 460 high schools (in 2015), which make the sample at average approximately 1% of the mathematics teacher population. Saturation does not make much sense on this level, where there are basically at average only two mathematics teachers per school. As soon as a consistent "patterned" response is established, a



recommendation for saturation would be attained. In Table 4.3 below, the mathematics teachers per sample groupings are outlined.

**Table 4.3:** Representative Cluster Sample of high school mathematics teachers

Historical Demographics	Previously Advantaged Schools			Previously Disadvantaged Schools		
	Ex-HOA	Maths and Science Specialised Schools	Independent Schools	Ex-HOR	Ex-HOD	Ex-DET
Mathematics Teachers per school	2	1	2	2	1	3

The cluster sampling in the case of the mathematics teachers was not necessarily balanced, because the teacher numbers varied from school to school.

#### 4.6.3 Focus Group Discussion sample size and sampling

The third and final sample category (i.e. the six focus group discussions) consists of between three to eight students per group. The only additional criterion which became a consideration in the student focus group discussions was the grades of the participating students. The schools refused access to their 12<sup>th</sup> year of school students, which is why I could only access students in earlier year of schooling. Further, the schools preferred to give me grades 9, 10 and 11 students, because the grade 8s were deemed to be new to the high school and might not have had enough experience at the time of the investigation to report on the school leader's influence on quality learning and teaching within the high school. Table 4.4 below, shows the new cluster lay-out of the sample.

**Table 4.4:** Representative Cluster Sample of participating students

Historical Demographics	Previously advantaged Schools			Previously Disadvantaged Schools		
	Ex-HOA	Maths and Science Specialised Schools	Independent Schools	Ex-HOR	Ex-HOD	Ex-DET
Grade 11	0	6	0	3	0	8
Grade 10	3	0	4	3	6	0
Grade 9	0	0	3	0	0	0
Grade 8	0	0	0	0	0	0

The same diversity in the sampling format which was used previously in the unstructured and semi-structured interview sampling have been applied to the focus group discussions. The decision on the sample size was based on Richie and Lewis's (2003) recommendation that the

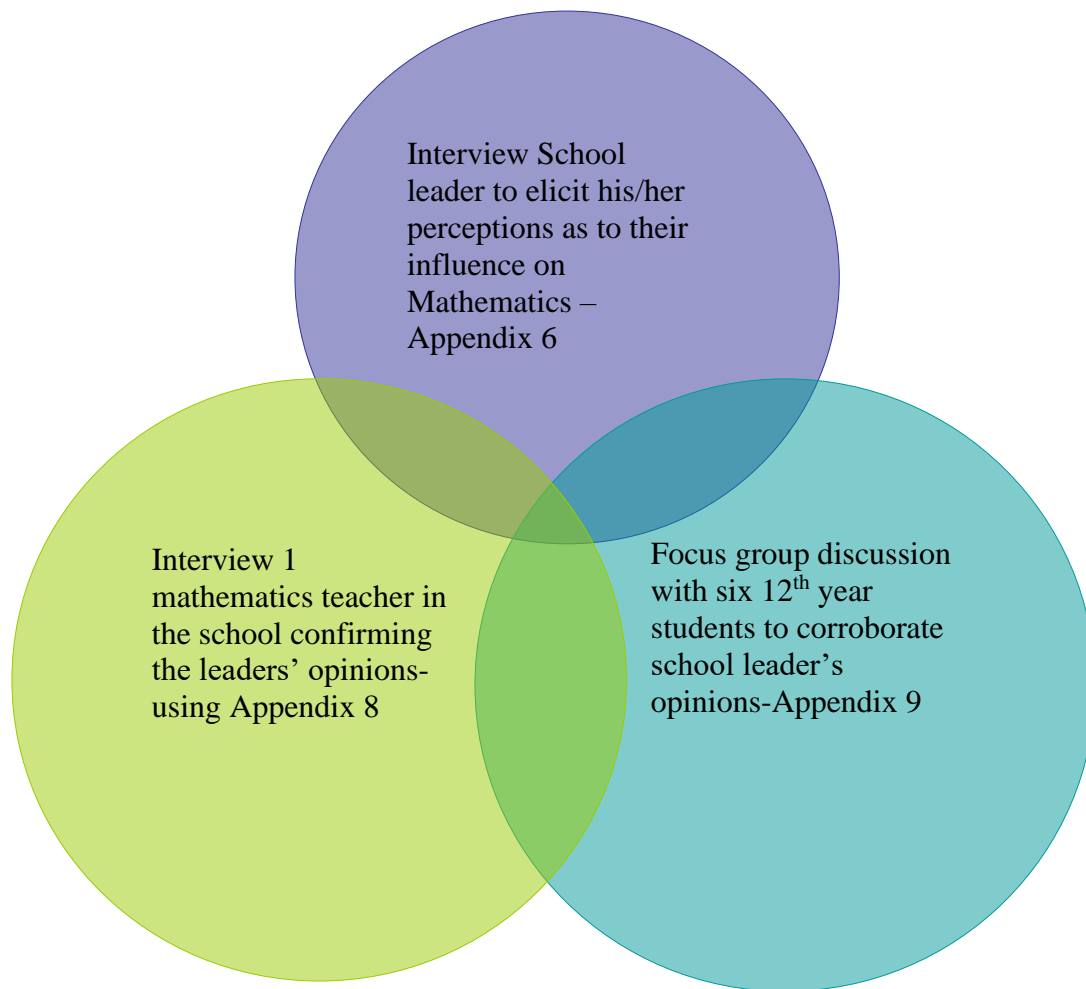
sample size for focus group discussion are comfortable at six participants. Unfortunately, one of the schools only sent three students to the focus group discussion, on the day. The list of questions which was eventually used in the implementation of the research was first trailed. The process of refining the questions before implementation is discussed in the next section.

#### **4.7 Piloting**

The decision to pilot the research was important in sharpening the interviewing questions to extract the most in-depth level of data. Trailing the questions (Appendix 6; Appendix 8 and Appendix 9) were embarked upon to ensure the most effective questions, to elicit in-depth data from the 1h30 minutes allocated per interview session. To this end, I embarked on a pilot session before the eventual implementation of the questions. Lists of questions in Appendix 6; Appendix 8 and Appendix 9 were trialed in the pilot phase, after which I eventually implemented as given in Appendix 8 and Appendix 9 (in the implementation phase).

##### **4.7.1 Pilot phase**

This pilot phase was originally earmarked to trial the first draft of qualitative questions (Appendix 6; Appendix 8 and Appendix 9). The trial research was conducted, to ascertain opinions by the school leader, mathematics teachers and mathematics students as to the impact of the school leader's influence on the quality of the learning and teaching of mathematics within their school. In terms of the design, the methods were simply applied to investigate the justification of acceptable data dependent on the potential for affirmation between the various data sources. The perceptions of the three role-players on the questions of the original lists (see appendices 18, 19 and 20) were noted for potential refinement of questions. The very first change which took place was the dropping of words like "impact" to "influence" because the influence was not obvious within the piloting of the list of questions. This verification of data can be viewed as the intersection of sets of data, (represented by Venn-diagrams) as per the diagram (figure 4.1) below:

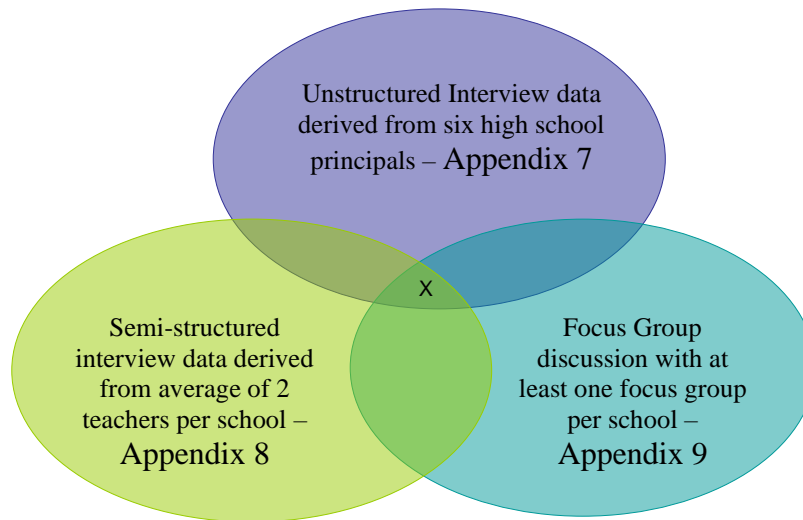


**Figure 4.1:** Pilot phase trailing of questions to illicit in-depth data

The pilot-phase produced data which could not be validated initially but questions in appendices 18-20 were adapted and trialled (Appendix 7; Appendix 8 and Appendix 9) with a group of 9<sup>th</sup> year of schooling students at the same school to conclude that the questions were good enough to elicit data to analyse whether leadership influences the quality of learning and teaching of mathematics in a high school. The school leaders' most relevant response to what she\he did to influence quality learning of mathematics in the school was her\his attempt to get all students to carry cards of theorem proofs in their pockets. The original questions did not yield much more than an attempt by the school leader to help the students score a few more marks in the pending high-stakes examinations. Revisions were made to the instruments and the revised instruments (Appendix 7; Appendix 8 and Appendix 9), were used for the primary data collection as the basis of the implementation phase.

#### 4.7.2 The implementation phase

The implementation phase is the full-on research implementation of the instruments finalised in the pilot-phase of interviews with school leaders and mathematics teachers as well as student focus group discussions. As in the pilot-phase, acceptable data was the triangulation of data sources, schematically represented by the intersection (X) of data sets in figure 4.2, below:



**Figure 4.2:** Schematic representation of implementation phase

The adapted lists of questions were used in the unstructured interviews, semi-structured interviews and focus group discussions (Appendix 7; Appendix 8 and Appendix 9) to collect the data. The use of three sources of data enabled me to get a more encompassing vantage from where to respond to the research questions, as well as to triangulate the data from three different source points. Mason (2006) supports the use of integrated sources of data because such an approach allows strengths to be combined to correct the deficiencies of any sole source or method. As mentioned earlier in this chapter, the data for this study was collected using a qualitative approach with coinciding methods: interviews with school principals who used to be mathematics educators; interviews with school principals who are not qualified mathematics educators; interviews with mathematics educators; focus group discussions with mathematics learners. Research instruments such as interviews (unstructured and semi-structured) and focus group discussions were thus used to collect qualitative data.

The two phases ensured that the interview questions were well structured to bring about sufficient in-depth data for evaluation from the implementation phase. According to Mouton (2005), one of the strengths of such an approach is the capacity of the researcher to establish

rapport and trust with the research subject, thereby affording high construct validity and insider perspective. For this reason, in conducting interviews and focus group discussions, the collaborative and participatory nature of this design intended to minimise suspicion and distrust of the research with a concomitant increase in trust and credibility with the participants.

#### **4.8 Conclusion**

In this chapter, I described the research design, method and instruments with relevant sources of error, limitations of the research and ethical considerations. The rationale for only employing qualitative methods was justified because this was an in-depth investigation into the influence of leadership on the quality of mathematics teaching and learning in high school classrooms. Further, all the necessary specifications to the research plan and the necessary precautions to validate, optimise and analyse the data has been clarified.

This research is not about, deductive logical reasoning nor generalising school leadership as a solution for quality learning and teaching of mathematics in the high school. The shortcomings in terms of limitations outlined as well as the acknowledgement of sources of error outlined in this chapter narrows the scope of this research. This research is thus about confirming the viability that leadership as another option (other than students and teachers) could influence quality learning and teaching within a high school.

As was argued earlier in this chapter, the integration of more than one technique of data collection intends to strengthen the justification of claims. In Chapter five to seven, I present sets of data collected during the research process. These chapters each present and analyse the data in the sequence in which it was gathered.

## Chapter 5

### Results of the unstructured interviews with school leaders

#### 5.1 Introduction

This chapter presents the results of the analysis of the data obtained through the unstructured interviews with high school leaders. The data collection focus was on three key themes emphasizing the research question as mentioned in chapter 1. The research question was around leaders' views on how classroom practices qualify as contributing to the quality of learning and teaching of high school mathematics, and how leadership responds to the demands of quality learning and teaching of mathematics.

The analysis of the data focused on focal points captured as a series of codes, derived from the transcribed interview data of school leaders from the participating schools. The codes were generated through indicators of quality teaching and learning developed in chapters 2 and 3. The analysis therefore followed a confirmatory approach (LeCompte & Preisle, 1993) in the sense that the objective was to identify codes that confirm those emanating from the literature review. The results of analysis according to LeCompte and Priesle (1993) may include codes that were not in the pre-defined list of codes to allow for literature omissions. Atlas.Ti7 was used with the data analysis.

#### 5.2 Presentation of unstructured interview codes

In this section I present the codes used for the analysis and the categorization of the codes as a family of codes. Not all the codes are relevant for this specific research but might have implications for recommendations for further studies. Relevance for this research includes the data supporting aspects of the arguments in the literature review. The rest of the unstructured interview data codes I present with the support of Table 5.1.

Data evident in transcribed data	Yes	Coded literature review items not evident within transcribed data	Not evident within this research (not in the literature review nor the transcribed data).
	No	Relevant transcribed data supported by coded literature review arguments.	Code transcribed data not evident within the scope of literature review.
		No	Yes
		Data evident from literature review	

**Figure 5.1** Scope confirmatory analysis of the unstructured interview transcribed data

Appendix 10 represents a list of relevant unstructured interview data slices to which I allocated codes originated from the literature review with the help of Atlas.ti7. I found 70 relevant data slices that I coded with 20 descriptive codes, by using hyphenated words capturing the concepts (Mason, 2006). The list of descriptive codes are non-exam-innovation; leader's-commitment-to-mathematics; leader-not-impacting-on-mathematics; leader-shortcoming; leaders'-mission; leadership-role; mathematics-experience-of-leader; beyond-school-mathematics; higher-order-testing; non-exam-innovation; quality-teaching-practice; school-culture; students-become-teachers; artefact-production; dare-to-innovate; innovations-in-school; test-students-on-intake; mathematics-teacher-quality; teacher-employment; exam-focus; importance-of-testing; non-exam-innovation.

The 20 codes were used further to formulate families of codes in line with labelling from literature review quotations with the intention of grouping relevant codes and thus responding to the research question confirming the notion of school leaders' influence the quality of learning and teaching of mathematics in their schools. I have decided on five families of descriptive codes which capture the literature review discourse. They are: Artefact-production; beyond-school-mathematics; innovative-measure; situated-leadership and quality-teaching.

Finding coded unstructured interview data slices that support claims made in the literature review (Evans, 2009) is the main objective of the analysis. This process of validating the literature review claims is intent on eventually (in chapter 8) evolving into a theory (Evans, 2009) through an inductive process.

Table 5.1 below, presents the family of codes with its constituent codes and the prevalence of unstructured interview transcribed data slices:

**Table 5.1:** Unstructured interview data codes

<b>Family of codes</b>	<b>Data codes</b>	<b>Frequency of data codes</b>
<b>Artefact-production</b>	Beyond-school-mathematics; higher-order-testing; non-exam-innovation; quality-teaching-practice; school-culture; students-become-teachers; dare-to-innovate; innovation-in-school; test-students-on-intake.	24
<b>Beyond-school-mathematics</b>	Exam-focus; higher-order-testing; importance-of-testing; non-exam-innovation; test-students-on-intake.	17
<b>Innovative- measure</b>	Dare-to-innovate; innovations-in-school; non-exam-innovation;	9
<b>Situated-leadership</b>	Leader's-commitment-to-mathematics; leader-not-impacting-on-mathematics; leader-shortcoming; leaders'-mission; leadership-role; mathematics-experience-of-leader.	9
<b>Quality-teaching</b>	Mathematics-teacher-quality; students-become-teachers; teacher-employment.	11

These codes are much more than mere labelling of analogous data slices with the literature review. The deductive aspect lies in the claim made by at least one of the school leaders and then corroborated through literature as per the literature review. It has been systematically deduced that, the answering of the research question should lead to a confirmation that school leadership can potentially influence the quality of teaching and learning of mathematics in high schools (Evans, 2009). The building of this first step to establishing a grounded theory is the research question that school leadership has the capacity to influence the quality of learning and teaching of mathematics. The extraction of coded data that is supported by the literature review is not the only way to gather reliable data from these unstructured interviews' data. The unstructured interview data that is not supported by the literature review (Appendix 10) is also a potential source of uncharted theory.

The unstructured interview data, not supported by the literature review are not necessarily completely lost to this research, because it is either not related directly to the research question or there may have been a shortcoming to the scope of the research. I present in Table 5.2 below, the constituent codes not supported in the literature review for each of the five families of codes.



**Table 5.2:** Unstructured interview data codes confirmed (or not) by literature review

<b>Family of codes</b>	<b>Unstructured interview data codes confirmed by the literature review</b>	<b>Unstructured interview data codes <u>not</u> confirmed by the literature review</b>
<b>Artefact-production</b>	Beyond-school-mathematics; higher-order-testing; non-exam-innovation; quality-teaching-practice; school-culture; students-become-teachers	Test-students-on-intake; dare-to-innovate; innovation-in-school.
<b>Beyond-school-mathematics</b>	Exam-focus; higher-order-testing; importance-of-testing; non-exam-innovation; test-students-on-intake.	NA
<b>Innovative-measures</b>	Innovations-in-school; non-exam-innovation.	Dare-to-innovate.
<b>Situated-leadership</b>	Leader's-commitment-to-mathematics; leader-not-impacting-on-mathematics; leader-shortcoming; leaders'-mission; leadership-role;	Mathematics-experience-of-leader.
<b>Teacher-influence</b>	Mathematics-teacher-quality; students-become-teachers; teacher-employment.	NA

From the table above, beyond-school-mathematics and teacher-influence are the two families of codes, which have all constituent codes corroborated in the literature review. The constituent codes not supported by the literature review might also be data relevant to the research question but might just not be “visible” because of the literature review scope. It is for this reason that I also included the codes not supported by the literature review. The family of codes not featuring in the literature review supported codes can simply be due to the limitations of the adopted research methods; the context of the mathematics; the school leaders not expressing these codes or otherwise a shortcoming of the research design.

This chapter’s response to the research question comes down to the comparison between a literature review and the research respondents about quality learning and teaching of mathematics. To find the coding of data in transcribed unstructured interviews compared to the literature review brings the data closer to the notion of validated data. In other words, three categories of coded data emerge from the transcribed raw data i.e. codes representing a category of data supported by the literature review; some codes representing a category of transcribed data not supported within the literature review, not within the context of the research framework, some literature review categories not representative of codes in use. These comparisons will be the basis whereby I present the actual findings (i.e. the specific quotes) of the data analysis.

### 5.3 Presentation of grounded unstructured interviews quotations

In line with a single core question (Smith *et al.*, 2009), which guided the unstructured interviews, the researcher did not ask too many follow-up questions allowing the interviewees to tell their stories. The follow-up questions focused on the themes: quality teaching and learning of mathematics; the practices which has quality learning and teaching as an outcome, and the influence of leadership on aspects of quality teaching and learning. Presented below are the perspectives of the school leaders, as it relates to the literature review data. The presentation focuses on the five descriptive families of codes: Artefact-production; beyond-school-mathematics; innovative-measures; situated-leadership and teacher-influence.

The family of codes: “artefact-production” is a grouped categorization (family of codes) consisting of four constituent codes (beyond-school-mission; higher-order-testing; non-exam-innovation and quality-teaching). I present the best slices of data to confirm the literature review quotes in Table 5.3, below:

**Table 5.3:** Literature review and data quotes confirming: “artefact-production”.

Code	Slices of transcribed unstructured interview data	Best fit quotes from the literature review to corroborate relevant quotes
<b>Beyond-school-mission</b>	“And the rationale for that course was that we found that we found that kids do well for the exams, but when they get to first year University mathematics then they don’t make it. And we found that they did not get the correct grounding in the University Mathematics”.	“... means supplying higher education (Smith, 2002, P.21) and the knowledge economy (Greer and Mukhopadhyay, 2003, P.18) with sufficiently skilled mathematics users...”, (P.22).
<b>Higher-order-testing</b>	“So, we won’t ask questions that are easier, so that the kids can score high marks, we will rather want to make the questions more complex than the once that they’ve.”	“The one thing that needs to be added to this discussion is that the decisive contribution that is being discussed here does not in itself imply a higher order quality contribution”, (Liskala, Vauras & Lehtinen, 2004, P.38).
<b>Non-exam-innovation</b>	“In terms of the extended program, we have the course that we offering as an eight subject which is called Advanced Programme Mathematics, It is an IEB ...”	“Some stand-alone extramural programmes which includes opportunities for doing mathematical artefacts requires a school leaderships sensitivity to take Mathematics beyond the classroom albeit to just allow the club or society to operate in the school”, (Greiffenhagen & Sharock, 2008, P40).
<b>Quality-teaching-practice</b>	“We have Saturday Classes. So, we sort of make up the backlogs that we see on a Saturday class, uhm you know. So, we are behind at this	“The notion that co-curricular or extracurricular mathematics experiences are the only quality learning exposure for high school students necessitates

	point in time, we are still busy with term two's work. So, what we (are) finding ...”	innovation into the regular mathematics classroom.” (Julie, 1992, P40)
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The school leaders interviewed perceived attempts at artefact-production activities predominantly as remedial actions to address the shortcomings of classroom mathematics. Even though the literature review (chapter 3) suggests that higher-order-thinking is applicable to school lessons and examinations, the school leaders were adamant that they should look beyond the school mathematics program to prepare students for a life in mathematics at universities and beyond school. The higher-order-testing code highlights the leadership's perspectives on issues around the need for independent learners, but do not say much about the literature review's connection with development of independence in students as well as getting students to take on teachers' roles. The code, non-exam-focus in the literature review is more than just a co-curricular or extra-curricular activity. School leaders however responded with co-curricular programs like remedial classes as the non-examination alternatives. The literature review recommends a move away from senseless grading whilst the school leaders see additional teaching as a strategy to eradicate student backlogs as the solution to “improve results”. The data indicates a strong indication that quality-teaching should also be prevalent in the regular daily mathematics classroom. The data is however silent on specifics in terms of what constitutes the artefacts of quality-teaching as it is described in the literature review. The family of codes consisting of the four codes therefore does not conclusively confirm the research objective.

The family of codes: “beyond-school-mathematics”, represents unstructured interview data slices confirmed or not, by the literature review for each of the five constituent codes in Table 5.4, i.e. exam-foci; higher-order-testing; importance-of-testing; non-examination-innovation; test-students-on- intake. Table 5.4 links the codes to the literature review to validate the family of codes: “beyond-school-mathematics”.

**Table 5.4:** Literature review confirming family of codes: “beyond-school-mathematics”

<b>Codes</b>	<b>Transcribed data slice</b>	<b>Literature grounding</b>
<b>Exam-focus</b>	“Now we have seven reports. Issued a year. We have mid-term reports as well. We have four for every end-of-term. March, June September and December. But then we have one in February as well. Then we have one around April and May. And then we have one in August as well. That	“Both orientations' foci are necessary dimensions of the definition however the concept of quality cannot be exclusively one-dimensional but should include the high-stakes examination drive as

	is what we call mid-term reports. So, we do much more testing and assessments.”	well as the meeting of the needs of the knowledge economies as the users of high school mathematics”, (Glennan and Resnick , 2004, P.29)
<b>Higher-order-testing</b>	“... in terms of the quality of the paper contents in terms of whether they comply with the blooms taxonomy and the level of questioning. So, it is just not if the kids get a 60% it must really be a quality 60%.”	“Wiliam endorses the value of assessment to also improve Mathematics learning. He goes further to link a good assessment to a good teaching activity. In order to achieve this, however, it is incumbent on the educator to design an interactive process whereby the educators can determine whether what they set out to teach was in fact learnt.” (Wiliam, 2007, P.23)
<b>Importance-of-testing</b>	“So, we first need to test. Whether they are or where they are at before we can actually implement an actual curriculum that is stated for grade 10.”	“... to get learners to produce good results in high-stakes curriculum-based-examinations cannot be the sole goal of mathematics driven by the school”, (Collins, 2006, P.19)
<b>Non-exam-innovation</b>	“So, ... extension on a horizontal level. They (are) going into the depth, because these are kids who can handle the depth?”	“...higher education and the knowledge economy with sufficiently skilled mathematics users should be the real focus of high school mathematics ...”, (Smith, 2002, P.22)
<b>Test-students-on- intake</b>	“We do an entrance exam, but it does not really uhm, but we don’t analyse that entrance exam. In terms of where each child is at. That is what we do with the classroom when we have them here. From the beginning of the year. So, and we don’t do it like intensively. We don’t give them a test where we analyse the data. It is not like that intense.”	“Heck and Hallinger (2009) maintain that such admission practices of taking on high-performing learners (who incidentally would be high-performing irrespective of the school they attend), have a distorted sense of quality learning and teaching of mathematics”, Heck and Hallinger, 2009, P32).

In the family of codes: “beyond-school-mathematics”, the school leaders strongly emphasize school examinations and related curriculum driven activities. The data expose an impression of the basis of quality learning and teaching of mathematics in the school by the leaders. According to some school leaders learning in mathematics is about the achievement of satisfactory results in high-stakes examinations. The data also highlights that the participating school leadership does not question the importance of high-stake mathematics-examination results. School leaders referred to the testing of higher-order thinking skills. They did not provide specific examples of this happening in their schools. However, higher-order-thinking skills are the problem-solving

skills in higher-order-thinking, which makes it imperative and relevant for quality teaching. The participating leaders were however very quick to imply that they get by with lower-order questioning, which is sufficient to make the learners pass the high-stake Mathematics examinations. The data extracted from the school leaders' interviews are non-existent on the literature review's emphasis for the need by knowledge economies and access to higher learning institutions. The over-emphasis on examinations, however, seem to be far more prevalent in the data.

The family of codes: "innovative-measures", is presented as unstructured interview data slices with corroborating literature review quotations. Table 5.5 below indicates how the literature review coincides with the constituent codes. Innovative-measures consist of the two codes: Innovations-in-school and non-curriculum-innovations outlined in Table 5.1. Table 5.5 below, is a set of codes correlated with the literature review slices, thus validating the reliability of the family of code: "Innovative-measures".

**Table 5.5:** Literature review supporting the code: "innovative measures"

<b>Code</b>	<b>Quote</b>	<b>Literature grounding</b>
<b>Innovations-in-school</b>	"We have Saturday Classes. So, we sort of make up the backlogs that we see on a Saturday class, uhm you know. So, we are behind at this point in time, we are still busy with term two's work. So, what we (are) finding ...."	"When teachers fail to sustain doing Mathematics in the classroom to bring about a quality learning and teaching of Mathematics practice there is a need for a call for innovation to find a solution to the dilemma at all costs. Jamrog, Vickers, Bear (2006) is of the opinion that innovation is vital, in fact a prerequisite to success and will be involve in any aspect of an organisation including learning and teaching." (Jamrog, Vickers, Bear, 2006, P.42)
<b>Non-curriculum-innovations</b>	"You see, we try to do both. The thing with the AP maths program, before we actually did that, we did an informal, where they did not have to write exams. It was an informal enrichment course." So, ... extension on a horizontal level. They not going into the depth, because these are kids, who can handle the depth. Now if I look at the current grade 12 group, because they also have AP, and some of them have Math 3 as well?"	"Some stand-alone extramural programmes which includes opportunities for doing mathematical artefacts requires a school leaderships sensitivity to take Mathematics beyond the classroom albeit to just allow the club or society to operate in the school." Koich and Berman (2005) reminds us that schools normally let their gifted students participate in "solving puzzles" but in the context of Mathematical Olympiads. Douglas (2009) however reminds us that the classroom instruction is complex and teachers can facilitate classroom learning in order to improve real student learning which can in other words also include the facilitation of "solving puzzles", (Douglas, 2009, P.39)

The innovations that are evident from the school leaders' perceptions of what constitutes quality teaching and learning focuses on enrichment activities. The level of influence by school leaders thus refers to the organizing of after-school activities and Saturday programs. These co-curricular programs benefit only a few students and include the likes of mathematics competitions and extension programs. The data is silent on the extra classes and remedial lessons in mathematics predominant in previously advantaged schools. There is, however, weak evidence found among the previously disadvantaged schools' data. Jensen (2009) places the responsibilities of student shortcomings in the hand of school leaders, i.e. to find solutions for disadvantaged children should be the responsibility of the school. The family of codes: innovative-measures, and its constituent codes (Table 5.1), consisting of slices of data (Table 5.5) from the unstructured interviews, do not match up well with the literature review. This lack of corroborating evidence is the reason why it does not confirm whether the school leaders influence quality of learning and teaching of mathematics based on the family of codes, "innovative-measures".

The family of codes: "leadership's-influence" applies to the unstructured interviews in line with the five constituent codes in Table 5.1 as they respond to the literature review in chapters 2 and 3. Table 5.6 below indicates how the literature review attempts to justify the codes. Each of the quotes represent slices of unstructured interview data supported by the relevant literature review quotations, deductively validating the codes as per Table 5.6, below.

**Table 5.6:** Literature review supporting the code: "Situated-leadership"

<b>Code</b>	<b>Leadership's Interview Data Slice</b>	<b>Literature grounding</b>
<b>Leader-commitment-to-mathematics</b>	"Because I am a Maths person, I have a stake in Mathematics. And I still teach as well. So, I have direct contact with Maths teaching. And with the curriculum."	"Leadership concerns itself predominantly with the stoic intention to bring about a desired performance in an organised activity like the learning and teaching of Mathematics in a high school", (Collins, 2006, P.15)
<b>Leader-not-impacting-on-mathematics</b>	"Well, that is required in every subject by the different subject curriculum advisors. But it is part of what we do in any case, so there is not a real explicit way that I actually do that – I trust that the teachers do that ..."	"Despite the many advances in Mathematics education, the influences on sustainability of innovations in quality learning and teaching of Mathematics are far between", (Sindelar, Shearer, Yendol-Hoppey, & Liebert, 2006, P.14; Giles & Hargreaves, 2006, P.14)

<b>Leader-shortcoming</b>	“... and it is difficult I haven’t had experience in HR and so on to look for a teacher. To know is this teacher going to abide or buy in to the ethos and culture of the school.”	“Leadership strategies maintaining a distorted sense of “quality” will be based on harsh leadership practices geared at non-developmental manoeuvring like “getting the right people on the bus” (Collins, 2006), with the business-like objective to meet higher profits and increase market share.” (Collins, 2006, P.18)
<b>Leaders-mission</b>	“If we want to conform to that we are going to do it at the expense of these kids, because we are going to lose them. At grade 10 level we don’t want loose them. We want them to love mathematics. We want them to continue with Mathematics, right?”	“The notion of an "engineered sense of quality" is quite readily borne from the two non-aligned missions of the role-players in leading and teaching of high school Mathematics”, (Bauer & Gaskell, 1999, P.17).
<b>Leadership-role</b>	“So obviously I have to take a leading role there. OF planning the curriculum, and adjusting it, because what I told those two young men, was that we have a curriculum that the Department gives us as pacesetters.”	“These attributes of quality learning contributions require a system which will make the entire school community accepting of the venture. This is the essence of a school culture and thus in the realm of leadership.” (Davies & Davies, 2008, P.34)

The school leaders were surprised that they are potentially accountable for the quality learning and teaching of mathematics in their schools. They placed this responsibility solely in the hands of their mathematics teachers. Even school leaders with a teaching background in mathematics did not necessarily see themselves as influencing quality learning and teaching of mathematics in their schools. Their responsibility for the improvement of quality performance of mathematics in the school is suggested by these school leaders as simply admitting better quality students. They even allowed for some students to “lose their quality” which they perceived the students to have had, when they started off at their school. Table 5.5 above links the data retrieved from the transcribed slices of data representing the unstructured interviews of the school leaders. These school leadership strategies for quality learning establishments were predominantly restricted to the admission of students perceived to have a “higher” level of performance in high-stakes examinations. Furthermore, the data confirm that mathematics teachers are taking the responsibility of the strategic direction of mathematics learning and teaching within the school, which is according to Sanborn (2006) a leadership function.

In Table 5.1, the family of codes: quality-teaching consists of the three codes: quality-teaching, students-become-teachers and employing-quality-teachers. From the same table, the

average number of quotes related to quality-teaching shows a low prevalence of the family of codes: quality-teaching in the data. Only 11 out of 70 (i.e. 15.7 %) of the quotes refer to the family of code, quality-teaching. In order to look at the quality of the unstructured interview data codes, I will give the best-fit quotations in the next table. Table 5.7 below presents transcribed unstructured interview data slices, which is the closest best-fit of the literature review representation of the code to thus validate the code and in turn the family of codes: quality-teaching.

**Table 5.7:** Literature review supporting the code: Quality-teaching

<b>Codes</b>	<b>Quotes by school leaders</b>	<b>Corroboration with the literature review (chapter 2 and 3)</b>
<b>Quality-teaching</b>	“There has to be space for the teacher to explain concepts and for the kids to do work together.”	“It is almost no surprise that a mathematical community that engages learners enhances the quality of learning”, (Lampert, 1988, P.20).
<b>Students-become-teachers</b>	“They are a bit more knowledgeable than the others. And in their groups their natural inclination is to explain to the others that don’t understand.”	“... developing intelligent conversation through an effort-based socialization ...” (Resnick & Hall, 2000, P.2) .
<b>Employing-quality-teachers</b>	“We try to recruit teachers who adhered to our, values man. And who really are committed to make a difference. I said that I ... would ... when I looked at uhm, When I look for a teacher...”	“ ... employ educators who meet the strategic intention of (curriculum-based) schools, i.e. to get learners to produce good results in high-stakes curriculum-based-examinations ...”, (Collins, 2006, P.19).

The school leaders were convinced that mathematics teaching quality involves the notion of students acting as teachers (see Table 5.7 above) however, these actions were not convincingly part of the school leaders’ perspectives of what really takes place in their schools. The school leaders seem to downplay the students’ ability to fulfil roles of teachers. The aspect to employ teachers who already possess qualities in line with the school’s strategic intention implies predominantly the production of satisfactory results which seem to be a strong quality learning condition for the school leaders. The quotations in Table 5.7 are slices of transcribed data intended to ground the codes described in Table 5.1. These codes feed into the family of code: “quality-teaching” i.e. the influence by the school leaders is to employ already capacitated quality teachers.

This section presented the analysis of the unstructured interviews by corroborating the data with the literature review (chapter 2 and 3). The research is not about the obvious data, but also



looks at the silences within the data. In the next section, I will discuss the analysis of data not entirely supported by the literature review.

#### 5.4 Analysis of data not corroborated in the literature review

The unstructured interview data is silent on numerous aspects highlighted in the literature review, especially aspects that refer to the development of teachers and students to acquire “quality” teaching and learning. Instead, participating school leaders use an aged-old leadership technique of “getting the right people on the bus” (Collins, 2006). Leadership situated in the broader mathematical community of practice is however not expected to replace practitioners but according to Lave and Wenger (1998) should secure the survival of the mathematical community by developing the quality of participation. School leaders who have the sustainability of the mathematical community at heart, will thus have to forego of Collins’ (2006) notion of employing and admitting quality teachers and students. Accordingly, some of the participating leaders profess to the admission of academically strong students. There are however a “deliberate sidestepping” of discussions on the likes of admitting academically strong students to the schools. In this section, I present the aspects not adequately addressed in the literature review.

There are literature review items not convincingly linked to the unstructured interview codes. It was for instance indicated in the literature review (chapter 2 and 3) that quality learning and teaching can be developed in the classroom if school leadership adopted and fostered the practice of “doing mathematics”. In Table 5.8, below the codes related to the notion of a “doing mathematics practice”, could not be substantiated through the collection of data (unstructured interviews). Below (Table 5.8), I itemize some of these codes earmarked for further investigation in the semi-structured interviews (chapter 6) as well as the focus group discussions (chapter 7).

**Table 5.8:** Unstructured interview codes not supported by literature review

<b>Family of Codes</b>	<b>Constituent codes requiring without literature review corroboration in the context of this research</b>
<b>Artefact-production</b>	Beyond-school-mathematics; non-exam-innovation; students-become-teachers; test-students-on-intake.
<b>Beyond-school-mathematics</b>	N/A
<b>Innovative-measures</b>	Dare-to-innovate

<b>Situated-leadership</b>	Leader's-commitment-to-mathematics; mathematics-experience-of-leader.
<b>Quality-teaching</b>	N/A

Table 5.8 does not show any literature review shortcomings for “quality-teaching” and “curriculum-based-foci”. The data indicate that school leaders have the perception that their teachers are involved in quality mathematics teaching, and that the curriculum-based-foci is meeting the expectations of high school mathematics. Consequently, the aspects of innovation seem to come up in the data as school leadership acknowledge that their teachers might just not be daring enough to try out innovative methods. Furthermore, the data is not obvious in linking the codes commitment-to-mathematics and mathematics-teachers-turning-school-leaders. I acknowledge that the “silence” might be, because of commitment-to-mathematics and mathematics-teachers-turning-school-leaders are not in all the school leaders’ realities, however, some of these leaders have been mathematics teachers. Another “silence” by the school leaders was the insensitivity to mathematical artefact-production (Julie, 2004) in the participating schools. There are also silences by high performing schools on direct probing into the culture of quality processes and products evident in the school’s culture.

### **5.5 Summary of the presentation of unstructured interviews data**

The research set out to find in-depth confirmation of literature review codes in the transcribed data however, the unstructured interview data is silent on the depth of the research question. In summary I included all the codes used in the research and recognised the literature review’s dichotomous foci of school leaders being high-stakes examination orientated or not as well as being innovative or not. In the Johari window below, I collated all the codes in figure 5.2, below to structure the scope of the unstructured data in terms of examination focus and innovation:

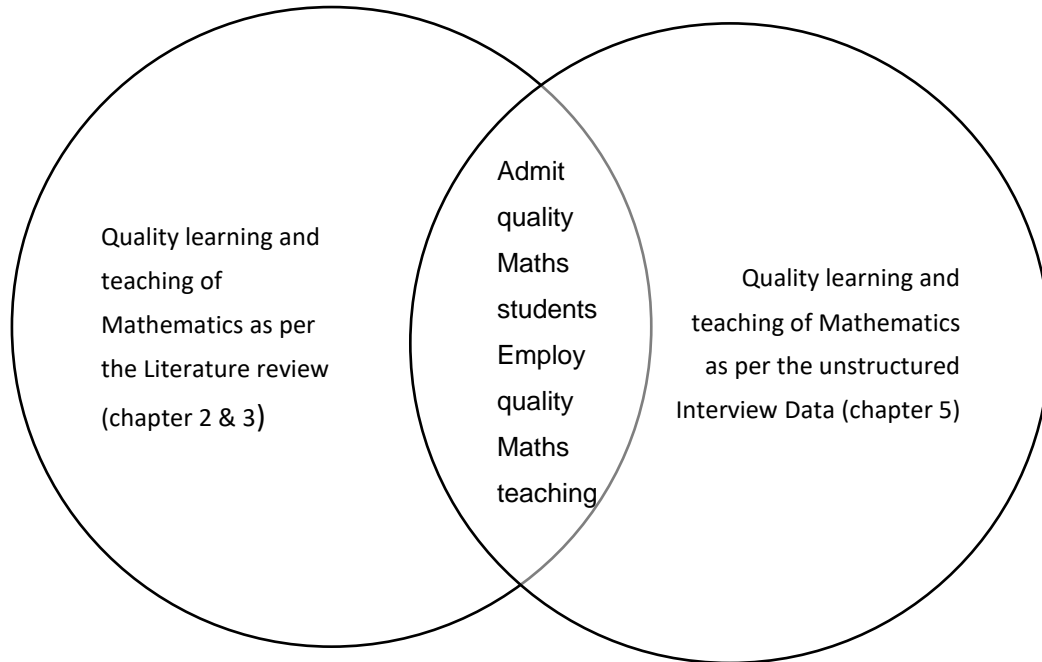
		Innovation		
High stake examination focus		School Culture; Teacher Quality; Quality Teacher-employment; quality teaching; Test-students-on-intake; Exam Focus;	Innovation-in- school; Students-become-teachers; High-order-testing	Yes
		Beyond-school-mission; Non-exam-innovation; leaders'-commitment-to-maths; leadership-impact; Leadership-role; Students-become-teachers;	Non-Exam innovation	No
		No	Yes	

**Figure 5.2:** Scope of school leaders' codes as examination focus vs innovation drive

The figure indicates that school leaders think they have a strong tendency towards examination with the only indication of non-examination codes being a reference to teaching certain topics earlier to create an advantage for the student during a high-stakes examination.

The “quality” aspects acknowledged by the school leaders are thus reduced to employment of “quality” teachers and the admission of “quality” students. To get behind the depth of this research question I visualize the family of codes, diagrammatically below. Figure 5.3 indicates: the literature review codes expecting that school leaders can influence quality of mathematics in the classroom; the unstructured interview data investigated for evidence of strong prevalence of perception by school leaders that they influence quality of mathematics taught and learnt at their

schools. The intersection of the literature review data and the interview data is represented as the corroborated data as in figure 5.3 below.



**Figure 5.3:** Corroboration between the literature review and the data

Figure 5.3 graphically represents the confirmation of the aspects of the unstructured interview data with the literature review. The literature review refers to the development of the learner as well as the teacher. The depth of the unstructured interview data does not show obvious school leadership's influence on the quality of the learning, nor the quality of the teaching of mathematics in their schools. It is thus appropriate to extend the research to additional data produced through the semi-structured interviews and focus group discussions mentioned in chapter 4. On its own unstructured interviews are hugely, insufficiently responding to the research. In chapter 6 and 7 I am presenting the semi-structured interviews data with high school mathematics teachers and discussion group sessions with high school students to find stronger evidence in the other data collection means.

## Chapter 6

### Results of the semi-structured interviews with Mathematics teachers

#### 6.1 Introduction

This chapter presents the results of the analysis of data obtained through in-depth semi-structured interviews with participating mathematics teachers. Results were generated around the perspectives of the mathematics teachers through a list of questions which was originally trialled in pilot 1 (Appendix 8), mentioned in Chapter 4. The in-depth semi-structured interview questions were adapted in response to the claims by the school leaders in chapter 5 and was intended to allow for reflection by the teachers on their mathematics practices and the influence their respective school's leadership had on the quality of their teaching (Mears, 2012) and the learning of the learners.

The analysis of the semi-structured interview data focused on the research question and related aspects captured by a descriptive series of codes. The intention behind the information gathered through the semi-structured interviews was primarily to assess the alignment with chapter 5's families of codes, and to confirm or not the development of the arguments in the literature review (Charmaz & Bryant (2011).

The analysis of the semi-structured interview data does not only confirm expected themes, in line with the literature review but also produced new and unexpected linkages between codes and families of codes. I present these results below.

#### 6.2 Presentation of the results of the semi-structured interviews with teachers

As stated before, the analysis of the semi-structured interview data was intended to confirm (or not) the arguments in chapters 2, 3 and validate chapter 5 claims. I arranged the data from the semi-structured interviews in the families of codes developed from the literature. The constituent codes come from the data of the semi-structured interviews with the teachers. I present these families of codes with its constituent codes and the prevalence of the quotes in Table 6.1 below.

The prevalence is merely an attempt to show the strength of the various families of codes but will not be used as part of the interpretation.

**Table 6.1:** Semi-structured interview data codes

Family of codes	Data codes	Frequency of data codes
<b>Artefact-production</b>	Curriculum-based-foci; Higher-order-questions; Importance-of-testing.	11
<b>Beyond-school-mathematics</b>	Higher- order-questions; Innovation-measures; Problem-solving-skills; Test-students-on-intake; Extra-curricular-mathematics.	27
<b>Innovative-measures</b>	Extra-curricular-mathematics; Higher-order-questions; Problem-solving-skills; Quality-learning; students-become-teachers; test-students-on-intake.	25
<b>Situated-leadership</b>	Extra-curricular-mathematics; Situated-leadership; Quality-learning; test-students-on-intake.	15
<b>Teacher-influence</b>	Curriculum-based-foci; Higher-order-questions; Importance-on-testing; Problem-solving-skills; Quality-teaching; Students-become-teachers.	37

The table of descriptive families of codes shows the constituent codes and the prevalence of these codes, as they make-up the various family of codes. Interpreting the codes in Table 6.1 makes far more sense if I look at the previous chapter's corresponding table (chapter 5.1), i.e. comparing data codes of the unstructured interviews and the semi-structured interviews. The difference in the constituent data codes between Table 6.1 and Table 5.1 can be summarised in the following table:

**Table 6.2:** Comparison between what school leaders and mathematics teachers say beyond what they confirm

Family of codes	Codes in teacher interview data not in school leader interview data	Codes in school leader interview data not in teacher interview data
<b>Artefact-production</b>	Curriculum-based-foci; Higher-order-questions; Importance-of-testing.	Beyond-school-mathematics; Higher-order-testing; Non-exam-innovation; Quality-teaching-practice; School-culture; Students-become-teachers; Dare-to-innovate; Innovation-in-school; Test-students-on-intake.
<b>Beyond-school-mathematics</b>	Higher- order-questions; Innovation-measures; Problem-solving-skills; Extra-curricular-mathematics; Test-students-on-intake.	Exam-focus; Higher-order-testing; Importance-of-testing; Non-exam-innovation; Test-students-on-intake.
<b>Innovative-measures</b>	Extra-curricular-mathematics; Higher-order-questions; Problem-solving-skills; Quality-learning;	Dare-to-innovate; Innovations-in-school; Non-exam-innovation;

	Students-become-teachers; Test-students-on-intake.	
<b>Situated-leadership</b>	Extra-curricular-mathematics; Situated-leadership; Quality-learning; Test-students-on-intake.	Leader's-commitment-to-mathematics; Leader-not-impacting-on-mathematics; Leader-shortcoming; Leaders'-mission; leadership-role; Mathematics-experience-of-leader.
<b>Teacher-influence</b>	Curriculum-based-foci; Higher-order-questions; Importance-of-testing; Problem-solving-skills; Quality-teaching; Students-become-teachers; Students-become-teachers.	Mathematics-teacher-quality; Students-become-teachers; Teacher-employment; Students-become-teachers.

Table 6.2 has constituent codes, which comes up for the first time in the teachers' interview data (Table 6.1) which is unsupported by the school leaders' interview data (Table 5.1). These codes are the perceptions of only the school leaders or only the mathematics teachers and are thus not applicable for the purpose of this research. The table has however, constituent codes repeated at least once in both columns, even though it is not necessarily under the corresponding family of codes. These repeated codes are "importance-of-testing", "students-become-teachers", "test-students-on-intake" and "quality-teaching". Even though the repeated (out of context) codes do not show corroborating evidence it was at least brought up by both the school leaders and the mathematics teachers. The corroborated codes are those codes both the school leaders as well as the teachers recognise as influence by the school leader on the quality of learning and teaching of mathematics in the high school. These corroborated codes are "test-students-on-intake" and "students-become-teachers".

The interpretation of Table 6.2 does not necessarily mean the two repeated codes ("test-students-on-intake" and "students-become-teachers") are necessarily independent of each other, nor do I imply that they are dependent. In order to argue for a viable interpretation for Table 6.2, I scoped the two codes for sensible scenarios. In figure 6.1 below, these variables are investigated for possible dependency, in order to investigate whether the school leaders' corroborated codes "students-become-teachers" and "testing-on-intake" are linked. This notion I investigate in figure 6.1 below, which is basically a Johari-window intent on providing a scope for interpretation of two-dimensional comparative concepts.

<b>Teacher-influence: Become-like-teachers</b>			
<b>Beyond School Mathematics: Test-students-on-intake</b>	<u>No: Become-like-teachers and</u> <u>Yes: Test-students-on-intake:</u> Two scenarios seem worthy of investigation in linking the two concepts “testing students on intake” and “the students become like teachers”. <u>Scenario 1a:</u> The testing of students on intake is deliberate but it fails to produce students who become like teachers. <u>Scenario 1b:</u> The testing of students on in-take was coincidental but did not influence the students in becoming like teachers, anyway. Scenario 1b seems far-fetched.	<u>Yes: Become-like-teachers and</u> <u>Yes: Test-students-on-intake:</u> Two scenarios for interpretations on linking the concepts seem probable as to whether “students’ being tested” can be linked to “students becoming like teachers”. <u>Scenario 2a:</u> The deliberate attempt at testing students on in-take was successful to get students to become like teachers. <u>Scenario 2b:</u> The unintended testing of students on in-take coincidentally produced students to become like teachers. Both scenarios seem viable and worthy of interpretation in the context of this research.	<b>Yes</b>
	<u>No: Become-like-teachers and</u> <u>No: Test-students-on-intake:</u> This combination of concepts, yields only one sensible scenario. <u>Scenario 3a:</u> The non-testing of students on intake is the reason for students are not becoming teachers.	<u>Yes: Become-like-teachers and</u> <u>No: Test-students-on-intake:</u> The linking of the notions that students can become like teachers and non-testing of students on intake, yielded only one sensible scenario. <u>Scenario 4a:</u> Students can become like teachers even though they are not tested on intake.	<b>No</b>
<b>No</b>	<b>Yes</b>		

**Figure 6.1:** Scoping sensible dependency scenarios between codes: “test-students-on-intake” and “students-become-teachers”

From figure 6.1 above I have six viable scenarios which basically boils down to possible interpretations of the leaders and teachers’ perceptions that students can be influenced to become-like-teachers if they are tested-on-intake.

The codes in Table 6.1 can also be categorised as those that are confirmed by the literature review and those that were developed from the semi-structured interviews which do not occur in the literature review. Table 6.3 below, presents the families of codes with the constituent codes.

**Table 6.3:** Semi-structured interview data codes split as confirmed (or not)

<b>Family of codes</b>	<b>Semi-structured interview data codes confirmed by the literature review</b>	<b>Semi-structured interview data codes <u>not</u> confirmed by the literature review</b>
<b>Artefact-production</b>	Curriculum-based-foci; Higher-order-questions.	Importance-of-testing.
<b>Beyond-school-mathematics</b>	Problem-solving-skills; Extra-curricular-mathematics.	Higher-order-questions; Innovation-measures; Test-students-on-intake;
<b>Innovations-measures</b>	Higher-order-questions; Quality-learning; Students-become-teachers.	Extra-curricular-mathematics; Problem-



		solving-skills; Test-students-on-intake.
<b>Situated-leadership</b>	Extra-curricular-mathematics; Situated-leadership; Test-students-on-intake.	Quality-learning.
<b>Teacher-influence</b>	Curriculum-based-foci; Higher-order-questions; Problem-solving-skills; quality-teaching	Importance-of-testing; students-become-teachers.

The confirmed codes in Table 6.3 are visible within the scope of the literature review whilst unconfirmed codes might simply just be “invisible” to the scope of this research. The unconfirmed codes are beyond the scope of the research question but was included because it had the potential for recommendations for further studies and conceptual framework expansion over and above this research. The confirmed codes will however be the first set of results presented, below.

### 6.3 Presentation of results of confirmed semi-structured interview codes

The semi-structured interviews evolve around the same three main positions (as in chapter 5): events, which signify quality learning and teaching in the mathematics classroom; role-player influence on the learning and teaching of mathematics and aspects about learning and teaching which can be influenced by school leadership specifically. The research explored these aspects through unstructured questions (Appendix 7) thus following a confirmatory approach (LeCompte & Preisle, 1993) to analyse the semi-structured interview data. The results focus on the core research question. Eventually, the research question forms the central drive for the analysis of the semi-structured interview data, which I present as codes confirmed (or not) by the literature review of this research. Below, I present the first of these confirmed results.

Table 6.4 below presents an analysis of the interview data of mathematics teachers condensed under the family of codes: “artefact-production” with its constituent codes of curriculum-based-foci and higher-order-questioning. The table presents the supporting quotations as they are contained within the literature review and the data.

**Table 6.4:** Artefact-production with constituent codes and supporting quotes.

<b>Codes</b>	<b>Best fit semi-structured interview quote validating relative code</b>	<b>Best fit literature review quotes validating semi-structured data quotes and relative codes</b>
<b>Curriculum-based-foci</b>	“I did it with the training uhm what we need from principals is to communicate	“The curriculum-based perspective of quality Mathematics teaching and learning is simply put a mathematics classroom focus

	with the department to give us clear assessments. It is all about assessments”.	on predominantly testing of curriculum-based skills. In this view quality is related to the studious nature of learners and examination orientated teachers as predominant indicators in the learning and teaching of Mathematics.” (Glennan & Resnick, 2004, P.16).
<b>Higher-order-questioning</b>	“If you deal with depth and connect that to our problem solving, you know our higher order, questions that (School X and School Y) is speaking about, they know the notion of higher order questioning.”	“... however do not acknowledge the presence of the teacher in the higher order contributions of learners as necessary and imperative in bringing about quality learning.” (Liskala, Vauras & Lehtinen, 2004, P.36)

In Table 6.4 above, the two constituent codes are corroborating the teachers’ view of artefact-production as it relates to curriculum-based-foci and higher-order-questioning, however the data are “silent” on the leaders’ role.

The code, curriculum-based-foci, has a strong emphasis on examinations as the do-all and end-all of high school mathematics learning and teaching. From the analysis, it appears that all the mathematics teachers really wanted from their school leaders was that the leader liaises with the necessary examination departments so that they have clarity on expected standards. This notion of prioritizing examination standards prevails in the literature review. The literature review is silent on quality indicators of examinations in the way the interviewed mathematics teachers professes it to be. The literature review refers to an artefact that speaks to a quality where the value of the assessment improves the mathematical learning. As seen from the data, there seems to be a prevalence of teachers relating quality to achievement in high-stakes mathematics examinations. “Higher-order-questions” is however, according to the literature review, more about problem solving. Teachers speak highly of high performing schools (X and Y) above, as having students who can handle higher order questions in examinations however, the literature review links student activity to sustaining the practice of the mathematical community of practices. In both curriculum-based-foci and higher-order-questioning, the teachers’ foci were not on causal relationships between mathematics teachers and their students. In other words, teachers did not see their role to include developing the quality of their teaching, whilst developing the quality of learning amongst their students. The teachers’ focus was predominantly on an inherent quality of the mathematics students rather than on their efforts to

develop the quality of learning they desire in a mathematics student. The data thus suggest that teachers expect the students to possess the desired learning quality prior to engaging with them in their mathematical endeavours.

The analysis of the interview data of the mathematics teachers also rendered the family of codes, “beyond-school-mathematics”. This family consists of two codes namely: extra-curricular-mathematics and problem-solving-skills. Table 6.5 below, presents these codes comparing the best-fit relevant data with its grounding in the literature.

**Table 6.5:** Literature supporting codes in the family of codes: beyond-school-mission

<b>Codes</b>	<b>Best fit semi-structured interview quote validating relative code</b>	<b>Best fit literature review quotes validating semi-structured data quotes and relative codes</b>
<b>Extra-curricular-mathematics</b>	“... here we identify ... number 1 our possible GEMs (outstanding students), right, yes we can go to past, report cards, primary schools etc. And have a conversation with primary school teachers, they will tell you, that is a gem, that’s a gem, that’s a gem ...”	“The notion that co-curricular or extracurricular mathematics experiences are the only quality learning exposure for high school students, necessitates innovation into the regular mathematics classroom.” (Meyer & Slechta, 2002, P.51) I have changed the alignment so that it is top left.
<b>Problem-solving-skills</b>	“Problem solving is a contentious issue, first of all. I found that problem solving questions and modelling questions for that matter, ... in most cases our students can do simple algorithms, ...”	“In other words it is incumbent on schools to teach problem solving skills if they don't have it or teach them to mathematize or teach them how to use the mathematical skills.” (Jensen, 2009, P.17)

During the interview process there was probing into whether the participating schools offered more than just classroom activities to influence quality learning and teaching of mathematics.

The literature review’s expectations of extra-curricular-mathematics was however, for activities that would benefit the knowledge economies. The teachers were adamant that students should have developed their mathematics learning qualities for high school at their primary schools.

There is almost an expectation that quality is in the child and is not the high school’s responsibility to develop. From the literature, school leaders are involved in the production of artefacts that influence the learning and teaching of mathematics in the high school. In the data, however, high school mathematics teachers have the perception that they do not have to deal with developing quality of learning in learners.

Table 6.6 below, presents my analysis of the interview data of the mathematics teachers for the family of codes, “innovative-measures”. There are three constituent codes underpinning innovative-measures: students-become-teachers, higher-order-questioning and quality-learning.

Table 6.6 is a presentation of these codes confirmed, by the literature review.

**Table 6.6:** Literature review confirming the code: “Innovative-measures”

<b>Codes</b>	<b>Best fit semi-structured interview quote validating relative code</b>	<b>Best fit literature review quotes validating semi-structured data quotes and relative codes</b>
<b>Students -become-teachers</b>	“What I am saying, as a teacher I would pre-select. Some learners have the knowledge of the content. But they don’t have the capacity to carry it over to others.”	“... professes for a mathematical community that engages learners along the lines of apprenticeship methodologies to enhance the quality of their learning experience in Mathematics ...”, (Lampert, 1988, P.20).
<b>Higher-order-questions</b>	“If you deal with depth and connect that to our problem solving, you know our higher order, questions that (School X and School Y) is speaking about, they know the notion of higher order questioning.”	“... sites the lack of problem solving exposure (which should be an intention of school Mathematics) as an obvious undervalued shortcoming in some South African high school Mathematics classrooms”. (Howie, 2004, P.17)
<b>Quality-learning</b>	“A high-quality learner, I can name, examples, basically as a teacher it will fit in my hands (lifting up his ten fingers). It is a minority of learners basically. The one work is independence. It is an independent learner. It is a learner that knows there is a future after the matric point. They know it. And they also know that the subject that they are studying, Maths, as a subject is a key to their further future after matric. They know it.”	“... to the notion that quality teaching depends on the quality of the teacher is a farfetched attribute to teaching. He (2010) feels strongly that it is what teachers do which in turn depends on the studious traits of the student which attributes to the extent of the quality learning experience of the learner.” (Kennedy, 2010, P.17)

The literature review bases quality learning on inter-personal relationships between the learning of the mathematics teacher and her/his mathematics students. A higher extent of quality learning would be when students start to reason on the level of their teachers. In other words, quality teaching of mathematics is about developing students’ reasoning skills to handle higher-order questioning. However, in the interview data teachers justify why their students cannot reach the literature review’s expectation. These explanations range from students’ lack of communication ability; to the quality of students on intake; to the students’ qualities and their limitations in terms of the nature of mathematics. The relevance in relation to the literature review with sustaining quality innovations lie with the lack of daring-to-innovate to develop student quality and in turn being developed. The above expectation is the essence of this

research that an external “force” (leadership) is required to manoeuvre teachers into action or at least “dare-to-innovate” before one can even talk about “sustaining-an-innovation” for quality learning and teaching of mathematics in high schools.

There are three constituent codes underpinning the family of codes “situated-leadership”. These constituent codes are extra-mural-mathematics, leadership-role and test-students-on-intake. Below, Table 6.7 presents an analysis of the interview data of the mathematics teachers by substantiation with the literature review.

**Table 6.7:** Literature review confirming the code: “Situating-leadership”

<b>Codes</b>	<b>Best fit semi-structured interview quote validating relative code</b>	<b>Best fit literature review quotes validating semi-structured data quotes and relative codes</b>
<b>Extra-mural-mathematics</b>	“... basically, management must have the structure, so we should set-up a structure where we identify number 1 our possible GEMs, right, yes, we can go to past, report cards, primary schools etc. And have a conversation with primary school teachers, they will tell you, that is a gem, that’s a gem, that’s a gem.”	“Some stand-alone and extramural programmes which include opportunities for quality learning and teaching of mathematics require school leadership’s sensitivity to secure it’s success.” (Greiffenhagen & Sharock, 2008, P.39)
<b>Leadership-role</b>	“what we need from principals is to communicate with the department to give us clear assessments.”	“It is not usual for school leadership to make contributions to Mathematical quality in the classroom, however the aspects which includes quality controls of learning and teaching lies within the scope of leadership.” (Wheatley, 2011, P.15)
<b>Test-students-on-intake</b>	“what they are not saying is that, they have a pre-selection. They have a gate that pre-select the learner. On the grounds of their abilities. So, they can expose their learners to higher order questioning etc.”	“... such admission practices of taking on high-performing learners (who incidentally would be high-performing irrespective of the school they attend), have a distorted sense of quality learning and teaching of mathematics ...” (Heck & Hallinger, 2009, P.19)

The literature review claims that the situated-leadership’s role should bring about quality learning beyond resorting to extra-curricular activities outside the classroom mathematics, or even if it implies testing students on intake. The perceptions of teachers however are that they do not expect from school leaders any quality mathematical artefact influence. All they require of their school leaders is that they test students on intake, and that they deal with the relevant state

authorities. Further, the data indicate that some teachers want school leaders out of the teaching process by focusing only on ensuring the examination departments gives them clear assessments. Teachers evaded direct probing into whether their schools actively searched for students who already have the qualities required for quality learning of mathematics within the school. The above attempts at confirming the interview-data generated codes within the literature review failed because there was no confirmation of teachers' perspectives with the literature review. Both the literature review and the data from interviewed teachers corroborate the notion that a specific quality of student is desirable, but they disagree on admitting the students who possess it as oppose to developing it.

The analysis of the interview data of the mathematics teachers brought about the family of codes, "teacher-influence". I expanded this family of code into four constituent codes: extra-curricular-foci; higher-order-questions; problem-solving-skills and quality-teaching, verified by means of the literature review in Table 6.8, below.

**Table 6.8:** Literature review confirming the code: "Teacher-influence"

<b>Codes</b>	<b>Best fit semi-structured interview quote validating relative code</b>	<b>Best fit literature review quotes validating semi-structured data quotes and relative codes</b>
<b>Extra-curricular-foci</b>	"I feel that yes, we need to upskill them in a sense - the learners but upskill them also prepare them effectively for the exam. Not our internal exam only, but for external examinations."	"The notion that co-curricular or extracurricular mathematics experiences are the only quality learning exposure for high school students, necessitates innovation into the regular mathematics classroom." (Moursund & Albrecht, 2011, P.41; Strong, Thomas, Perini & Silver, 2004, P.41)
<b>Higher-order-questions</b>	"If you deal with depth and connect that to our problem solving, you know our higher order, questions that (School X and School Y) is speaking about, they know the notion of higher order questioning."	"... higher order quality contributions of students as a necessary and imperative aspect of student learning." (Liskala, Vauras & Lehtinen, 2004, P.36)
<b>Problem-solving-skills</b>	"I think the majority of learners can be brought to that point, where they can do algorithms, where they can work though	"... sites the lack of problem solving exposure (which should be an

	basic algorithms showing them basic steps. That's easy. When you turn that question around and you give that same question in words, and you ask them to model, ... our learners are very weak in that sense. They are very weak in modelling questions.”	intention of school Mathematics) as an obvious undervalued shortcoming in some South African high school Mathematics classrooms.”(Howie, 2004, P.17)
<b>Quality-teaching</b>	“The maths, the maths teacher if he really wants to take his learner a bit further, number 1 he needs to challenge those learners, uhm, instead of just teaching the curriculum, he must always remind his learners that there is a journey after school.”	“... formulate wonderings or thought-provoking questions designed to encourage reflection and new practices that would lead to increasingly higher quality teaching in an individual classroom ...” (Goldman, Bill, Johnston & McConachie, 2005, P.24).

The literature review expects students to develop skills to make quality contributions as part of their learning, but there is an acknowledgement in the data that teachers can get away with not doing what the curriculum intends. According to the interviewed mathematics teachers, their responsibility stops with their students passing the required high-stakes examinations. Further, they claim that students have limitations with problem-solving, and cannot handle anything other than algorithms. The closest statement from the interview data to confirm school leader influence are references to motivational talks. Unfortunately, no literature review-likened developmental activities aimed to produce quality students are evident from the interview data. The above attempts at validating the data through the literature review are thus not conclusive. The final family of codes in this chapter could not validate the teachers' perceptions as to whether their responsibility should include quality development of students. Rather, teachers expect students to possess a learning quality, in order to produce quality learning of mathematics.

All five family of codes considered in this chapter indicated that there is a gap between the data from the semi-structured interviews and the expectation of the literature review. It is prevalent from the data that teachers expect a specific quality student from primary schools in order to produce students who will meet the needs of higher learning and the knowledge economies. In the next section, I investigate the issues not confirmed by the literature review.

#### 6.4 Results of data not confirmed by the literature review

The analysis of semi-structured interview data corresponded more to the literature than the unstructured interview data in chapter 5. Prevalent from the data, participating teachers (as was the case with school leaders in the unstructured interviews) believe quality mathematics learning is a pre-high school quality possessed by students. None of the high school mathematics teachers interviewed saw themselves as the orchestrators of the quality they desired in their students. This is almost in direct contradiction to Jensen (2009) who professes that teachers need to develop students of the quality they would like to see in their schools. Below, I will expound on these gaps for formulations of further enquiries.

I summarised the gap between the interview data and the literature review, in the same way as I did the unstructured data (chapter 5) to imply that participating teachers believe quality learning has to do with a specific inherent character and work ethic teachers and students possess. In other words, the mathematics teachers who have been interviewed, do not admit that they can develop the quality in their students they sought. It is thus necessary to look beyond the obvious data, confirmed by the literature review. In Table 6.9 below, I present the family of codes not confirmed by the literature review.

**Table 6.9:** Semi-structured interview codes not confirmed by the literature review

<b>Family of codes</b>	<b>Codes which could not be confirmed by the literature review</b>
<b>Artefact-production</b>	Importance-of-testing.
<b>Beyond-school-mathematics</b>	Higher-order-questions; Innovation-measures; Test-students-on-intake;
<b>Innovative-measures</b>	Extra-curricular-mathematics; Problem-solving-skills; Test-students-on-intake.
<b>Situated-leadership</b>	Quality-learning.
<b>Teacher-influence</b>	Importance-of-testing; Students-become-teachers.

Table 6.9 indicates that the data was obvious on notions indicating importance-of-testing which would have confirmed the family of code: “artefact-production”, however, the literature review refuted this notion in terms of the research question. The family of codes, “beyond-school-mathematics” on the other hand, fell short because the data and the literature review has different definitions of the three codes referring to the testing of students on intake, higher-order questioning and innovative measures. The “silences” in this family of codes (beyond-school-



mathematics) could be teachers' underlying assumptions that students who are successful in their entrance examinations can handle their required higher-order questions. The inconsistency of the family of codes "innovative-measures" was because the data were "silent" on three of its constituent codes. These three codes are extra-curricular-mathematics, problem-solving-skills and test-students-on-intake. Teachers' opinions about whether extra-curricular mathematics developed problem-solving skills, could not be linked to the shortcomings of admission tests, which was implied by the analysis of data in chapter 5. The code "students-become-teachers" are not obvious in the data, even though linked to the family of codes "quality-learning". Also, seemingly not noticeable from the quality learning discussions by teachers, was the code of "higher-order-questioning". In the family of codes "situating leadership", the concept of quality learning is not obviously an underlying factor. Finally, the family of codes: "teacher-influence", was where I expect teachers to be the custodians of creating more teachers (Lave, 1989), but instead the data are "silent" on teachers talking about influencing students to be peer teachers nor do they seemingly question the notion of what is so important about testing. Teachers were silent to whether they develop the quality of their students. There is however prevalence in the data of teachers resorting to seek for student quality instead of developing the quality as the objective of their teaching.

The analysis was to find answers to the research question that considers school leadership have the capacity to influence the quality of learning and teaching of mathematics within their schools. The theory which was supposed to come from the substantiation of the literature review was found wanting, as was the case in the previous chapter.

## **6.5 Summary of semi-structured interview data**

It is not very obvious what teachers' overall perceptions about their school leaders are because it is not easy to get teachers to speak negative things about their school leaders out of respect for the leader. All the codes representing teachers' perceptions of their leaders as influencers of learning and teaching of mathematics (as I did in the previous chapter), are represented in the figure 6.1 below, purposed to provide a scope of the relevance of high-stakes examinations as an innovating tool to improve quality learning and teaching of mathematics.

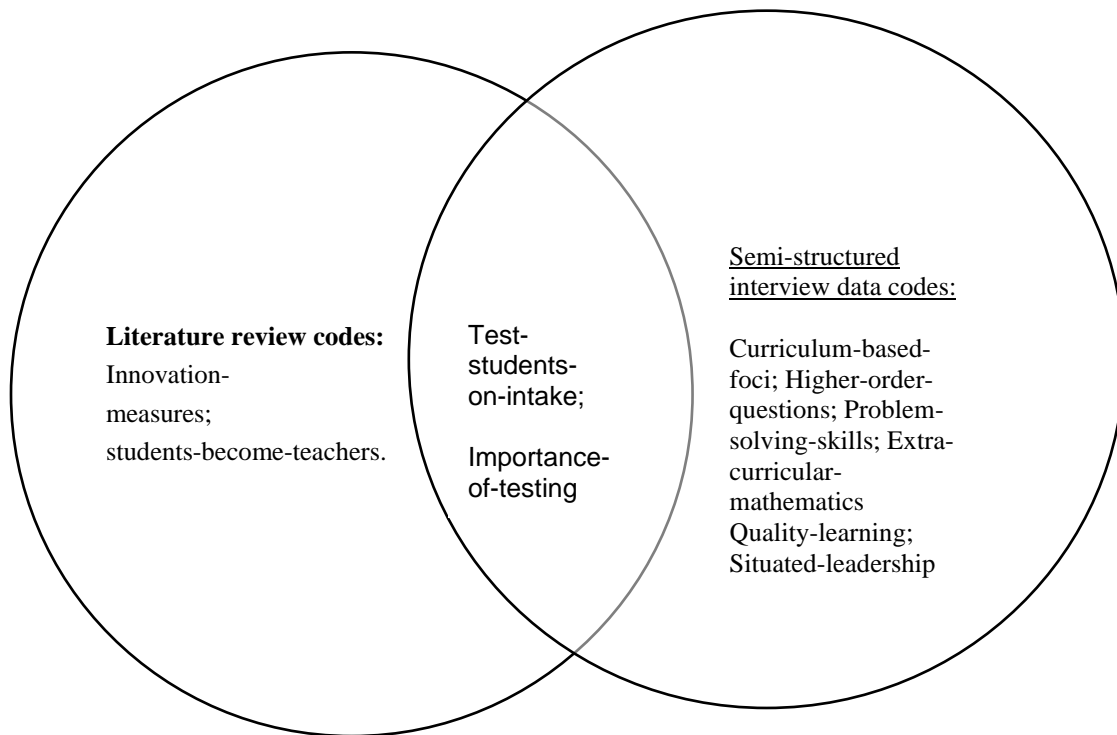
		Innovation		
High stake examination focus	Curriculum-based-foci; higher Order Questioning; Problem-solving-skills; Extra-curricular; Higher Order Questions; Quality Learning; test-students-on-intake;		X	Yes
	X		X	No
		No	Yes	

**Figure 6.2:** Codes in terms of examination focus vs extent of innovation of leaders

In the previous chapter the focus on high-stakes examinations with very little innovation to move to a different quality indicator, was also prominent. The quality development of mathematics learning is prevalent, however, with low innovation and high examination focus among teachers. They view their school leader as the one who employs quality teachers and admit quality students to their schools.

Figure 6.2 is a schematic representation of the depth of the literature review confirmed codes. The confirmed codes are curriculum-based-foci; higher-order-questions; problem solving skills; extra-curricular-mathematics; quality-learning and situated-leadership. These confirmed codes are predominantly implied but are not necessarily detailed enough to substantiate the codes as representative of the literature review items. Further, the research is not looking for undisputed evidence but merely the likelihood of school leaders to influence quality of learning and teaching of mathematics at the school. Some of the codes specifically test-on-intake and importance-of-testing are visible but not confirmed by teachers in the data. These two items are however in stark contradiction with what the literature review deems to be quality in learning and teaching of mathematics. Figure 6.3 below shows the lack of depth in the corroborated data

as it relates to the teachers' perceptions as to whether their leaders influence the quality of their teaching and the learning of their students' mathematics in the high schools, where they teach.



**Figure 6.3:** Semi-structured interview data codes confirming literature review claims

Figure 6.3 shows that semi-structured interview data do not yield sufficient evidence to confirm the literature review's claim that school leaders influence the quality of learning and teaching of mathematics within their high schools. The next chapter will investigate whether focus group discussions with mathematics students can bring better data to the fore to confirm the research claims in the literature review.

## Chapter 7

### Presentation of results from the focus group interviews with students

#### 7.1 Introduction

This chapter presents the analysis of the data obtained through focus group discussions with high school mathematics students. Like chapters 5 and 6, the transcribed focus group data were coded and further grouped into the family of codes. The analyses, as in the previous chapters, attempts to establish confirmation of arguments developed in the literature review.

In Table 7.1 the family of codes column are the same families identified in chapter 5 but only those that could be identified in the data collected from the students. A similar situation is of relevance for the constituent codes.

**Table 7.1:** Focus Group Discussion transcribed data codes

<b>Family of codes:</b>	<b>Codes per families</b>	<b>Number of Quotes</b>
<b>Artefact-production</b>	Artefacts; discourse; higher-order-testing; problem-solving-skills; quality-learning; School-culture.	48
<b>Beyond-school-mathematics</b>	Discourse; exam-focus; higher-order-testing; innovations-in-school; leaders'-mission; leadership-role; mathematics-teacher-quality; quality-teaching-practice.	23
<b>Innovative-measures</b>	Artefacts; dare-to-innovate; discourse; exam-focus; innovations-in-school; leaders'-mission; mathematics-teacher-quality; problem-solving-skills; quality-learning; quality-teaching-practice; school-culture.	60
<b>Situated-leadership</b>	Artefacts; discourse; exam-focus; higher-order-testing; importance-of-testing; innovations-in-school; leaders'-mission; leadership-role; non-exam-innovation; problem-solving-skills; quality-learning; quality-teaching-practice; school-culture; teacher-employment.	59
<b>Teacher-influence</b>	Artefacts; discourse; exam-focus; higher-order-testing; importance-of-testing; innovations-in-school; problem-solving-skills; quality-learning; quality-teaching-practice; school-culture.	58

The number of quotations per family of codes indicates the prevalence of the codes representing the family of codes. The same codes identified and used in the structured and unstructured interview data were used in the focus group interview data. The family of codes with its

constituent codes in line or not with the codes represented in the literature review are summarised in Table 7.2 below.

**Table 7.2:** Focus Group Discussion codes supported by the literature review

<b>Family of codes:</b>	<b>Codes derived from the focus group discussions data</b>	<b>Focus group discussion data codes represented in the literature review</b>	<b>Focus group discussion data codes not confirmed by the literature review</b>
<b>Artefact-production</b>	Artefacts; discourse; higher-order-testing; problem-solving-skills; quality-learning; school-culture; beyond-school-mission; student-become-teacher; test-students-on-intake.	Artefacts; discourse; higher-order-testing; problem-solving-skills; quality-learning; school-culture.	Beyond-school-mission; student-become-teacher; test-students-on-intake.
<b>Beyond-school-mathematics</b>	Discourse; exam-focus; higher-order-testing; innovations-in-school; leaders'-mission; leadership-role; mathematics-teacher-quality; quality-teaching-practice; importance-of-testing; leader's-commitment-to-mathematics; intake-testing; non-exam-innovation.	Discourse; exam-focus; higher-order-testing; innovations-in-school; leaders'-mission; leadership-role; mathematics-teacher-quality; quality-teaching-practice.	Importance-of-testing; leader's-commitment-to-mathematics; intake-testing; non-exam-innovation.
<b>Innovative-measures</b>	Artefacts; dare-to-innovate; discourse; exam-focus; innovations-in-school; leaders'-mission; mathematics-teacher-quality; problem-solving-skills; quality-learning; quality-teaching-practice; school-culture; beyond-school-mission; non-exam-innovation; student-become-teacher; test-students-on-intake.	Artefacts; dare-to-innovate; discourse; exam-focus; innovations-in-school; leaders'-mission; mathematics-teacher-quality; problem-solving-skills; quality-learning; quality-teaching-practice; school-culture.	Beyond-school-mission; non-exam-innovation; student-become-teacher; test-students-on-intake.
<b>Situated-leadership</b>	Artefacts; discourse; exam-focus; higher-order-testing; Importance-of-testing; innovations-in-school; leaders'-mission; leadership-role; non-exam-innovation; problem-solving-skills; quality-learning; quality-teaching-practice; school-culture; teacher-employment; dare-to-innovate; beyond-school-mission; leader-not-impacting-on-mathematics;	Artefacts; discourse; exam-focus; higher-order-testing; importance-of-testing; innovations-in-school; leaders'-mission; leadership-role; non-exam-innovation; problem-solving-skills; quality-learning; quality-teaching-practice; school-	Dare-to-innovate; beyond-school-mission; leader-not-impacting-on-mathematics; leader-shortcoming; mathematics-experience-of-leader; mathematics-teacher-quality; student-become-teacher; leader's-commitment-to-mathematics.

	leader-shortcoming; mathematics-experience-of-leader; mathematics-teacher-quality; student-become-teacher; leader's-commitment-to-mathematics.	culture; teacher-employment.	
<b>Teacher-influence</b>	Artefacts; discourse; exam-focus; higher-order-testing; importance-of-testing; innovations-in-school; problem-solving-skills; quality-learning; quality-teaching-practice; school-culture; beyond-school-mission; non-exam-innovation; student-become-teacher.	Artefacts; discourse; exam-focus; higher-order-testing; importance-of-testing; innovations-in-school; problem-solving-skills; quality-learning; quality-teaching-practice; school-culture.	Beyond-school-mission; non-exam-innovation; student-become-teacher.

Table 7.2 indicates the specific codes which corresponds or not with literature review codes. As mentioned in the previous two chapters there are codes not confirmed in the literature review.

Below, I discuss the confirmed data.

## 7.2 Presentation of confirmed focus group interviews results

This section presents the analysis of data confirming the literature review arguments. I will now expound on the five family of codes (like in chapters 5 and 6) with samples of evidence from the constituent codes underlying the family of codes. This section thus presents quotations from the data to represent the constituent codes of the family of codes: artefact-production, beyond-school-mathematics; innovations-measures; situated-leadership; teacher-influence.

### 7.2.1 Artefact-production

The family of codes: artefact-production below in Table 7.7, presents the best quotation from the data of the constituent codes: higher-order-testing, discourse; problem-solving-skills and quality-learning and relevant best-fit literature review claim. The idea is that the best quotations from the literature review confirms the data which represents the codes which in turn presents evidence of influence by the school leader in Table 7.3, below.

**Table 7.3:** Literature review supporting the code: Artefact-production

<b>Codes</b>	<b>Best fit focus group discussion quote validating relative code</b>	<b>Best fit literature review quotes validating focus group discussion data quotes and relative codes</b>
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<b>Higher-order-testing</b>	“This is the first time I hear about this ... These types of explanations I did not know about...these things. Yea, they are amazing.”	“Innovating artefact production aspects as a minimum requirement for "doing mathematics" in secondary schools' classroom is indeed a possibility.” (Julie, 2004, P.39)
<b>Discourse</b>	“Ja, he does not want to accept defeat, but I know that I won that argument.”	“ ... the context of making contributions in the mathematics classroom is the essence of doing school mathematics” (Walls, 2007, P.37)
<b>Problem-solving-skills</b>	“It tells me like at home. My aunt wants me to cut the tiles, I had to cultivate the area, I had to cultivate the area for the lounge, to measure the sides and then the other sides. I could measure the area and tell her how many tiles to buy.”	“School leadership can in other words harness the potential in student leadership to bring about great establishment of problem solving and mathematising skills within the school.” Trompenaars & Hampden-Turner, 2002, P.28).
<b>Quality-learning</b>	“I listened very hard so that I can go home knowing what to do. And when I get home, I struggle and work hard.”	“Doing Mathematics (attributes related to “knowing” and “doing” are) ... indicator(s) of quality learning and teaching of Mathematics in high schools” (Schoenfeld, 1989, P.26; Julie, 1992, P.26).

The four slices of transcribed data representing the codes (Higher-order-testing, problem-solving, discourse and quality-learning) as the constituent family of codes: artefact-production, are intended to be confirmed by the literature review claims. Julie (2004) argues for conversation in the classroom. The apparent private discussion between two students, however, is what should be happening in the classroom to qualify as quality learning. Once again, these two students are test-on-admission students. The two students do not know about the depth of discourse, which makes it eventually just a normal interesting conversation and not necessary discourse. Under the code problem-solving-skills, the student showed low-level (for his grade) problem solving skills, which I deemed to be a real-life problem. This is certainly something school leadership can harness within a school with students chosen for their ability and apparent “inherent” quality. Students under the code of quality-learning lacks a sense of metacognition (Resnick, 1995) which is a quality learning indicator a student at grade 11 level could handle. This is an indication of a student who was chosen for their inert quality ability but performing below expected quality by the end of their high school years. The transcribed focus group discussion data in Table 7.7 looks at prominent aspects about learning and teaching of mathematics showed that only the quality of the teacher and students were part of the students’ awareness.

### 7.2.2 Beyond-school-mathematics

The presentation of the analysis of results below shows literature review quotations and the best focus group discussion quotation I could find in the data confirming the family of codes: “beyond-school-mathematics”. Table 7.4 demonstrates the validity of the perceptions of students as to their high school leader’s influence on the quality of their learning and the teaching of mathematics. The quotations in Table 7.4 are to substantiate the coded student statements with literature review quotes, thus validate the reliability of the best choice quotations.

**Table 7.4:** Literature review supporting the code: Beyond-school-mathematics

<b>Codes</b>	<b>Best fit focus group discussion quote validating relative code</b>	<b>Best fit literature review quotes validating focus group discussion data quotes and relative codes</b>
<b>Discourse</b>	“We were arguing about Polya’s last theorem. I think he said Pythagoras or Euclid was the best Mathematician, thus far. I think I said it was Euler. We like discussing or debating who, was the best in mathematics. The Mathematicians, all the Mathematicians.”	“Student contributions ... is necessary in order to develop the quality of learner contributions ...” (Michaels & O’connor, 2012, P.31; Kumpulainen & Lipponen, 2010, P.31).
<b>Examination-focus</b>	And also, our teachers are very motivating. Because like in a classroom they don't like doing stuff for us. They like us to do the stuff for ourselves. They give us numerous problems and then we have to solve the problems on our own. And then if you get stuck then you can ask them.	“ ... if curriculum-based examinations does not meet the real intentions behind school mathematics, then schools should adopt the responsibility ... the lack of problem solving exposure (which should be an intention of school mathematics) as an obvious undervalued shortcoming in some South African high school mathematics classrooms ...” (Howie, 2004, P.17; Jensen, 2009, P17).
<b>Higher-order testing</b>	The things that we are more interested in. That is why we are like. When Mr ... teachers, he almost want each one to be with a textbook, But the, when we write the test, the things which are in the test, those are the things which are in the textbook. What it does, he expose us to other textbooks and other things. Most of the things we do are in the book, but they are the examples to him. When we come to tests, we do something different.	“... the lack of problem solving exposure (which should be an intention of school Mathematics) as an obvious undervalued shortcoming in some South African high school Mathematics classrooms ... scarce classroom activities despite these being very much part of classical problem solving and the curriculum-based classroom ...” (Knuth, 2002, P.40).
<b>Innovations-in-schools</b>	You see sir. My school is more advanced than the school of my friends. The things that makes me say that is. I love Maths. I never go to them to ask for help. For them to help me. They come to me	“The consistency of sustaining innovations in quality teaching and learning by teachers is, however, found wanting” (Giles & Hargreaves, 2006, P.14; Giles, Shearer, Yendol-Hoppey & Liebert, 2006, P.14).



	for help. In this school there are more people who helps me too.	
<b>Leaders'-Mission</b>	<p>There they take the top students and they learn more about the Mathematics that we are going to do next year. Or Mathematics that is not in our syllabus.</p> <p>S10: Like currently right now we are doing Calculus, and we are not suppose to do Calculus. And we already know how to differentiate. So that is also a skill that we have from the AP Maths class. So that is also our learning of Mathematics in this school.</p>	<p>“The implication is thus that high achieving Mathematics schools claiming to have “quality” learning and teaching of Mathematics might be in a position to propogate their ulterior motive to “engineer” a false value-proposition for quality learning and teaching of Mathematics” (Bauer &amp; Gaskell, 1999, P.17)</p>
<b>Mathematics-teacher-quality</b>	<p>Well maybe, like some examples in the Ap where Ms C was telling us about this <math>1 + 10^2 = 10^2</math>. When 1 goes to 10 on the side, it becomes sexy. (he laughed quite heartily about this comment he made). I knew ok, I will never forget this one. Those are the examples that I love.</p>	<p>“ ... finds a middle road between the two extreme roles of educators in development of student learning quality in mathematics. They see educator instructions as the key area to establishing a desire within learners to make quality contributions” (Turner &amp; Patrick, 2004, P.37)</p>
<b>Quality-teaching-practice</b>	<p>“I think like quality, Mathematics lies within the individual. Like Athi said, it is useless that we have a good Maths teacher. But we do not like do something to better our mathematics. And I know like what I get here (at my school), is like good Maths, because before I came here, I use to go to school in (different high school), I always got like 100% and 80%. But when I first came here, it was hard like children to get 80% and I got code 3s at first. But then I adapted. And then I also know it is like quality mathematics, because here learners from other schools they also do ... math. And when I compare like there question papers and what we got here for our tests, it's different. What they do in their tests is what we do in class works</p>	<p>“Rather than drawing conclusions from the evidence, these leaders should formulate reflections or thought-provoking questions designed to encourage new practices that can potentially lead to increasingly higher quality teaching in an individual classroom or in the school as a whole...”( Goldman, Resnick, Bill, Johnston, Micheaux &amp; Seitz, 2004, P.24)</p>

Table 7.4 shows the validity of the family of code: examination-focus as a learning and teaching of mathematics area of influence by leadership from the vantage point of the focus group discussions. Quality learning is however about discourse, according to the literature review. The student displaying a sense of “discourse” according to the data is a test-on-intake student, hence not convincingly an influence by the school leader other than the admission of the student to the

school. Examination focus is a quality aspect, which the literature review (from the vantage point of curriculum-based proponents) requires should be a consistent achievement, where-as some students (Table 7.4) are of the opinion that it could be achieved independently from the school. “Higher-order” thinking as a quality development aspect is not an occurrence in the focus group discussion data. The literature review expects activity around the students involved in teaching each other, but instead students focus on individual examination orientation and independent skill honing. A disconnect between the student activities described by the students as putting them above other schools, whilst the literature review requires school leaders to be involved and almost central to the development of people in the school. The mission of schools according to the focus group discussions are mostly driven by giving students an advantage over students at other schools, in terms of “knowing” the curriculum. The literature review, however, expects school leaders to have the mission of the broader mathematics community at heart, i.e. the objective of knowledge economies and higher educational institutions. Students expect their teacher to already be of high quality and not develop with them in a teaching process, whereas the literature review expects the nature of mathematics exposure to be relevant for both teacher and student. The focus group discussion data in Table 7.4 focuses on the aspects about learning and teaching of mathematics, which high school leaders can influence as it relates to the family of codes: examination-focus. The original teacher qualities are in the data still (as in previous two chapters) dominating the overall impression of the respondents as an outcome of the enquiry.

### 7.2.3 Innovative-measures

In Table 7.5 below, I expand the family of code, “innovative-measures”, into its constituent codes (i.e. artefact-production; mathematical-discourse; higher-order-testing; problem-solving-development; quality-learning; school-culture). The table validates the constituent codes with quotes from the literature review confirming slices of data. The appropriate literature review quotation is to justify the piece of evidence in the data that represents the various codes that makes up the family of codes.

**Table 7.5:** Literature review quotes confirming the family if codes: Innovative-Measures

<b>Codes</b>	<b>Best fit focus group discussion quote validating relative code</b>	<b>Best fit literature review quotes validating focus group discussion data quotes and relative codes</b>
<b>Artefacts</b>	“Sometimes (the problems given by teachers) are challenging. Because you get "do nows". It is a 5-minute exercise. Where they give us challenging stuff which we have to do within the 5 minutes. And then at the end of the 5 minutes they tell us to solve that problem we should have done this and that...”	“... classroom instruction is complex and educators can facilitate classroom learning in order to improve real learning which can in turn also include the facilitation of solving puzzles” (Douglas, 2009, P.39).
<b>Mathematical-discourse</b>	“We were arguing about Polya's theorem. I think he (S3) said Pythagoras or Euclid was the best Mathematician, thus far. I think I said it was Euler. We like discussing or debating who was the best in Mathematics ...”	“ ... the opportunities created for discourse (in the classroom) are important considerations for viable production of Mathematical artefacts and hence a "doing Mathematics" practices in high schools” (Scarlatos & Scarlatos. 2006, P.41).
<b>Higher-order-testing</b>	... (our teacher) want each one to be with a textbook, but the ... when we write the test, the things which are in the test, .... When we come to tests, we do something different ...”	“... see educator instructions as the key area to establishing a desire within learners to make quality contributions” (Turner & Patrick, 2004, P.38).
<b>Problem-solving-development</b>	“I don't know why I ... I like challenging things. I see ...it like a challenge. So, like if they give me like a very tough problem, and then I succeed in solving it. I feel on top of the world. There is this one example of where my teacher, gave me this question like, it took us about an hour, to solve it. But then finally we solved it ...”	“... lack of problem solving exposure as an obvious undervalued shortcoming in some South African high school Mathematics classrooms” (Howie, 2004, P.17).
<b>Quality-learning</b>	“For me ... Maths means working hard. You see, if you are given a problem here in school and when the teacher teaches in the classroom ... I listen very hard ... so that I can go home knowing what to do. And when I get home, I struggle and work hard. Because I know when I was at school, I knew this ... “	“The essence of quality learning and teaching of mathematics in a classroom context is about making contributions in the mathematics classroom” (Walls, 2007, P.37).
<b>School-Culture</b>	It is not something ... in our class, but somebody (a volunteer) who is visiting us. Also, another guy (ex-student) who is doing (a) mathematics (degree). If you do well in Mathematics you get respect, because to people it is a challenge. It is more like reward, you get respect.	“In order for a learning and teaching school culture to be sustained within a Mathematics classroom it must transcend the Mathematics class to include the entire school community and all learning disciplines” (Mathews, 2009, P.37).

The family of codes: “innovative measures”, discussed in the literature review is a very high-level doing-mathematics discussion, which took place among students. The data reference is about a five-minute activity given to children to do a challenging exercise. This level of activity leaning towards artefact-production (Julie 2004) is a once-off encounter in the data. In this encounter, two students recalled a discussion they had which took place outside of classroom time and beyond the teacher’s influence. This incident however fit the literature review’s profile of what constitutes “doing mathematics”. The school leader influenced the incident by providing a platform for student access to history of mathematics books. This was in fact the first school leader influence on quality learning visible within this research. One of the students acknowledged that their mathematics teachers gave difficult problems in the examinations and tests. This is in fact typical according to the literature review (Lowery, 2003) of Bloom’s taxonomy structured tests. This, however, does not necessarily imply that higher order thinking developed in classrooms other than the exposure during the tests and examinations. Julie (1992) indicated that clubs and societies outside classroom activities are typical problem-solving developmental sites, which is why one student indicated that he could sit for many hours with problems at home. This level of challenging work and motivated actions is according to Philott *et.al.* (2007) the essence of quality learning and teaching of mathematics, which should really take place at schools in mathematics classrooms. Linking the classroom to outside entities is a move to quality mathematics according to students and confirmed by the literature review. This was the very first indication in the data that a school leader influenced quality of learning of mathematics by a student. Test-on-intake distorted the validity of the data and noted as a limitation to the research. Even though not sufficient valid influence can be determined, the school leader did however influence the quality of learning through the incident.

#### **7.2.4 Situated-leadership**

I present data from the focus group discussions illustrating the family of codes: “leadership-influence” in Table 7.5, below as it confirms literature review claims. Leadership-influence has eight constituent codes. In the table below. I attempt to validate it with the best student quotes confirming the relevant literature review claims.

**Table 7.6:** Literature review confirming data induced code: Situated-Leadership

<b>Codes</b>	<b>Best fit focus group discussion quote validating relative code</b>	<b>Best fit literature review quotes validating focus group discussion data quotes and relative codes</b>
<b>Artifact-Production</b>	“... Where they give us challenging stuff which we have to do within the 5 minutes. And then at the end of the 5 minutes they will tell us to solve that problem we should have done this and that ...”	“... practises where a "tension" leading to "a need to sustain" by teachers and students in a mathematical classroom is necessarily worthy of inclusion ... (Harkness & Portwood, 2007, P.28)
<b>Students-become-teachers</b>	“I want to learn how to stand for myself. In class I do normally understand what the teacher says. And also, now in class we are doing circles. And there is a girl next to me and she ask me the theorems ... I like to explain to her. I like that there is someone ... that I can explain something to her.”	“ ... peer learning (i.e. students learning from other students) as a aspect of a classroom practice which could influence the quality of learning” (Topping, 2005, P.37).
<b>Quality-teaching-practice</b>	“... Mathematics lies within the individual. ... it is useless that we have a good Maths teacher. But we do not like do something to better our mathematics ...”	“ ... the notion that quality teaching depends on the quality of the teacher is a farfetched attribute to teaching.” (Kennedy, 2010, P.17).
<b>Non-exam-innovation</b>	“You know his (Euclid) famous last theorem? You know the one which says there are no whole number solutions to the equations like $8$ to the power $3$ . No eight to the power $n$ plus $b$ to the power $n$ is $n$ is greater than $2$ . Mathematicians struggle to deal with the problem. But he tried to make a breakthrough with the problem. Euler said that he just ignored it. I hear about Euler's number, but I never hear much about him, but he is ...”	“ ... to take mathematics beyond the classroom albeit to just allow the club or society to operate in the school. idea of "solving puzzles" is not necessarily unique to the notion of "doing Mathematics" innovations” (Julie, 2004, P.39).
<b>Innovations-in-school</b>	“We have Saturday classes, where the students who are not very good at math, they have extra lessons, catch up on the things that we do during the week. And then there is AP for those who get 80 and above for Mathematics.”	“Differentiated groups are ... an opportunity to develop concepts in mathematics” (Kirkey, 2005, P.41).
<b>Higher-order-testing</b>	“I also think the way our teachers teach us, when they make examples, they make examples like what is particular to youth.”	“Higher order problems can be achieved to great success in solving puzzles, working with classical problems, calculational procedures and the activities learner experience in their daily lives ...” (Julie, 2004, P39).
<b>Beyond-school-mission</b>	“Like currently right now we are doing Calculus, and we are not supposed to do Calculus. So that is also a skill that we have from the AP.	“ ... schools having to resort to exposure of students to problem solving skills in mathematics clubs or similar structures outside of

	So that is also our learning of Mathematics in this school.”	normal school class ...” (Julie, 1992, P.39).
<b>Test-students-on-intake</b>	“Last year. In my previous school I got 95%. Then the first year when I got here, I got 35% for Maths. And I felt like crying. “	“When a high school’s mathematical department’s mission is non-aligned with the broader intention ... the acceptance of known high achieving junior school students ...” (Collins, 2006, P.15).

Artefact-production from the vantage of the literature review speaks to the creation of a tension by school leadership. The data could only come up with the most appropriate quote about leadership influence referring to a mere five-minute encounter intended to create such a “tension”. School leaders, according to the literature review, should be able to create and improve the likelihood of harnessing students to become teachers. Only the individual students who were tested-on-intake met the requirements of the literature review. The participating students and literature review agree that quality teaching does not depend on the quality of the teaching only. Students however, felt that the quality of the teacher is important, though. The literature review includes the school leaders as influencers, which is not convincingly acknowledged by the students. Under the non-examination-innovation code, students are more prone to agree to quality-learning as an individual activity stemming from student interests. The literature review however refers to stand-alone extra programs, clubs, etc. This misalignment between student perceptions and the literature review, disregards non-examination-innovation as a convincingly justifiable quality of learning and teaching of mathematics influence by school leadership. The literature review sees opportunities for innovations, where school leaders can get involved in the setting up of differentiated groupings and innovations of tutor-tutee relationships. The students, however, sees the additional Saturday classes to be extra lessons, where extension lessons, are dedicated to getting further with more syllabi items and catch-up with a demanding CAPS curriculum. According to the literature review, higher-order-testing is about getting students in on the details of artefact-production. Students, however, do not see school leadership’s involvement in this regard. Furthermore, school leaders should expose or lead students to problem-solving opportunities. Students only recognised the exposure to syllabus completion, and backlog catching-up. The literature review does not necessarily see test-on-intake as being aligned to the notion of “doing mathematics” but are instead indifferent to quality

learning of mathematics. Students, however, do not devalue their test-on-intake “status” as a disadvantage to the research but rather an advantage to their performance. Unfortunately, none of the codes related to the student data convincingly places school leaders as influencers of quality learning and teaching of mathematics in the high schools. Table 7.6 fails to confirm the family of code, “situated-leadership”, convincingly.

### 7.2.5 Teacher-influence

The presentation of results of the family of code: “teacher-influence” indicates the highest likelihood for all the codes presented by at least one quote, which is supported by the literature review. Table, 7.7, below focuses on aspects about quality learning and teaching of mathematics, which the literature review claims can be influenced by school leadership. Teacher-influence consists of nine constituent codes, i.e. exam-focus, higher-order-testing, importance-of-testing, artefacts, discourse, innovations-in-school, problem-solving-skills, quality-learning and quality-teaching-practice.

**Table 7.7:** Literature review supporting the family of code: “Teacher-Influence”

<b>Codes</b>	<b>Best fit focus group discussion quote validating relative code</b>	<b>Best fit literature review quotes validating focus group discussion data quotes and relative codes</b>
<b>Examination-focus</b>	“And also, our teachers are very motivating. Because like in a classroom they don't like doing stuff for us. They like us to do the stuff for ourselves. They give us numerous problems and then we have to solve the problems on our own. And then if you get stuck then you can ask them”.	“The curriculum-based perspective of quality mathematics teaching and learning is simply put a mathematics classroom focused on predominantly testing of curriculum-based skills.” (Heck & Hallinger, 2009, P.16; Lesch & Zawojewski, 2007, P.16).
<b>Higher-order-testing</b>	“... he exposes us to other textbooks and other things. Most of the things we do are in the book, but they are the examples to him. When we come to tests, we do something different...”	“Schools which place high prominence on Higher Order thinking in examinations, testing and even school lessons having a major focus on items like Blooms Taxonomies ...” (Lowery, 2003, P.36).”
<b>Importance-of-testing</b>	“...That is why I like to explore problems that have not been solved yet. Like the book we've been reading, have a lot of those problems.”	“The high-stakes examination's purpose in this regard also has the intention of testing the written curriculum, which was till now the only recognised "tension" created by the "curriculum" under-writers” (Trompenaars & Hampden-Turner, 2002, P.28; Harkness & Portwood, 2007, P.28).

<b>Artefacts</b>	“They give us numerous problems and then we have to solve the problems on our own. And then if you get stuck then you can ask them.”	“No teacher of Mathematics would want their students to be making any old contribution which does not make substantive contribution.
<b>Discourse</b>	“We were arguing about Polya's last theorem... We like discussing or debating ...”	“ ... do not come up with any clear directive or idea as to the extent to which discoursing attributes in learning and teaching can be inculcated or developed” (Julie, 1992, P.33).
<b>Innovations-in-school</b>	“No, it was more a physics camp. But the guy there told us about a Mathematician called ... I can't remember but the new Mathematics ideas to describe the Universe this way and that way. So, I said, well Maths is applied everywhere.”	“The highest likelihood of potential ulterior benefit derived from the notion of sustaining "quality" learning and teaching of mathematics innovations in high schools rests with teachers and school leadership” (Bauer & Gaskell, 1999, P.17).
<b>Problem-solving-skills</b>	“... so, like if they give me like a very tough problem, and then I succeed in solving it. I feel on top of the world ...”	“... it is incumbent on school to teach problem solving skills if they don't have it or teach them to Mathematize or teach them how to use the mathematical skills” (Jensen, 2009, P.17).
<b>Quality-learning</b>	“You see if you are given a problem here in school, and when a teacher teaches in the classroom, I listened very hard so that I can go home knowing what to do.”	“ ... it is the educator’s use of the studious traits of the learner that attributes to the extent of the quality of the learning experience of the learner ... learners do not necessarily benefit by attending better schools ...” (Heck & Hallinger, 2009, P.17; Kennedy, 2010, P.17).
<b>Quality-teaching-practice</b>	“They give us numerous problems and then we have to solve the problems on our own. And then if you get stuck then you can ask them.”	“According to the notion that quality teaching depends on the quality of the teacher is a farfetched attribute to teaching” (Kennedy, 2010, P.17).

All nine codes representing the family of codes: teacher-influence, had at least one quote from the data, which best presents a code attempting to confirm the literature review. Only the original quality of the students and teachers are however justified as quality indicators. Firstly, the exam-focus code confirms that inert quality of the teacher and the students are desirable by school leaders. Higher-order-testing is secondly, not necessarily developing deductive reasoning skills as per the literature review, if the quality is already inert to the students. The literature review opens an opportunity for high-stakes-examinations to thirdly, create a tension for quality learning and teaching, however, the way materials are structured, with answers already supplied in textbooks almost dispel the sense of achievement and contribution of “new things”. The



production of artefacts is recognised by students when teachers insists on a level of independence, however, the literature review points out that it is refuted as development because the students do not necessarily develop. Solutions are already known and publicised in the textbooks. The closest evidence of discourse among students was with the schools selecting students on in-take. This type of discourse did not meet Julie's (2004) notion of artefact production, but merely student interest in which mathematicians made the best contribution to the mathematical knowledge store. The contribution by these students was on a conversational level and not on a level of depth; bearing in mind that these two discoursing students are selected-on-intake students. The code innovation-in-school also produced an interest, but not necessarily an in-depth contribution according to the literature review. A test-on-intake student indicated that they do not know why they think in a specific way. This shows a gap in the quality teaching of these mathematics students in a school where students are tested-on-in-take. In the literature review a very distinct call for a relational value to be developed within children from the vantage point of moving them from the start of high school on a concrete level to a more formal abstract level. One of the students from the data indicates that he listens well in class so that he can work harder at home. In terms of quality-teaching-practice code, the literature review dispels the inert quality of the teacher as being the most important attribute in developing students, whilst the students describe it as being imperative. The focus group discussion data in Table 7.6 above confirm or not the literature review related to learning and teaching of mathematics that high school leaders can influence. Very little influence other than admission of quality students and the employment of quality teachers were prevalent under the above code.

### **7.3 Results of focus group discussion data not confirmed in the Literature Review**

The data produced from the transcribed focus group discussion data, which responds to the research question is valuable data, which becomes the source for confirmed theory (Evans, 2009). New uncharted theory not confirmed by the literature review might indicate additional dimensions not considered by the respondents however, it is part of the conceptual framework of this research. Further, Mason (2006) also highlights the validity of differences, which comes into play because of different contexts. Even though some data was not confirmed by the

literature review, it is still organised as constituent codes which is not confirmed by the literature review. There are now two types of data applicable: Data confirmed by the literature review, discussed in the previous section; and new uncharted data, the makings of brand-new contributions to the knowledge store of Mathematics.

**Table 7.8:** Focus Group Discussion Codes not supported by the literature review

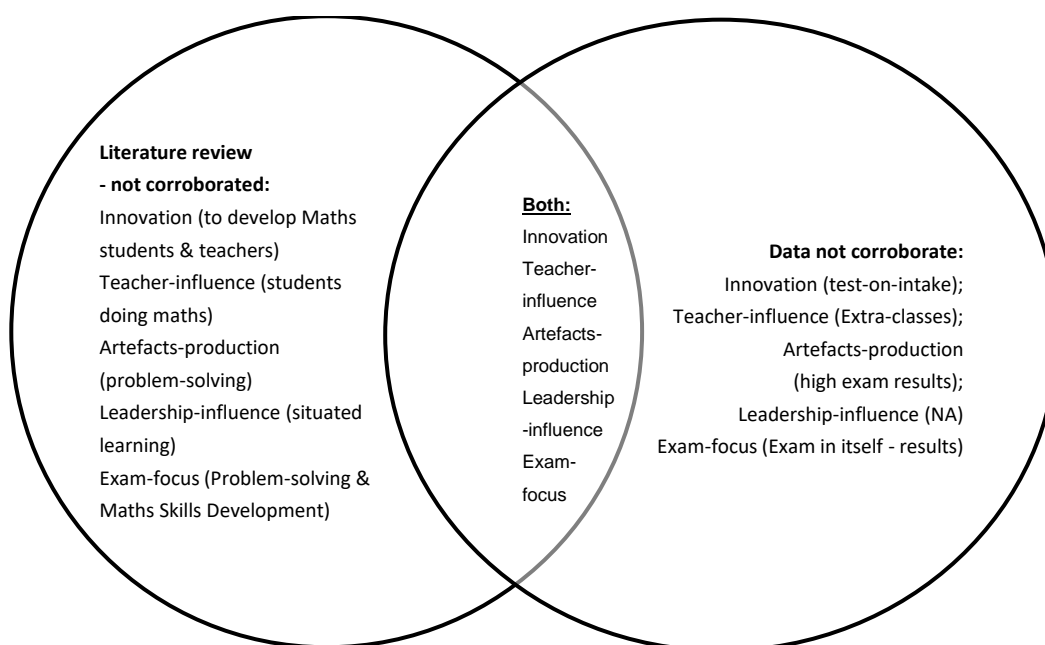
<b>Family of Codes</b>	<b>Constituent codes without literature review corroboration in the context of this research</b>
<b>Artefact-production</b>	Beyond-school-mission; Students-becoming-teachers
<b>Beyond-school-mathematics</b>	The-relevance-of-testing; Non-exam-innovation; Students-becoming-teachers; Students-tested-on-intake
<b>Innovative-measures</b>	Beyond-school-mission; Non-exam-innovation; Students-becoming-teachers; Students-tested-on-intake
<b>Situated-leadership</b>	Maths-experience-of-the-leader; Quality-of-the-mathematics-teacher; Leader-commitment-to-mathematics; Leader-shortcomings
<b>Teacher-influence</b>	Non-examination-innovation; Students-becoming-teachers; Beyond-school-mission

The codes above indicate that the family of codes are not sufficiently confirming the literature review. The developed quality of the students at admission and the teachers on employment, are prevalent in Table 7.8. The “silence” of data on certain codes were organised against the unmatched literature review categories. In the next chapter, the “non-disclosure” in terms of the literature review will follow.

#### **7.4 Summary of data from focus group discussions**

Table 7.8 does not merely expose the silences in the focus group discussion data, as it responds to the research question on the influence a school leader has on the quality of learning and teaching of mathematics. It also exposes the literature review as insufficient to confirm the data. The previous two chapters concluded with the same realisation as to why quality is not necessarily developed in teachers or students but merely expected as inert qualities. The possibility that the data methodology did not bring about information that would evoke responses to the school leaders’ influence on developing students or teachers is viable, however, it can also imply that it is simply not there.

The data collected through the unstructured, semi-structured interview as well as the focus group discussions did not move the research forward in terms of the research question to investigate the influence school leaders can have on the quality of learning and teaching. In the schematic below, I depict the literature review confirmed by the student discussion data. Figure 7.1 illustrates the huge gap between the focus group discussion data and the literature review. The influence on learning implied by the literature review is much more than the aged-old-leadership phenomenon (Collins, 2006) to employ quality teachers or to admit quality students.



**Figure 7.1:** Graphic representation of corroborated interview data

Under innovation, students do not have the notion of developing student discourse and teachers becoming teachers as is prescribed in the literature review. Further, the students' notion around teacher-influence is not referring to "doing-mathematics", but rather on helping to pass the ensuing examination. Under artefact production, students are once again exam-focused and about getting good marks. Leadership's role in situating the learning is not even a consideration for students. The biggest concern for students in the family of codes examination-focus is a teacher's expertise in preparing them for examinations, and their test readiness in total contradiction to the relevance allotted by the literature review. In the next chapter, the previous three chapters' analyses will be discussed, conclusions reached and recommendations for further studies suggested.

## Chapter 8

### Conclusions, Discussion and Recommendations

#### 8.1 Introduction

This chapter concludes and makes recommendations based on how the literature review's arguments were confirmed by the research data. The research question pursued was: "What influence do school leaders have on the quality of learning and teaching of high school mathematics?" Firstly, there is a summary discussion of the results of school leadership. This includes results of the school leaders, teachers and learners. Secondly, the overall conclusions of the results are given. Further, limitations of the research, recommendations and issues for further research that are opened up by the research are presented. Finally, concluding comments are given.

#### 8.2 Discussion of results related to school leaders

The research results are based on the analysis of the data from three sets of stakeholders interviewed: The high school leaders, mathematics teachers and learners. In this section, the focus is on the leaders' influence on quality learning and teaching of mathematics. This is followed by discussions on the results emanating from the analysis of the data from the mathematics teachers and then those of learners.

##### 8.2.1 Summary of results related to high school leaders

Most of the high school leaders who were interviewed agreed that they influence quality learning and teaching of mathematics in their schools. The school leaders did, however, have different vantage points from which they viewed what constitutes quality learning and teaching. These vantage points vary from having no experience with mathematics teaching to having previously been teachers of mathematics. From the results, it is evident, that the school leaders' proximity to mathematics teaching and their resolve to quality learning and teaching had much to do with the influence school leaders had on the quality of mathematics taught and learnt in their schools. This is, for example, illustrated by the differences expressed by a non-mathematically trained school leader who insists on his grade 12 mathematics class carrying a card with a

theorem in their pockets versus a qualified mathematics teacher-leader who accommodates conversations around problem-solving.

Not all the school leaders with mathematics teaching backgrounds did, however, demonstrate a sense of quality learning and teaching of mathematics. It is, however, evident from the research, that the instances of school leaders displaying a sense of quality learning and teaching of mathematics came from the group of leaders with experience with mathematics teaching.

High school leaders claimed to have a resolve for quality learning and teaching of mathematics. It is evident from the research that having learners and teachers of quality in their schools is the primary objective of the school leaders. This objective is far more prevalent than developing the quality desired in learning and teaching of mathematics. Some of the school leaders were less open about their motives behind employing quality teachers or admitting quality students to their schools. Predominantly, the employment and admission of quality learning and teaching capacity is a strong motive for high school leaders.

The literature review acknowledges that leaders situated within a specific community of practice are far more sensitive to the mission of the practice. As such a school leader who is (or was) situated in doing mathematics practices will more likely influence the quality of learning and teaching of mathematics within the school. Situated leadership can include among other prevalent notions of the subject head, or a mathematics subject leader dependent on the practice at of the school. Such an instructional leader would report his/her actions to enhance quality teaching and learning of mathematics to the school leader.

### **8.2.2 Summary of results from high school mathematics teachers**

The high school mathematics teachers' perspectives as to whether school leaders influence the quality of their teaching or the learning of their students of mathematics is, predominantly, negative. In other words, mathematics teachers do not necessarily value the role of the school leader in the quality they attach to quality learning and teaching. The teachers agree that direct quality learning and teaching influence is not a school leader's imperative. The only expectation these mathematics teachers have of their school leaders is that they take the responsibility to

provide them with students of quality. The mathematics teachers' and school leaders' perspectives are thus in alignment with the school leaders that the leaders' focus should be on enrolling learners deemed to be quality "mathematics learners".

The notion around the value of school culture to enhance the learning of mathematics was seen to be a leaders' imperative by both the school leaders and teachers, however, they were silent on what the culture entails. There was an individual reference to a school leader who creates a culture to bring about tension and ease, whereby mathematics learning could flourish, but this perspective was not widely supported.

School leaders, as well as the mathematics teachers who were interviewed, placed doing mathematics related activities in the same category as all other extra-curricular events, outside formal school hours. The literature review did, however, mention that quality learning should transcend beyond the classroom and even the school. The additional after-school times were eventually also used to make-up for incomplete curriculum work thus, negating attempts at doing mathematics. A very strong time-on-task focus intended for curriculum completion seems to be the mission of the leaders and teachers.

The teachers in the research sample focus on the delivery of the prescribed curriculum, which the research highlighted as a typical default when there is an overbearing focus on results. In line with a curriculum-based learning perspective (as per the literature review), the school leaders are not even considered by the teachers as having any role other than being providers of resources and protectors from the role players beyond the school. The mathematics teachers' responses to quality indicators relating to doing mathematics were not visible in these teachers' utterances.

### **8.2.3 Summary results from high school mathematics students**

High school students of mathematics were more acknowledging of school leaders' efforts to influence the quality of learning and teaching of mathematics in their school than the mathematics teachers. The proximity of the school leader to mathematics, irrespective of whether it is in line with accepted quality learning and teaching criteria, was sufficient evidence for the learners that their school leader influenced their learning. Where the school leader was very

involved in the students learning of mathematics, as their mathematics teacher (or not), was admired by these students. Students are positive about school leaders who are somehow involved in their learning activities in mathematics. This notion is confirmed in the literature review, as school leaders being situated within the practice of mathematics. The literature review responds favourably to a school culture focused on doing mathematics if the school leader demonstrates the learning practice as a full participant.

Finally, the high school mathematics students are openly (unlike the school leaders and teachers) proud of their achievement to be chosen as students of mathematics at their respective schools. Students interviewed were celebratory about being chosen based on their quality of mathematics learning and that some of them still survive as students of mathematics who did not change to mathematical literacy students.

### **8.3 Limitations**

The scholarships cited in the literature review did not refer to many proponents for the influence of leadership on quality learning and teaching of mathematics. The few related studies, which were cited, did, however, have negative results. This is a limitation according to Mouton (2005) who ascribes literature reviews to existing scholarships and selective interpretations, to suit particular viewpoints. Other limitations are the inherent limitations of the methods employed. Further, the leader's resolve beyond the mere enrolment of learners deemed with high potential to excel in mathematics and the employment of "quality" mathematics teachers may be limitations to the research. Finally, the fact that the researcher is a school leader could also be seen as a limitation.

### **8.4 Recommendations for further studies**

Some of the limitations above form the basis of my recommendations for further study. Linked to the limitation of the leaders' resolve for enrolment of learners deemed with high potential to excel in mathematics and the employment of "quality" mathematics teachers, it needs to research the kinds of continuing professional development that must be offered to leaders in order for them to foster quality teaching of mathematics for all learners and varying qualities of teachers. Given that school leaders who are experienced high school mathematics

teachers are more likely to influence the quality of the teaching and learning of mathematics, it is recommended that future research is conducted on how school leadership can devolve the facilitation of leadership of this tasks to a more knowledgeable member of the school's staff. This is not only for mathematics but other subjects as well. The literature review's focus is on situated leadership within the context of doing mathematics. As such a leader, who exercises distributive leadership would devolve the task of leadership for curriculum, teaching and learning matters to a mathematically qualified teacher.

The researcher's limited encounter with the student discussion groups did not bode well to eradicating suspicion and distrust (Mouton, 2005), because the students tend to be protective of their school leader. I thus recommend that future research focus on a longitudinal ethnographic study to be conducted on learners' perceptions of what school leaders do to foster quality teaching of mathematics.

There are as many evaluation frameworks as there are research on the quality of teaching. What is needed is an easily implementable instrument for use by both teachers and the school's leadership to monitor the quest for high quality teaching of mathematics. I suggest future research on the development, in a design research manner, of an easily implementable and context adaptable instrument which teachers and a school leadership can use to monitor the development of high-quality mathematics teaching in a school. Such an instrument would assist schools to monitor the efficacy of their own strategic manoeuvres to foster quality learning and teaching of mathematics, based on the school's specific needs and competencies.

## **8.5 Concluding Remarks**

The value of this research is that it exposes school leadership as a mathematics education stakeholder. School leadership influence on the quality of learning and teaching of mathematics might not be obvious in high schools, however there are indications that their influence on the quality of learning and teaching of mathematics is viable. Even though this research is not conclusive and other research on leadership's influence on quality learning and teaching of mathematics are not popular, the relevance has to be considered for consideration beyond this research.



In an article on professional development of teachers, Ratcliffe (2013) emphasises the relevance of school culture in her reference to influential environments, which the literature review allocates as an expectation of the school leader:

*"Almost always, if a pupil is struggling in the classroom, it's not because there is a problem with the child – actually, there's a problem with the environment in which the child has been placed." Ratcliffe (2013)*

For the development of a conducive environment alluded to by Ratcliffe, the school leaders play the most important role.

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## Appendices

### Appendix 1: Request for permission to conduct research in WCED Schools.

Dear .....

I want to thank you for your willingness to listen to my informal request to conduct research at your school. Thank you for your provisional permission.

As I've indicated, I would like to visit your school at a time convenient to you. I would like to recommend *Tuesday, 12 August and Wednesday, 13 August*.

As per my discussion I am currently studying towards a PhD at the University of The Western Cape. As part of my studies, I am to do research and submit a thesis. This letter serves to formally request permission to do my research at your school.

My research involves an investigation into the impact of any high school leadership (on all levels of school levels including student leadership, teacher leadership, the principal, etc) on the quality of learning and teaching of Mathematics.

The research involves

- A 45-minute (video and audio recorded) interview with you, in your capacity as School Principal,
- A 45-minute (video and audio recorded) interview with your head of Department of mathematics,
- A 45-minute (video and audio recorded) interview with a teacher of mathematics and
- A 45-minute (video and audio recorded) session with a group of 8 grade 10 and/or 11s - students of Mathematics - can these be students who have a tendency to help other students in Mathematics,
- Only with the permission of your Mathematics teacher if I could observe and video record a lesson of preferably a Grade 10 or 11 Mathematics class.

The completion of this study will not only be beneficial to me, but to the teaching fraternity as well, in that I will have added to the pool of knowledge about the opportunities for quality



Mathematics learning and teaching. Attached I have included all the relevant information required in terms of the research.

I hope you will see the value in this research and grant me permission to visit your schools.

Yours in education

Ronald Fortune

**Appendix 2 - Letter of permission from Director of WCED**

Directorate: Research

[Audrey.wyngaard2@qwc.gov.za](mailto:Audrey.wyngaard2@qwc.gov.za)  
 tel: +27 021 467 9272  
 Fax: 0865902282  
 Private Bag x9114, Cape Town, 8000  
 wced.wcape.gov.za

**REFERENCE:** 20130613-12737  
**ENQUIRIES:** Dr A T Wyngaard

Mr Ronald Fortune  
 59 Second Avenue  
 Fairways  
 7800

Dear Mr Ronald Fortune

**RESEARCH PROPOSAL: THE INFLUENCE OF EDUCATIONAL LEADERSHIP ON THE QUALITY OF TEACHING AND THE LEARNING OF MATHEMATICS AT HIGH SCHOOL LEVEL**

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Approval for projects should be conveyed to the District Director of the schools where the project will be conducted.
5. Educators' programmes are not to be interrupted.
6. The Study is to be conducted from **01 July 2013 till 30 June 2014**
7. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
8. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
9. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
10. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
11. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
12. The Department receives a copy of the completed report/dissertation/thesis addressed to:

**The Director: Research Services**  
**Western Cape Education Department**  
**Private Bag X9114**  
**CAPE TOWN**  
**8000**

We wish you success in your research.

Kind regards.

Signed: Dr Audrey T Wyngaard  
**Directorate: Research**  
**DATE: 13 June 2013**

Lower Parliament Street, Cape Town, 8001  
 tel: +27 21 467 9272 fax: 0865902282  
 Safe Schools: 0800 45 46 47

Private Bag X9114, Cape Town, 8000  
 Employment and salary enquiries: 0861 92 33 22  
 www.westerncape.gov.za

**Appendix 3: Letter of permission to parents of children participating research**

59 Second Avenue

Fairways

7800

26 March 2013

Dear Parent / guardian of .....

**Re: Request for permission to include your child in a focus group discussion**

My name is Ronald Fortune, a school principal and teacher of Mathematics and currently studying towards a PhD at the University of The Western Cape. As part of my studies, I am to do research and submit a thesis. This letter serves to request permission to do my research with your child as part of a focus group. My research involves an investigation into the impact of any high school leadership (on all levels of school levels including student leadership, teacher leadership, the principal, etc) on the quality of learning and teaching of Mathematics. The completion of this study will not only be beneficial to me, but to the teaching fraternity as well, in that I will have added to the pool of knowledge about the opportunities for quality Mathematics learning and teaching.

I hope you will see the value in this research and grant me permission to allow your child as part of the focus group.

Ronald Fortune

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I ..... Parent / Guardian of .....

Herewith give my child permission to be part of the research conducted by Ronald Fortune, (Student: 8513617) a PhD student at the University of The Western Cape.

.....

.....

*Signature (parent)**Date*

**Appendix 4: Letter of permission from UWC Ethics Committee**

OFFICE OF THE DEAN  
DEPARTMENT OF RESEARCH DEVELOPMENT

10 June 2013

**To Whom It May Concern**

I hereby certify that the Senate Research Committee of the University of the Western Cape has approved the methodology and ethics of the following research project by:  
Mr RA Fortune (Education)

Research Project:                      The influence of educational leadership on the quality of teaching and the learning of mathematics at high school level.

Registration no:                         13/4/39

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

*Ms Patricia Josias  
Research Ethics Committee Officer  
University of the Western Cape*

Private Bag X17, Bellville 7535, South Africa  
T: +27 21 959 2988/2948 . F: +27 21 959 3170  
E: pjosias@uwc.ac.za  
www.uwc.ac.za

A place of quality,  
a place to grow, from hope  
to action through knowledge

**Appendix 5: Letter of Introduction****Research Information Sheet**

**Research Title:** The influence of educational leadership on the quality of teaching and the learning of Mathematics at high school level

**Researcher:** Ronald Fortune

**Supervisors:** Prof. Cyril Julie and Prof. Monde Mbekwa

**University:** University of The Western Cape

**Purpose of the Research:** The purpose of this study is to investigate the influence of the actions of leadership on the quality of learning and teaching of Mathematics.

**Participation and withdrawal:** Participation in this study is completely voluntary and you are free to withdraw from this study at any time without prejudice or penalty. If you wish to withdraw, simply stop completing the exercises. If you do withdraw from the study, the materials that you have completed to that point will be deleted and will not be included in the study on your request.

**What is involved:** Adult participants are asked to participate in an interview and student participants are asked to be part of a focus group discussion. Participation in this study will take approximately one hour.

**Risks:** Participation in this study should involve no physical or mental discomfort, and no risks beyond those of everyday living. If, however, you should find any question or procedure to be invasive or offensive, you are free to omit answering or participating in that aspect of the study.

**Confidentiality and security of data:** All data collected in this study will be stored confidentially. Only members of the research team will have access to identified data. All data will be coded in a de-identified manner and subsequently analysed and reported in such a way that responses will not be able to be linked to any individual. The data you provide will only be used for the specific research purposes of this study.

**Ethics Clearance and Contacts:** This study has been cleared in accordance with the ethical review processes of the University of The Western Cape and within the

guidelines of the National Statement on Ethical Conduct in Human Research. If you would like to speak to an officer of the university not involved in the study, you may contact one of the ethics review officers: Estelle Maart ([emaart@uwc.ac.za](mailto:emaart@uwc.ac.za) , tel: 27 (0)21 9592246).

If you would like to learn the outcome of the study in which you are participating, you can contact me at the email: [rfortune@sa.christelhouse.org](mailto:rfortune@sa.christelhouse.org) and I will send you an abstract of the study and findings.

Thank you for your participation in this study.

Ronald Fortune

**Appendix 6:** Pilot: Semi-structured list of Questions

- What do you understand by quality learning and teaching of Mathematics in high schools?
- How do you think you can achieve quality learning and teaching in your teaching of Mathematics in your classes?
- What are the biggest challenges to sustain the innovations in your teaching of quality Mathematics?
- What do you expect of your school leader to help you achieve your goals in teaching quality Mathematics?
- Do you find a place for problem solving, Mathematizing aspects into your teaching?
- What is your involvement with extra-curricular mathematics?
- What are those special aspects about your teaching that inspires students to hone skills that prepares them for a life requiring mathematics?
- What can you tell me about Higher Order questioning and the role there-off in your school?
- What are the academic rigorous aspects in your teaching which make your students talk and contribute in the Mathematics class?
- How do you create a climate of active participation in your classroom? In what way does the school leadership assist you or do you feel the school can assist you to make this realised?

**Appendix 7: Main Study: Unstructured Themes and Core Question.****Core Question:**

How do you (as school leader) influence the quality teaching and learning of Mathematics in the high school you lead?

**Questions:**

1. What does quality learning and teaching of Mathematics, mean to you, in your school (in the context as the leaders of the school)?
2. What are the innovations in mathematics which you (as school leader) implemented within your school? Can you expand on the motivation behind your actions?
3. What do you do to sustain innovations of Mathematics within your school? Can you expand on the reasoning behind the actions?
4. How do you appoint Mathematics staff in your school? What are the factors which assists you with the decisions you take?
5. What does the school do in addition to the curriculum requirements within the school?
6. What are the aspects of the school's mission that impact on the mission of Mathematics?
7. Are there any frustrations about Mathematics teaching and learning within the school, which you feel can still be improved?
8. What is your mission for Mathematics in your school?



**Appendix 8: Main Study: Semi-structured List of Questions**

1. Do you think school leadership are you aware of the current issues that are taking place in high school Mathematics currently?
2. Are there any room for innovations which involves the school leader?
3. What are the quality learning and teaching innovations taking place in your school?  
Would you like to see any support for what you do from the school's leadership?
4. How does the expectations of Universities and knowledge economies impact on what is happening with Mathematics in your school?
5. What does your school do in relation to student admission and teacher appointments so that the school have an advantage?
6. What can you say about the quality of the students at your high school? Are you satisfied and what do you do to improve quality of learning and teaching of Mathematics in your school?
7. What are the qualities you would like to see in a mathematics student's quality which can be developed?
8. What are you doing in your teaching which improves the quality of mathematics learning in your classroom?
9. How do you see Problem solving and Mathematical modelling aspects of learning being focus upon in your mathematics classroom?
10. What do your school do in publicising student quality work? Like Mathematicians' work being published?
11. What do students do to develop themselves? Do students also get involve in teaching practices?
12. How does Mathematics impact on the school's culture?

**Appendix 9: Focus Group Discussion Questions**Section A:

1. Do you know the objectives/standards / outcomes your Mathematics teacher wants you to meet?
2. Do you know (as a student) if your curriculum in Mathematics meet the standards?
3. Do you somehow get involved in a group set-up to assist low functioning students in your Mathematics class – in your groups?
4. Is it your expectation that your teacher will give special assignments to students who are willing to do the work?
5. Are you responsible and willing to be held accountable for completion of your academic work – Especially if it was specified and negotiated?
6. Do you complete all the specified work your teacher give you – All of the Time?

Section B:

1. Do you normally know what are expected of you or what the answer is?
2. Would you say that your participation is stimulated because the problems are normally of a personal nature?
3. Would you say that your participation is stimulated because the problems are normally of a personal nature?
4. Do you normally investigate resources for the use of problem-solving processes?
5. Do you normally consult with other students and discuss problems?
6. Do you normally see the making of mistakes as natural and part of the problem-solving process?
7. Do you normally change specific solution paths for different and better strategies?
8. Do you normally have a goal directed use of mathematics?
9. Do you normally publicize your results?

**Appendix 10:** Atlasti7-coded data slices of unstructured interviews

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HU: unstructured interviews

File: [C:\Users\rfortune\Documents\Scientific Software\ATLAsTi\TextBank\unstructured interviews.hpr7]

Edited by: Super

Date/Time: 2014-09-06 08:34:35

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Code Family: innovation

Created: 2014-08-28 22:09:09 (Super)

Codes (3): [dare to innovate] [innovations in school] [non exam innovation]

Quotation(s): 9

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Code Family: Leadership

Created: 2014-08-28 22:17:54 (Super)

Codes (6): [Leader's commitment to Mathematics] [leader not impacting on Mathematics] [Leader shortcoming] [leaders' mission] [leadership role] [Mathematics experience of leader]

Quotation(s): 9

---

Code Family: non exam focus

Created: 2014-08-28 22:13:19 (Super)

Codes (10): [artefacts] [beyond school mission] [dare to innovate] [higher order testing] [innovations in school] [non exam innovation] [quality teaching practice] [School Culture] [students become teachers] [test students on intake]

Quotation(s): 24

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Code Family: Quality Teaching

Created: 2014-08-28 22:19:19 (Super)

Codes (3): [Mathematics teacher quality] [students become teachers] [teacher employment]

Quotation(s): 11

---

Code Family: Test and exam focus

Created: 2014-08-28 22:10:33 (Super)

Codes (5): [exam focus] [higher order testing] [Importance of testing] [non exam innovation]

[test students on intake]

Quotation(s): 17

---

HU: unstructured interviews

File: [C:\Users\rfortune\Documents\Scientific Software\ATLAS.ti\TextBank\unstructured interviews.hpr7]

Edited by: Super

Date/Time: 2014-09-06 10:34:55

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**P 1: Interview School leader.docs- 1:1 [P: We try to recruit teachers ..] (10:10) (Super)**

Codes: [teacher employment - Family: Quality Teaching]

P: We try to recruit teachers who adhered to our, values man. You know. And to really are committed to make a difference. I said that I ... would .. when I looked at uhm, When I look for a teacher

**P 1: Interview School leader.docs- 1:2 [P:... and it is difficult I hav..] (11:11) (Super)**

Codes: [Leader shortcoming - Family: Leadership]

P:... and it is difficult I haven't had experience in HR and so on . to look for a teacher. To know is this teacher going to abide or buy in to the ethos and culture of the school.

**P 1: Interview School leader.docs- 1:3 [P: And then I say Ok. If I am ..] (12:12) (Super)**

Codes: [teacher employment - Family: Quality Teaching]

P: And then I say Ok. If I am looking for people who are committed. Who are willing to work hard. You end up with people who .. will .. will know their work. You know. But thenm I added.

**P 1: Interview School leader.docs- 1:4 [P: But I think for us that wou..] (13:13) (Super)**

Codes: [teacher employment - Family: Quality Teaching]

P: But I think for us that would is not enough ne, because commitment and hard work but knowing their stuff.

**P 1: Interview School leader.docs- 1:5 [Being very knowledgeable about..] (14:14) (Super)**

Codes: [teacher employment - Family: Quality Teaching]

Being very knowledgeable about their subject. So that they don't only teach what is in the textbook, but they will expand the mind of the learners a little bit. They will go a little deeper.

**P 1: Interview School leader.docs- 1:6 [P: I wanted to say that the th..] (19:19) (Super)**

Codes: [teacher employment - Family: Quality Teaching]

P: I wanted to say that the third thing that I realized now as we growing in numbers is that I really have to look out for a teacher. And I don't know how I am going to gauge it or how I am going to measure it. Is that they must have a love for these children. They Must love the children. Because I have seen with some teachers that they are here and their discipline these kids so severely and it is not necessary. And for me it does not reflect that they actually have that loving nature in them So I never thought that... I never thought that for a teacher will come naturally, I didn't look that they have to have it. But I think that is something that I really have to find out first before I take on a new teacher.

**P 1: Interview School leader.docs- 1:7 [P: Yes, Because because but yo..] (23:23) (Super)**

Codes: [Mathematics teacher quality - Family: Quality Teaching]

P: Yes, Because because but you know kids I believe and this is not scientific, but I believe that kids actually feel the energy that your that you give out so that if you don't like kids and you don't like to teach then they can feel it.. they just know it.

**P 1: Interview School leader.docs- 1:8 [P: Because I am a Maths person..] (31:31) (Super)**

Codes: [Leader's commitment to Mathematics - Family: Leadership]

P: Because I am a Maths person, I have a stake in Mathematcis. And I still teach as well. So I have direct contact with Maths teaching. And with the curriculum.

**P 1: Interview School leader.docs- 1:9 [P: I am not the head of depart..] (32:32) (Super)**

Codes: [leadership role - Family: Leadership]

P: I am not the head of department. So but then I naturally take the leadership role when it comes to the grade. That I am involved in. Although, Ok. With the grade 10s for instance this year, I haven't taught grade 10 for a while so the two other teachers that is teaching grade 10, first time teachers.

**P 1: Interview School leader.docs- 1:10 [P: SO obviously I have to take..] (33:33) (Super)**

Codes: [leadership role - Family: Leadership]

P: SO obviously I have to take a leading role there. OF planning the curriculum, And adjusting it, because what I told those two young men, was that we have a curriculum that the Department gives us as pacesetters.

**P 1: Interview School leader.docs- 1:11 [P: Then I have my years of exp..] (34:34) (Super)**

Codes: [Mathematics experience of leader - Family: Leadership]

P: Then I have my years of experience only to learn that the kids are not at that level where we can just jump into the curriculum.

**P 1: Interview School leader.docs- 1:12 [P: SO we first have to ascerta..] (35:35) (Super)**

Codes: [quality teaching practice - Family: non exam focus]

P: SO we first have to ascertain where they are at, and then once we've found and gauged they are here, then we can move from there. Instead of going into the curriculum and say it says for instance for grade 10 Multiply binomial by trinomial, well we first have to identify can they multiply a monomial by a monomial. And the Monomial by a Binomial and then a binomial by a binomial. And so on., Before.

**P 1: Interview School leader.docs- 1:13 [P: So we first need to test. W..] (36:36) (Super)**

Codes: [Importance of testing - Family: Test and exam focus]

P: So we first need to test. Whether they are or where they are at before we can actually implement an actual curriculum that is stated for grade 10.

**P 1: Interview School leader.docs- 1:14 [P: My opinion is I can teach, ..] (38:38) (Super)**

Codes: [Mathematics teacher quality - Family: Quality Teaching]

P: My opinion is I can teach, I can teach Calculus to a grade 8 child. I have taught it. But will the child understand it? Because they are not that developed to get that theoretical understanding.

You need to get that from level one to level two to level three and so on and so on. So if they don't know the basic procedures of how to multiply in other words let's say we only take procedures, IF you multiply you must take the integers of, If you don't know those procedures how on earth can you go on with grade 10? Work if they don't know the basics. My take is get. Then it will go faster afterwards, Because you can teach it. You can tick off I have taught it, And, But the kids will have difficulty understanding it

**P 1: Interview School leader.docs- 1:15 [P: Our challenge is that our k..] (40:40) (Super)**

Codes: [test students on intake - Families (2): non exam focus, Test and exam focus]

P: Our challenge is that our kids come from grade 9. I think this is the last year where before, before ne where we have all our grade 10s, come in from all different schools. Around Khayalitsha and and even outside of Khayalitsha.so we could not assume that they have been taught or that they were supposed to have been taught. This year we have had half of our kids , where we knew that the one half of the kids had a strong back ground, But even among them, there were kids that were struggling with Mathematcis. And the other half that didn't know. We know that they got a six or a five or a seven o there

**P 1: Interview School leader.docs- 1:16 [P: We do an entrance exam but ..] (44:44)**

**(Super)**

Codes: [test students on intake - Families (2): non exam focus, Test and exam focus]

P: We do an entrance exam but it does not really uhm, but we don't analyze that entrance exam. In terms of where each particular child is at. That is what we do with the classroom when we have them here. From the beginning of the year. So, and we don't do it like intensively. We don't give them a test where we analyse the data. It is not like that intense. It is just a matter of (interrupted by a knowck on the door) amatter of. She got up

**P 1: Interview School leader.docs- 1:17 [P: My Idea is. We are behind w..] (47:47) (Super)**

Codes: [leaders' mission - Family: Leadership]

P: My Idea is. We are behind with the syllabus now. But I feel the conformity of what outside people – not knowing what is happening on the ground. If we want to conform to that we are going to do it at the expense of these kids, because we are going to lose them. At grade 10 level

we don't want loose them. We want them to love mathematics. We want them to continue with Mathematics, right?

**P 1: Interview School leader.docs- 1:18 [P: We sort of twig the program..] (49:49) (Super)**

Codes: [dare to innovate - Families (2): innovation, non exam focus]

P: We sort of twig the program.

**P 1: Interview School leader.docs- 1:19 [P: We have Saturday Classes. S..] (50:50) (Super)**

Codes: [innovations in school - Families (2): innovation, non exam focus]

P: We have Saturday Classes. So we sort of make up the backlogs that we see on a Saturday class, uhm you know. So we are behing at this point in time, we are still busy with term two's work. So, what we finding is.

**P 1: Interview School leader.docs- 1:20 [P: What we found actually Once..] (52:52)**

**(Super)**

Codes: [Mathematics teacher quality - Family: Quality Teaching]

P: What we found actually Once we've laid the foundation properly, and those are skills that they use everywhere, if they've got those skills, then we can actually move a little bit faster than what the pacesetter indicates.

**P 1: Interview School leader.docs- 1:21 [P: So we taught it properly by..] (54:54) (Super)**

Codes: [Mathematics teacher quality - Family: Quality Teaching] [quality teaching practice - Family: non exam focus]

P: So we taught it properly by showing the link between the products and the factorization. Right at the beginning and we don't have to spend that much time and we can say remember this is what we did and then we will move faster. So it sort of balances out towards the end.

**P 1: Interview School leader.docs- 1:22 [P: We add more time for grade ..] (56:56)**

**(Super)**

Codes: [innovations in school - Families (2): innovation, non exam focus]

P: We add more time for grade 9, in Physical Science but not on Mathematics. We have a few minutes later as a school, so in general we have more time for our kids.

**P 1: Interview School leader.docs- 1:23 [P: I just want to add we also ..] (59:59) (Super)**

Codes: [quality teaching practice - Family: non exam focus]



P: I just want to add we also try to use our holidays, But we have classes mostly for the grade 12s, though. During the March Holidays, During the June Holidays, And September Holidays. That is just to give them that extra bit of confidence.

**P 1: Interview School leader.docs- 1:24 [P: So what this brings now is ..] (65:65) (Super)**

Codes: [quality teaching practice - Family: non exam focus]

P: So what this brings now is that immediately as they enter, they know here there is something on the board we've got to start working. SO time is not wasted. It is a limited time – 4 – 5 minutes. Feedback is given very quickly and then the lesson can start. But happened before is that a couple of minutes was wasted on first person enters and the last person enters and then the last person enters and let everybody stands and then greets. So just to eliminate that kind of time wastage, we ...

**P 1: Interview School leader.docs- 1:25 [P: Ja. And it is like a cultur..] (67:67) (Super)**

Codes: [School Culture - Family: non exam focus]

P: Ja. And it is like a culture . That is now part of our culture.

**P 1: Interview School leader.docs- 1:26 [P: What we do and what we did ..] (71:71)**

**(Super)**

Codes: [quality teaching practice - Family: non exam focus]

P: What we do and what we did here is we have a Maths subject room. And in that Maths subject room we have a couple of books. What I did with some funding that we got was that I bought some of those Mathematical books. And they are available in the library. So they do have access to those kind of works. And they are fun books like they will have Mathematical puzzles, and stories about Mathematicians, Biographies, and so on.

**P 1: Interview School leader.docs- 1:27 [P: I am really not going to be..] (76:76) (Super)**

Codes: [innovations in school - Families (2): innovation, non exam focus]

P: I am really not going to be humble when I say that ... a lot of the things – structures were in place. So I will mention those. Because it is not my doing. But I must really also say

**P 1: Interview School leader.docs- 1:28 [P: A lot of those Ideas and st..] (77:77) (Super)**

Codes: [Mathematics teacher quality - Family: Quality Teaching]

P: A lot of those Ideas and structures would not would not have been successful had it not been for the commitment of the teachers and the cooperation of the teachers.

**P 1: Interview School leader.docs- 1:29 [P: If you need to think of art..] (78:78) (Super)**

Codes: [artefacts - Family: non exam focus]

P: If you need to think of artefacts or whatever you call it, its commitment of the teacher if you look at the tangible something. That is very important, because you need that.

**P 1: Interview School leader.docs- 1:30 [P: You need the buy in and the..] (79:79) (Super)**

Codes: [leadership role - Family: Leadership]

P: You need the buy in and the acceptance of changes that you bring in. From the teachers first and foremost.

**P 1: Interview School leader.docs- 1:31 [P: But you asked about, How do..] (80:80)**

**(Super)**

Codes: [leadership role - Family: Leadership]

P: But you asked about, How do we recognize achievements? And that is one of the structures that have been at COSAT, When I came here. We have what we call Choch-awards. So every. Now before I go onto the chock-awards, because it is linked to the first part of your question which is about testing and assessment.

**P 1: Interview School leader.docs- 1:32 [P: Now we have seven reports. ..] (81:81) (Super)**

Codes: [exam focus - Family: Test and exam focus]

P: Now we have seven reports. Issued a year. We have mid-term reports as well. We have four for every end-of-term. March, June September and December. But then we have one in February as well. Then we have one around April and May. And then we have one in August as well. That is what we call mid-term reports. So we do much more testing and assessments.

**P 1: Interview School leader.docs- 1:33 [P: So we do much more testing ..] (82:82) (Super)**

Codes: [exam focus - Family: Test and exam focus]

P: So we do much more testing than what is required by the CAPs document. Because we have to uhm. Lets say you have to have one Class test. For the term. Then we will have two tests before the big one. P: And those are also recorded and the kids know that they get the reports of those tests in the mid term reports.

**P 1: Interview School leader.docs- 1:34 [P: But it is also letting them..] (83:83) (Super)**

Codes: [exam focus - Family: Test and exam focus]

P: But it is also letting them gain some familiarity with the testing style and the assessment test that is required, for their formal portfolio and formal assessment you know uhm, that template, then it is not the first time they are writing a test on the topic that they are writing. They've done it before.

**P 1: Interview School leader.docs- 1:35 [P: Uhm, we also have in terms ..] (84:84) (Super)**

Codes: [exam focus - Family: Test and exam focus]

P: Uhm, we also have in terms of the standards of the tests, we try to emulate as much as possible of the end of year questions.

**P 1: Interview School leader.docs- 1:36 [P: So we won't ask questions t..] (85:85) (Super)**

Codes: [higher order testing - Families (2): non exam focus, Test and exam focus]

P: So we won't ask questions that are easier, so that the kids can score high marks, we will rather want to make the questions more complex than the once that they've .

**P 1: Interview School leader.docs- 1:37 [P: Well, that is required in e..] (87:87) (Super)**

Codes: [leader not impacting on Mathematics - Family: Leadership]

P: Well, that is required in every subject by the different subject curriculum advisors . But it is part of what we do in any case, so there is not a real explicit way that I actually do that – I trust that the teachers do that.

**P 1: Interview School leader.docs- 1:38 [P: And we have a system of mod..] (88:88)**

**(Super)**

Codes: [higher order testing - Families (2): non exam focus, Test and exam focus]

P: And we have a system of moderation where subject heads actually moderate the quality ... in terms of the quality of the paper contents in terms of whether they comply with the blooms taxonomy And the level of questioning So it is just not if the kids get a 60% it must really be a quality 60%.

**P 1: Interview School leader.docs- 1:39 [P: In terms of the extended pr..] (89:89) (Super)**

Codes: [higher order testing - Families (2): non exam focus, Test and exam focus] [innovations in school - Families (2): innovation, non exam focus]

P: In terms of the extended program, we have the course that we offering as an eight subject which is called Advanced Programme Mathematics, It is an IEB ...

**P 1: Interview School leader.docs- 1:40 [P: You see, we try to do both,..] (91:91) (Super)**

Codes: [non exam innovation - Families (3): innovation, non exam focus, Test and exam focus]

P: You see, we try to do both,. The thing with the AP maths program, before we actually did that , we did an informal, where they did not have to write exams. It was an informal enrichment course. With the kids (R: which is a club notion?).

**P 1: Interview School leader.docs- 1:41 [P: Uhm, it was formal classes ..] (92:92) (Super)**

Codes: [non exam innovation - Families (3): innovation, non exam focus, Test and exam focus]

P: Uhm, it was formal classes that they had to attend. Informal Formal. It was just that they did not write. They wrote exams but it did not reflect on their reports at the end of grade 12. You see what I mean. They wrote tests, They wrote tests in it, but it was just a course that was developed, by somebody who was knowledgeable and the kids were taught that.

**P 1: Interview School leader.docs- 1:42 [P: And the rationale for that ..] (93:93) (Super)**

Codes: [beyond school mission - Family: non exam focus]

P: And the rationale for that course was that we found that we found that kids do well for the exams, but when they get to first year University mathematics then they don't make it. And we found that they did not get the correct grounding in the University Mathematics. And you must also remember that you can get good Marks in Matric by doing the same things over and over and over. When you get to University you don't have time to do things over and over. You just have to work very hard because of the volume of the work.

**P 1: Interview School leader.docs- 1:43 [P: The one is a remedial – I d..] (96:96) (Super)**

Codes: [exam focus - Family: Test and exam focus]

P: The one is a remedial – I don't want to call it a remedial programme, I like to call it an improvement program. So from Grade 9 to Grade 12, we receive funding for this. This is one of two programs running concurrently. In grade 9 you will have two classes in grade 9 for example. The one will be for those kids who are scoring below 50, or even way below the like the lowest scoring kids in Mathematics. And we will put them together in one group. So as it were we are streaming them on a Saturday. Then we will put them in one group and the focus of

the teacher will then be to mature the things that they don't understand. That those are reinforced. SO the things are taught and retaught. In those section. That they can improve their mark.

**P 1: Interview School leader.docs- 1:44 [P: Then there is another grou..] (97:97) (Super)**

Codes: [exam focus - Family: Test and exam focus]

P: Then there is another group of grade 9 students. In fact this goes for every grade ne. And they are taught – not retaught the things that they have already done, but they are taught extra things. It is enrichment. Either the same work but then they are taught problem solving about those concepts. Like more complex procedure problems. (R: Is that your AP maths?) No...For Grade 9 it is different because there are no AP Maths, But for grade 10 – 12 they are split. – there are the once who score below 50,

**P 1: Interview School leader.docs- 1:45 [P: Then there are those who sc..] (98:98) (Super)**

Codes: [exam focus - Family: Test and exam focus]

P: Then there are those who score above 70 and above., And for thos once we feel they can cope with the normal school maths. So we want to prepare them for university mathematics. And there is a specific Syllabus that they have to follow. This is the Advance Program Maths, because it is an IEB program. And they write exams at the end of grade 12. And the topics, some correspond with school Mathematics but most of it is, University topics. That they will not encounter in school. They must just It obviously can't cover all University mathematics. But at least when they get to University they have been introduced to the concepts of Matrices, and concepts like integration and graph theory.

**P 1: Interview School leader.docs- 1:46 [P: So it extension on a horizo..] (99:99) (Super)**

Codes: [non exam innovation - Families (3): innovation, non exam focus, Test and exam focus]

P: So it extension on a horizontal level. They not going into the depth, because these are kids who can handle the depth? Now if I look at the current grade 12 group, because they also have AP, And some of them have Math 3 as well? So Math 3 you cover in the school time? So that is normal school period? You see the idea would have been that every single child in grade 12 (R: they have nine subjects then?) Ja, they have nine. But the idea would have been for all of our kids to do Paper three in any case. But we know there some who are struggling. So we have

about 30 – say half of them doing paper three. But what I've done is to take it upon myself to teach the paper three. And on a Wednesday, All three classes are combined. In a double period. And we will split the group. Soemtimes he takes them all when I am not available – then it is Big Group teaching. They use the hall. That is one of the measures I've implemented, becasu The work load of the teachers. If we did not do that then we would have taught, 37 out of the (40 periods). Accomodating the workload of the teacher. Now he is teaching one group and it reduces his teaching load – not his marking load. It is not that bg. It is one group of about 60 students. And But what happens most of the time is that the class is split and I take out the Paper three children. And I will work with them while he works on just revising a section with the other people.

**P 1: Interview School leader.docs- 1:47 [P: Well what I would like to s..] (105:105)**

**(Super)**

Codes: [quality teaching practice - Family: non exam focus]

P: Well what I would like to see is for teachers to say how they see practically learner-centred-learning. P: It is not just about, I giving them work and letting them wo

**P 1: Interview School leader.docs- 1:48 [P: There has to be space for t..] (107:107) (Super)**

Codes: [quality teaching practice - Family: non exam focus]

P: There has to be space for the teacher to explain concepts and for the kids to do work together.

**P 1: Interview School leader.docs- 1:49 [P: (R: so it is about kids bec..) (109:109) (Super)**

Codes: [students become teachers - Families (2): non exam focus, Quality Teaching]

P: (R: so it is about kids becomingteachers?) Yes, it will be nice to actually follow them and actually research how they do it, because it is not done. Intentionally like that. It happens. We just find that this happens. As a matter of course, but from my side there is no intention of creating this , but has that effect. They are a bit more knowledgeable than the others. And there naturally, They do talk a lot. And in their groups there natural inclination is to explain to the others that don't understand.

**P 1: Interview School leader.docs- 1:50 [P: Like I said this is one of ..] (113:113) (Super)**

Codes: [innovations in school - Families (2): innovation, non exam focus]

P: Like I said this is one of the structures, that I inherited.

**P 1: Interview School leader.docs- 1:51 [I spoke about the choch-awards..] (111:111)****(Super)**

Codes: [exam focus - Family: Test and exam focus]

I spoke about the choch-awards. The once who are in the top four. What we do of course is after every mid term, Every report including the midterms, we have the chock awards where we recognize the top four in every grade and so we celebrate their achievements.

**Appendix 11:** Atlasti7 coded slices of data of student focus group discussions

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HU: focus\_group\_discussions

File: [C:\Users\rfortune\Documents\Scientific

Software\ATLAS.ti\TextBank\focus\_group\_discussions.hpr7]

Edited by: Super

Date/Time: 2014-09-06 07:50:39

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Code Family: Artefacts

Created: 2014-09-06 07:20:57 (Super)

Codes (10): [artefacts] [beyond school mission] [discourse] [higher order testing] [problem solving skills] [quality learning] [School Culture] [student become teacher] [students become teachers] [test students on intake]

Quotation(s): 48

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Code Family: exam focus

Created: 2014-09-06 07:21:59 (Super)

Codes (14): [discourse] [exam focus] [higher order testing] [Importance of testing] [innovations in school] [Leader's commitment to Mathematics] [leader not impacting on Mathematics] [Leader shortcoming] [leaders' mission] [leadership role] [Mathematics teacher quality] [non exam innovation] [quality teaching practice] [test students on intake]

Quotation(s): 23

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Code Family: innovation

Created: 2014-09-06 07:22:16 (Super)

Codes (16): [artefacts] [beyond school mission] [dare to innovate] [discourse] [exam focus] [innovations in school] [leaders' mission] [Mathematics teacher quality] [non exam innovation]



[problem solving skills] [quality learning] [quality teaching practice] [School Culture] [student become teacher] [students become teachers] [test students on intake]

Quotation(s): 60

---

Code Family: Leadership influence

Created: 2014-09-06 07:22:54 (Super)

Codes (23): [artefacts] [beyond school mission] [dare to innovate] [discourse] [exam focus] [higher order testing] [Importance of testing] [innovations in school] [Leader's commitment to Mathematics] [leader not impacting on Mathematics] [Leader shortcoming] [leaders' mission] [leadership role] [Mathematics experience of leader] [Mathematics teacher quality] [non exam innovation] [problem solving skills] [quality learning] [quality teaching practice] [School Culture] [student become teacher] [students become teachers] [teacher employment]

Quotation(s): 59

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Code Family: Teacher influence

Created: 2014-09-06 07:22:42 (Super)

Codes (14): [artefacts] [beyond school mission] [discourse] [exam focus] [higher order testing] [Importance of testing] [innovations in school] [non exam innovation] [problem solving skills] [quality learning] [quality teaching practice] [School Culture] [student become teacher] [students become teachers]

Quotation(s): 58

## 1 - Quotations

**All current quotations (60). Quotation-Filter: All**

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HU: focus\_group\_discussions

File: [C:\Users\rfortune\Documents\Scientific

Software\ATLAS\TextBank\focus\_group\_discussions.hpr7]

Edited by: Super

Date/Time: 2014-09-06 10:39:03

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**P 1:** fousgroup.docx1:1 [R: Ok. Now how do you help stu..] (31:36) (Super)

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: Ok. Now how do you help student?

S2: In the class, next to me is a friend. She, Shes sometimes, she usually does not understand what the teacher says. I help her in many ways. By explaining everything that the teacher says.

R: She's helped. Are you helped in return?

S2: Yes, the more I help her, the more I get to understand the work.

R: Ok. So that makes you stronger?

S2: Ja?

**P 1:** fousgroup.docx1:2 [S3: Yes, because it helps me t..] (41:41) (Super)

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S3: Yes, because it helps me to understand. I feel pleased when somebody tels me that I helped them to understand. To me good. Then later they understand. I like being explained to and explaining to. I don't like to always explain when I don't understand. I just ask the person next to me. Do you understand? Then they get to explain to me.

**P 1:** fousgroup.docx1:3 [R: So we can talk from that va..] (48:51) (Super)

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: So we can talk from that vantage point then. Are there people in this group that you've ever helped?

S4: Yes (looking around the group).

R: Who?

S4: Him. (S2 also put up her hand saying - "me")

**P 1:** fousgroup.docx1:4 [S5: Sometimes I work with othe..] (56:58) (Super)

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S5: Sometimes I work with others in helping them. The boy sitting next to me in the Maths room.

R: Tell me you are now the third person to mention that you are helping the boy sitting next to you. Tell me was that boy or person placed next to you? For a specific reason? In other words by the teacher?

S5: Yes

**P 1: fousgroup.docx1:5 [R: And in the class itself, ar..] (61:64) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: And in the class itself, are there anybody who would like to come to you, to you specifically? Because of the way you explain it?

S5: Yes, a girl - my friend.

R: SO she prefers coming to you?

S5: (Nods affirmatively).

**P 1: fousgroup.docx1:6 [S6: In the class some people w..] (68:70) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S6: In the class some people want me to explain to them. There is a girl who sits at the back of me. Sisana. She always wants help from me. Then I explain something to her. And then sometimes I also need help, from some people here, then I always like ..

R: Who helps you?

S6: I always ask S3 or S10.

**P 1: fousgroup.docx1:7 [R: Ok. Then tell me what is yo..] (71:74) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: Ok. Then tell me what is your impression of the two of them? In other words how strong are they. Who is the strongest of the two of them?

(all of them started to laugh and giggle at this question)

R: Ok. Who do you prefer to go to? And I would like to know why?

S6: I think they are both like good. They can both explain good.

**P 1: fousgroup.docx1:8 [S7: I am not good at explainin..] (83:85) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S7: I am not good at explaining things. But. I am not shy. I like talking but explaining things. I am not good at it.

R: Are there anybody in this group that you go to if you normally don't understand stuff?

S7: This one (indicating S8) and others.

**P 1: fousgroup.docx1:9 [R: Ok. Among the people that y..] (86:89) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: Ok. Among the people that you mentioned who explains things best to you? And I would like to know why?

S4: (Pointing our student S10, who smiles very broadly).

R: Why him. What is so outstanding in the way he explains?

S7: For example in physics, you can read something at home. When I go to him, he explains things that I see it in another way. That is not in the way it is in the book.

**P 1: fousgroup.docx1:10 [R: So he does not do things in..] (90:91) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: So he does not do things in the way it is in the book? You know the obvious way in the book?

Is his explanations sometime different than the teachers explanations?

S7: Yes.

**P 1: fousgroup.docx1:11 [S8: Yes sir. If I don't unders..] (95:97) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S8: Yes sir. If I don't understand something, I ask her to help me. And she help me.

R: Which topic specifically is she helping you?

S8: In Geometry.

**P 1: fousgroup.docx1:12 [R: Ok. Now she is saying that ..] (100:104) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: Ok. Now she is saying that you helping her. (turning to S7).

S7: We are helping each other.

R: Which section does she normally help you with?

S7: Paper one.

R: She is good at paper one and you are good at paper 3 - the one hand helps the other hand.

**P 1: fousgroup.docx1:13 [S9: (smiling very uncomfortabl..)] (107:108) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S9: (smiling very uncomfortably) My name is Athenkosi. I also do Maths, Maths is my favourite subject. The main person that helps me with my Maths is him (pointing out student S3)

S9: I am sometimes a slow student and could not understand. When they ask me to explain, I over explain. So that is a sort of disadvantage to me.

**P 1: fousgroup.docx1:14 [R: So in what way is over expl..] (109:110) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: So in what way is over explain a disadvantage?

S9: Sometimes I explain and then ...say more than what I should, then they get confused. That is why people don't like me to explain to them. I confuse them in some way.

**P 1: fousgroup.docx1:15 [S10: My name is Satiam. Mathem..] (116:118) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S10: My name is Satiam. Mathematics is also one of the subjects that I love. But normally, I don't like things to be explained to me. I normally want to sit next to a person who. Not a person who is higher than me, so that I can also learn how to stand for myself.

R: In other words, you want to be the person who do the explaining?

S10: Not that I want to make the explanation. I want to learn how to stand for myself. Like not asking the person who is next to me. In class I do normally understand what the teacher says. And also now in class we are doing circles. And there is a girl next to me and she ask me the theorems the measurements. I like to explain to her. I like that there is someone in the class that I can explain something to her.

**P 1: fousgroup.docx1:16 [R: When you say that you get t..] (121:122) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: When you say that you get to see it that way. When people get to explain it that way,...

S11: Its also when I explain it but when I ask Athi. Then Athi will do it better. Then I understand things better.

**P 1: fousgroup.docx1:17 [R: And here he says he is over..] (123:124) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: And here he says he is over explaining.

S11: I think the over explaining helps me a lot. Because I like him to explain to me, because I like to see the things in different way.

**P 1: fousgroup.docx1:18 [S12: ja. It is great. For myse..] (130:134) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S12: ja. It is great. For myself if I don't understand a certain section I always ask the perosn that is near me.

R: Does it happen often?

S12: it does not happen often.

R: Is it an issue if it happens often?

S12: ja I think it is. Ja it will be an issue.

**P 1: fousgroup.docx1:19 [R: Lest talk about your exampl..] (140:142) (Super)**

Codes: [discourse - Families (5): Artefacts, exam focus, innovation, Leadership influence, Teacher influence]

R: Lest talk about your example. Can you remember the example?

S9: In Maths? Uhm.

S5: Sometimes they don't argue about Maths, General things. I remember one day they argued about CDs. Its not always Maths. But sometimes, they do argue about Maths.

**P 1: fousgroup.docx1:20 [R: Give me some Math examples...] (143:146) (Super)**

Codes: [discourse - Families (5): Artefacts, exam focus, innovation, Leadership influence, Teacher influence]

R: Give me some Math examples.

S9: I have one.

R: Ok

S9: We were arguing about Polya's last theorem. I think he (S3) said Phythagorus or Euclid was the best Mathematician, thus far. I think I said it was Euler. We like discussing or debating who was the best in Mathematics. The Mathematicians, all the Mathematicians.

**P 1: fousgroup.docx1:21 [R: So, when you talk about you..] (147:149) (Super)**

Codes: [discourse - Families (5): Artefacts, exam focus, innovation, Leadership influence, Teacher influence]

R: So, when you talk about you interest, it is beyond what you do in the class? Now lets go to the argument. Who won the argument?

S3: Ja, he does not want to accept defeat, but I know that I won that argument.

**P 1: fousgroup.docx1:22 [S3: So I see his works. We hav..] (153:153) (Super)**

Codes: [non exam innovation - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

S3: So I see his works. We have a part in our syllabus that deals with his works, Euclidean geometry. So When I hear about his life I knew that he was very intelligent. He make like a very .. You know his famous last theorem? You know the one which says there are no whole number

solutions to the equations like 8 to the power 3. No eight to the power n plus b to the power n is n is greater than 2. Mathematicians struggle to deal with the problem. But he tried to make a break through with the problem. Euler said that he just ignored it. I hear about Euler's number, but I never hear much about him, but he is ...

**P 1: fousgroup.docx1:23 [S9: Euler is the best. Even in..] (155:157) (Super)**

Codes: [non exam innovation - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

S9: Euler is the best. Even in the book, because it is said that he is the father of mathematics.

And even of modern Mathematics. Because in the Mathematics he formed a formula called  $p + r - l = 1$ . Where p is the number of vertices and r is the ridges and l is the lines. So, that helped a lot and it even helped us buildt buildings, and build computer networks.

So Euler also made his constant, Euler's number, you know it. There is a lot to say about Euler.

He was about Euler. During the century he was also friends with David Banoyl (21:05) from the Banoyl family.

He was known that if he was given any problem at any time he would solve it. The community relied on him. So Euler was the best of the best.

**P 1: fousgroup.docx1:24 [R: Now you listening to this c..] (158:159) (Super)**

Codes: [quality teaching practice - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

R: Now you listening to this conversation. Are you all listening to this conversation? (Students: All says yes.) So what is your opinion about this conversation (turning to S5) between the two of the?

S5: I think they really like Maths. Because uh uh uh .

**P 1: fousgroup.docx1:25 [R: Now what is your opinion ab..] (164:167) (Super)**

Codes: [artefacts - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: Now what is your opinion about this conversation between the two of them?

S2: (Laughing) these guys really know Maths.

(everybody else joined them in laughter).



S2: This is the first time I hear about this Mathematics conversation. These types of explanations I did not know about...these things. Yea, they are amazing.

**P 1: fousgroup.docx1:26 [: Ok, lets ask him (referring ..) (170:172) (Super)**

Codes: [artefacts - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

[problem solving skills - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

: Ok, lets ask him (referring to S3) So what I this obsession - wanting to know a little bit more to want to have a conversation around Mathematics.

S3: It tells me like at home. My aunt want me to cut the tiles, I had to cultivate the area, I had to cultivate the area for the lounge, to measure the sides and then the other sides. I could measure the area and tell her how many tiles to buy. That tells me that one of these days I want to be an engineer.

SO I hear that ... I want to be an engineer because I love Maths, not because I love Maths because I love engineering.

**P 1: fousgroup.docx1:27 [S3: My love for maths. Yes. I ..] (174:176) (Super)**

Codes: [problem solving skills - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S3: My love for maths. Yes. I don't know why I .. I like challenging things. I see it like a challenge. So like if they give me like a very tough problem, and then I succeed in solving it. I feel on top of the world. There is this one example of where my teacher, gave me this question like, it took us about an hour, to solve it. But then finally we solved it. So.

R: So this was outside of Class time?

S3: Yes.

**P 1: fousgroup.docx1:28 [R: So what is your interest in..] (180:181) (Super)**

Codes: [beyond school mission - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: So what is your interest in Maths? Where do you see your Maths take you?

S10: Personally I want to be a Mathematician. Or an Actuary. But I don't see a big future in this country for Mathematicians, because ... for myself. I don't see for myself. Because in my house

they expect me to bring money in and stuff. When you are a Mathematician, you don't normally focus on bringing in the money. My passion is for Mathematics not for money. So I don't see how that will benefit my family as a career.

**P 1: fousgroup.docx1:29 [S3: There is this quote from t..] (185:192) (Super)**

Codes: [beyond school mission - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S3: There is this quote from the book that we are reading. It's a ..

R: What is the name of the book?

S3: Maslers' theorem.

R: Ok

S3: It says, Achimededs will be remembered, when Shakespear is forgotten. Because languages die and Math ideas do not. That is one of the things I ..

S10: James Harding

S3: Yes, James Harding said that

S3: that is one of the reasons, I love Maths, but languages, I don't like them. (others chuckle)

**P 1: fousgroup.docx1:30 [S1: You see sir. My school is ..] (194:194) (Super)**

Codes: [innovations in school - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

S1: You see sir. My school is more advanced than the school of my frineds. The things that makes me say that is. I love Maths. I never go to them to ask for help. For them to help me. They come to me for help. In this school there are more people who helps me a ot.

**P 1: fousgroup.docx1:31 [R: So the school took you on a..] (198:199) (Super)**

Codes: [innovations in school - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

R: So the school took you on an outing. To look at a telescope?

S3: Yes.

**P 1: fousgroup.docx1:32 [S3: No it was more a physics c..] (203:203) (Super)**

Codes: [innovations in school - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

S3: No it was more a physics camp. But the guy there told us about a Mathematician called ... I can't remember but the new Mathematics ideas to describe the Universe this way and that way.

So I said, well Maths is applied every where.

**P 1: fousgroup.docx1:33 [S10: We have Saturday classes,..] (209:213) (Super)**

Codes: [innovations in school - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

S10: We have Saturday classes, where the students who are not very good at math, they have extra lessons, catch up on the things that we do during the week. And then there is AP for those who get 80 and above for Mathematics.

R: What is AP?

S10: its advanced programme in Mathematics.

R: Can I focus on that, what happens there?

S10: There they take the top students and they learn more about the Mathematics that we are going to do next year. Or Mathematics that is not in our syllabus.

**P 1: fousgroup.docx1:34 [S10: There they take the top s..] (213:214) (Super)**

Codes: [beyond school mission - Families (4): Artefacts, innovation, Leadership influence, Teacher influence] [innovations in school - Families (4): exam focus, innovation, Leadership influence, Teacher influence] [leaders' mission - Families (3): exam focus, innovation, Leadership influence] [non exam innovation - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

S10: There they take the top students and they learn more about the Mathematics that we are going to do next year. Or Mathematics that is not in our syllabus.

S10: Like currently right now we are doing Calculus, and we are not suppose to do Calculus.

And we already know how to differentiate. So that is also a skill that we have from the AP Maths class. So that is also our learning of Mathematics in this school.

**P 1: fousgroup.docx1:35 [S12: And also our teachers are..] (216:216) (Super)**

Codes: [artefacts - Families (4): Artefacts, innovation, Leadership influence, Teacher influence] [exam focus - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

S12: And also our teachers are very motivating. Because like in a classroom they don't like doing stuff for us. They like us to do the stuff for ourselves. They give us numerous problems and then we have to solve the problems on our own. And then if you get stuck then you can ask them.

**P 1: fousgroup.docx1:36 [R: So tell me are the problems..] (217:218) (Super)**

Codes: [artefacts - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: So tell me are the problems which the teachers put on the board, are they challenging?

S12: Sometimes they are challenging. Because you get "do nows". It is a 5 minute exercise.

Where they give us challenging stuff which we have to do within the 5 minutes. And then at the end of the 5 minutes they will tell us to solve that problem we should have done this and that .

**P 1: fousgroup.docx1:37 [S10: I think Mathematics itsel..] (220:222) (Super)**

Codes: [problem solving skills - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S10: I think Mathematics itself is itself is a fundamental problem solver. Because, you know this problem where they say seven bridges, where they say can you make a journey, of the bridges and find your way back, to that bridge, I think .

R: Without crossing the same bridge twice?

S10: Yes, that is impossible, we all know it. But evaluate to tell us why and how it is impossible? So that was a really live problem, in Europe. So it actually applied in real life. He did solve the problem.

**P 1: fousgroup.docx1:38 [S3: We do get the kind of prob..] (224:226) (Super)**

Codes: [problem solving skills - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S3: We do get the kind of problem, but they are in words, and for some of us it is very difficult to understand.

R: Lets talk about that. So you see them as word problems?

S3: Yes. Things like I can't remember the problem, but we had to make it a quadratic equation.

Then after that we did understand it. But word problems can be difficult at times.

**P 1: fousgroup.docx1:39 [S11: I also want to do medicin..] (233:233) (Super)**

Codes: [problem solving skills - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S11: I also want to do medicine. Mathematics is a subject that will sharpen my brain. In Mathemtaics we are to think and we are to think out of the box. In medicine I see its like a subject, like if you got to how to do problem like if you did medicine, in hospital, if you did not do like Mathematics, you will not have that brain. The way you gonna you you gonna solve things. If you use Mathematics, most of the time you gonna solve problems, so each and every day you deal with problems.

**P 1: fousgroup.docx1:40 [R: If I look at his problem, y..] (236:237) (Super)**

Codes: [problem solving skills - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: If I look at his problem, your problem where you had to calculate the the floor space, ne? That really interested you.

S3: yes. It made me say that ja, I did this. I was hot in Math.

**P 1: fousgroup.docx1:41 [S9: I want to become a Pharmas..] (241:243) (Super)**

Codes: [beyond school mission - Families (4): Artefacts, innovation, Leadership influence, Teacher influence] [innovations in school - Families (4): exam focus, innovation, Leadership influence, Teacher influence] [non exam innovation - Families (4): exam focus, innovation, Leadership influence, Teacher influence] [problem solving skills - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S9: I want to become a Pharmasist.

R: And the Mathematics in Pharmacy?

S9: Don't know.

**P 1: fousgroup.docx1:42 [R: Now this is the question. D..] (244:245) (Super)**

Codes: [beyond school mission - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: Now this is the question. Do you believe that the mathematics in school, lends itself to prepare you for Pharmacy?

S9: I can say that, because everything is about Maths. SO Maths can really help me to be a Pharmacist

**P 1: fousgroup.docx1:43 [S12: We were looking at questi..] (249:249) (Super)**

Codes: [beyond school mission - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S12: We were looking at questions that has to do with graphs. We also got a word problem investigate. We could not do it by asking someone else outside. We had to do it in the classroom.

**P 1: fousgroup.docx1:44 [R: Excellent. Right. So I am g..] (255:256) (Super)**

Codes: [student become teacher - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: Excellent. Right. So I am going to continue then. I want to go back to the AP programme. Because the AP programme certainly puts you ahead of your class. That is what the AP class does. Isn't it? In other words you are doing Calculus now, which will only be dealt when your teacher deals with it next year when your teacher does it with the class, right? Who of you are in the AP class. (A few hands went up). What are you gonna do now next year, when you get to regular class? And then they do Calculus in the class.

S5: I think it will be like more easier because it is something that I have done, before. So where the teacher explains, it will not be difficult. I will have a chance like to explain to others. While in the Ap class I have done it.

**P 1: fousgroup.docx1:45 [S3: We have a very good Maths ..] (266:268) (Super)**

Codes: [Mathematics teacher quality - Families (3): exam focus, innovation, Leadership influence]

S3: We have a very good Maths teacher. His examples have us to understand for example, yesterday he was explaining the difference between, a theorem and a converse of the theorem. He said, if she is dating him and me, we can conclude that she is teaching. That is a theorem. But then the converse says, If she is cheating, then we know she is dating more than one guy. He has this example, that I don't know ..

R: so uses examples of a personal nature, of the example that makes sense to you?

S3: Ya, I never forget it. Like when he said that thing, though O ja then I know the difference between them. (They all started laughing very heartily.

**P 1: fousgroup.docx1:46 [S3: Well maybe, Like some exam..] (272:273) (Super)**

Codes: [higher order testing - Families (4): Artefacts, exam focus, Leadership influence, Teacher influence] [Mathematics teacher quality - Families (3): exam focus, innovation, Leadership influence]

S3: Well maybe, Like some examples in the Ap where Ms Cooper was telling us about this  $1 + 10^2 = 10^2$ . When 1 goes to 10 on the side, it becomes sexy. (he laughed quite heartily about this comment he made). I knew ok, I will never forget this one. Those are the examples, that I love. (one of the students made a comment which made them all laugh almost uncontrollably).

S3: (hear what was said,) No, NO.

**P 1: fousgroup.docx1:47 [S11: The things that we are mo..] (280:280) (Super)**

Codes: [artefacts - Families (4): Artefacts, innovation, Leadership influence, Teacher influence] [higher order testing - Families (4): Artefacts, exam focus, Leadership influence, Teacher influence]

S11: The things that we are more interested in. That is why we are like. When MR XXX teachers, he almost want each one to be with a textbook, But the, when we write the test, the things which are in the test, those are the things which are in the textbook. What it does, he expose us to other textbooks and other things. Most of the things we do are in the book, but they are the examples to him. When we come to tests, we do something different.

**P 1: fousgroup.docx1:48 [S10: It is not something who i..] (293:297) (Super)**

Codes: [innovations in school - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

S10: It is not something who is in our class, but somebody who is visiting us, Liezle Mapay. Also another guy who is doing mathematics grade (degree). If you do well in Mathematics you get respect, because to people it is a challenge. It is more like reward, you get respect.

R: Is that happening in the school or just outside?

S10: In school.

R: So the respect lies with you and among your friends?

S10: Yes.

**P 1: fousgroup.docx1:49 [R: You have a prizegiving at t..] (301:306) (Super)**

Codes: [innovations in school - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

R: You have a prizegiving at the end of the year?

S3: Every term.

R: Every term, you have a prizegiving? A termly prizegiving. That is more than what most schools do. That is a lot, jo. (they all seem to be likeing the researcher's acknowledgement of the prizegiving). So when is the next prizegiving?

S3: There is a mid term and a term.

R: So that is two a term? So you have eight prizegivings a year?

S3 (Shouts louder than everybody else): seven.

**P 1: fousgroup.docx1:50 [S3: The thing is I don't limit..] (310:312) (Super)**

Codes: [beyond school mission - Families (4): Artefacts, innovation, Leadership influence, Teacher influence] [Imprtance of testing - Families (3): exam focus, Leadership influence, Teacher influence]

S3: The thing is I don't limit myself.

R: Don't limit yourself. In other words you don't look at marks? In an exam you have three hours.

S3: No I don't. I just work out the problem. Onetime. If it is not on my side it is not on my side. I have like this ego. I don't like giving up. You see that problem when we were in that bus. I felt like giving up, but then I thought, this thing does not talk. It won't defeat me. Someone ones proved it, so I am also good enough. That ego helps me a lot.

**P 1: fousgroup.docx1:51 [R: Don't it put you off that s..] (313:316) (Super)**

Codes: [beyond school mission - Families (4): Artefacts, innovation, Leadership influence, Teacher influence] [Imprtance of testing - Families (3): exam focus, Leadership influence, Teacher influence]

R: Don't it put you off that somebody already solved it?

S3: Yes.



R: It's not like I am making a contribution, because the answer is there in the book.

S3: (All of them laughing) That is why we like to explore problems that have not been solved yet. Like the book we've been reading, have a lot of those problems. Then there is this one that I read about last week, the P vs NP problem. I don't think you may know about it, but hasn't been solved. And the person who gets to solve it will get one million US Dollars.

**P 1: fousgroup.docx1:52 [S11: I like challenges. So Mat..] (332:332) (Super)**

Codes: [artefacts - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S11: I like challenges. So Math is like challenging to me. So I like to do more something that is hard to other people. I like to make it easy for me. And to overcome it and make it right. That is about it.

**P 1: fousgroup.docx1:53 [S11: Quality Math I thing! Le..] (334:334) (Super)**

Codes: [artefacts - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S11: Quality Math I thing! Learning. If your teachers have teach you not to rely on people. For example on the if you start a chapter or so, before the teacher does. It is like you hear him for the second time. Now it goes for you like you understand it better and better. If you learn for yourself, you can like understand like you can be exposed to many things.

**P 1: fousgroup.docx1:54 [S10: To me the Mathematics is ..] (336:336) (Super)**

Codes: [artefacts - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S10: To me the Mathematics is to get to the Mathematics without struggling a lot. And I also thing quality mathematics comes from the teacher. He is doing in his participation. It is no use we have a good teacher and the students do not participate. And then, our Mathematics will not be quality. I think it is between teacher and the learner. That is quality.

**P 1: fousgroup.docx1:55 [S7: Ok. I think like quality, ..] (343:343) (Super)**

Codes: [quality teaching practice - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

S7: Ok. I think like quality, Mathematics lies within the individual. Like Athi said, it is useless that we have a good Maths teacher. But we do not like do something to better our mathematics. And I know like what I get here (at my school), is like good Maths, because before I came here, I use to go to school in (different high school), I always got like 100% and 80%. But when I first

came here, it was hard like children to get 80% and I got code 3s at first. But then I adapted. And then I also know it is like quality mathematics, because here learners from other schools they also do maths. And when I compare like their question papers and what we got here for our tests, it's different. What they do in their tests is what we do in class works

**P 1: fousgroup.docx1:56 [S3: Athenkosi said it all. Lik..] (350:352) (Super)**

Codes: [artefacts - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S3: Athenkosi said it all. Like we need like for Maths both contributions from both the teacher and students. And I know what S7 said, because the same thing that happened to her, happened to me. In my previous high school.

R: Which year did you come to this school?

S3: Last year. In my previous school I got 95%. Then the first year when I got here I got 355 for Maths. And I felt like crying. I thought you drank like Tequila's here. The first term I got 37%. Then I knew that this is unlike me. I have to push hard. And my teacher, taught us well. And I contributed a lot. And then I got like high marks. I improved a lot. And then, I knew ja, this is quality Maths. I contributed a lot, and quality Maths has to have that need for the students, to contribute too. Not just to become lazy and get good marks. Because at my previous school I did not work very hard, ..

**P 1: fousgroup.docx1:57 [S2: Quality maths for me is be..] (358:358) (Super)**

Codes: [quality teaching practice - Families (4): exam focus, innovation, Leadership influence, Teacher influence]

S2: Quality maths for me is being responsible in everything I do. Like if I don't understand, something, then I must not just sit there. I must go and find help like to my fellow classmates, or teachers. And to be determined and focused. And that is what I think is quality Maths.

**P 1: fousgroup.docx1:58 [R: Now I want to ask you, what..] (361:362) (Super)**

Codes: [artefacts - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

R: Now I want to ask you, what about the school brings about that focus? There must be attributes, or something? That you can say, we are focused, because ...

S2: Like here in the school the teachers are the one. The teachers are the ones who play an important role. The teachers are the one who motivates us. Yes they support us.

**P 1: fousgroup.docx1:59 [S1: For me, quality Maths mean..] (364:364) (Super)**

Codes: [quality learning - Families (4): Artefacts, innovation, Leadership influence, Teacher influence]

S1: For me, quality Maths mean working hard. You see if you are given a problem here in school, and when a teacher teaches in the classroom, I listened very hard so that I can go home knowing what to do. And when I get home, I struggle and work hard. Because I know when I was at school, I knew this. So, ja.

**P 1: fousgroup.docx1:60 [S7: I was going to add one tha..] (368:368) (Super)**

Codes: [test students on intake - Families (3): Artefacts, exam focus, innovation]

S7: I was going to add one that S1 said. Like what makes us to be focused here. I think it is because like all the people that have the same mindset. We are here for the same reason. People who are here, they are determined, to like achieve. Because we are from the poor back grounds. Like most of us here. So we have like that drive, the same drive. We are doing what we doing here for the same reason. And also like the teachers are from the same back grounds. So they understand like what we are going through. They are very inspiring and motivating. That is it.

**Appendix 12:** Atlasti7 teacher semi-structured interview data slices**Codes-quotations list****Code-Filter: All**


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HU: teacher semi-structured interviews

File: [C:\Users\rfortune\Documents\teacher semi-structured interviews.hpr7]

Edited by: Super

Date/Time: 2014-10-19 21:48:19

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**Code: beyond school mission {7-0}****P 1: Teacher 1 interview.docx - 1:4 [A: Ja, the thing about it. The..] (26:26) (Super)**

Codes: [beyond school mission - Families (3): Beyond school Mission, Innovations, Leadership role]

A: Ja, the thing about it. The problem I foresee, with CAPs, same with OBE, We are not actually preparing our kids for real life out-there.

**P 1: Teacher 1 interview.docx - 1:5 [e go percentage wise, to matri..] (26:26) (Super)**

Codes: [beyond school mission - Families (3): Beyond school Mission, Innovations, Leadership role]

A: e go percentage wise, to matric. I have been teaching Maths now for 23 year now. And I always found that the percentage of learners , who after matric, really, really, go out there, and the go to University and they study, in the line of Mathematics, is minimal. I would say it is less than 6%.

**P 1: Teacher 1 interview.docx - 1:6 [A: Ja there's different reason..] (28:28) (Super)**

Codes: [beyond school mission - Families (3): Beyond school Mission, Innovations, Leadership role]

A: Ja there's different reasons we have that why we have a small percentage of learners going to university and n n the basic thing is in our communities our society out there. There's learners

with potential, lots of them. They don't have the the funding or the ability the funding in a sense, more the funding to study at tertiary level. Uhm yes we might argue that there's bursaries availa

**P 1: Teacher 1 interview.docx - 1:16 [nd you can't do that very effe..] (48:48) (Super)**

Codes: [beyond school mission - Families (3): Beyond school Mission, Innovations, Leadership role] [quality teaching - Family: Teacher influence]

A: nd you can't do that very effectively in a in a group, class group, etc, but if you meet them on a more one-to-one basis, that would be number 1, if you could tell them that you are prepared to sit with them during interval, what you actually tell them is that i am prepared to sacrifice my interval for you.

**P 1: Teacher 1 interview.docx - 1:28 [And if you go to meetings the ..] (69:69) (Super)**

Codes: [beyond school mission - Families (3): Beyond school Mission, Innovations, Leadership role] [exam focus - Families (2): Artefacts, Teacher influence]

And if you go to meetings the advisor will tell you, .. No, that's for the top top echelon. The top group, those learners really wishing to go into CA, forensic science and those and that, and some teachers they look at it and say I got no CAs at my school, I've got no potential doctors at my school and therefore, am I wasting my time going the extra-mile and doing that. And some people are also of the notion that the top learnner, he will sort out that himself. He'll deal with that.

**P 1: Teacher 1 interview.docx - 1:30 [When we get to that modeling q..] (69:69) (Super)**

Codes: [beyond school mission - Families (3): Beyond school Mission, Innovations, Leadership role] [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

When we get to that modeling question he simply, turn the page and say and pass on.

**P 1: Teacher 1 interview.docx - 1:42 [A: Again that s when society i..] (97:97) (Super)**

Codes: [beyond school mission - Families (3): Beyond school Mission, Innovations, Leadership role]

A: Again that s when society impacts. I don't know if he studies because he comes from a no-father and a single mother, ... the last time I heard because I spoke to his sister, he left for the

army. He joined the army because that was the only way he could be assisted with his studies. HE wanted to go into astronomy. He wanted to go to Stellenbosch University of the course.

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**Code: exam focus {10-0}**

**P 1: Teacher 1 interview.docx - 1:1 [I did it wth the training uhm ..] (6:6) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [importance of testing - Families (2): Artefacts, Teacher influence]

I did it wth the training uhm what we need from principals is to communicate with the departement. to give us clear assessments. It is all about assessments.

**P 1: Teacher 1 interview.docx - 1:2 [A: You know the concern of any..] (22:22) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [importance of testing - Families (2): Artefacts, Teacher influence]

A: You know the concern of any teacher when it comes to ANAS and systemic tests. I mean we don't have any insight into what will happen with the systemics. Now sometimes if you not certain as to how the departement set up the exam and how they set up the testing etc, and and basically working in the dark, in a sense., I might teach number patterns and I might think of and research and find questions that's innovative etc, and now you spend lots and lots of time, and thinking that they might give you this type of question, now you get to the systemic tests, and now you find that it is not actualy being tested. It was not tested. And you might have concentrated and put all your weighting on taat type of question. And at the end of the day that is what will measure you as a successful teacher.

**P 1: Teacher 1 interview.docx - 1:3 [And again the TOT – “the time ..] (22:22) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence]

And again the TOT – “the time on task” for the kids, I feel that yes, we need to upskill them in a sense - the learners, but upskill them also prepare them effectively for the exam. Not our internal exam only, but for external examinations.

**P 1: Teacher 1 interview.docx - 1:22 [A: Yes, English or even in the..] (63:63) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence]

A: Yes, English or even in their own slang. I always motivate them. Uh, learners. If I teach something I have to teach it according to the linguist frame of the textbook. Or the lingua franca of the examination. I am very specific about that. I will always spell out to them that this question will be tested in the following way. The following manner. They must get used to the wording of certain questions,

**P 1: Teacher 1 interview.docx - 1:27 [A: You see Mr Fortune, many ... ..] (69:69) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [Innovation - Family: Beyond school Mission]

A: You see Mr Fortune, many ... I know a lot of Maths teachers, etc. And many is of the notion that they will rather concentrate, on those sure questions, that will take the learner over like 60% and 50%. That sure questions where only algorithms are involved. Where they know there is an equation there is a calculator and there is a solution. Those questions. Questions that's easy to spot and easy to practice, etc. And somehow the education department when they set up questions, they give us the weighting the weighting questions, they tell us clearly as maths teachers, listen here, its only about 15 Marks in the final examination, its only about 7,5% of your examination, etc.

**P 1: Teacher 1 interview.docx - 1:28 [And if you go to meetings the ..] (69:69) (Super)**

Codes: [beyond school mission - Families (3): Beyond school Mission, Innovations, Leadership role] [exam focus - Families (2): Artefacts, Teacher influence]

And if you go to meetings the advisor will tell you, .. No, that's for the top top echelon. The top group, those learners really wishing to go into CA, forensic science and those and that, and some teachers they look at it and say I got no CAs at my school, I've got no potential doctors at my school and therefore, am I wasting my time going the extra-mile and doing that. And some people are also of the notion that the top learner, he will sort out that himself. He'll deal with that.

**P 1: Teacher 1 interview.docx - 1:29 [But he would spend the time. H..] (69:69) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [Innovation - Family: Beyond school Mission] [quality learning - Families (2): Innovations, Leadership role]

But he would spend the time. He would be independent, sit down and he would come back to you, also to work with you through the questions, etc. But even also from the learners side this idea that, and sometimes it also comes from the teachers, and sometimes it comes also from their reading also, that the higher order questions is not for them. They not, they not expected to know that question. That is for the A student, that is for the A plus student

**P 1: Teacher 1 interview.docx - 1:32 [A: Uhm, the first thing I alwa..] (77:77) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence]

A: Uhm, the first thing I always tell the learners is that in most cases, when they are tested, they are tested, in the examinations, that is the assessments, it is formal, and there is a mark allocation to that. Now the mark allocation is critical, very critical. Because the mark allocation is your first gauge.

**P 1: Teacher 1 interview.docx - 1:33 [Because they fail to start wit..] (77:77) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence]

Because they fail to start with the very simple thing, the aspect of solving the problem. Look at the mark allocation, Look at what it is they really want from me? Uh, a two marker will not send you on a path where you will have to spend fifteen minutes on it. I always tell them that.

**P 1: Teacher 1 interview.docx - 1:34 [So that they can score that My..] (77:77) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

So that they can score that My advice to them is one mark per minute. One Mark per minute. When you do a question – check your marks. That is what I sell to them. One Mark per minute. So when they write their final examination, out of 150 Marks, it is a three hour paper, and three times 60 is 180. So if you follow that pace of 1 mark per minute, you end up saving yourself, 30 minutes at the end. Because if you just try to do your paper in 150 minutes, you have 180 minutes to do the paper. Now that extra 30 minutes, is part of strategy, now you go back to that question, so then you change your path. So if 20 minutes part of 30 minutes part or 50 minutes part, took you know where, scratch it out and start over again. That is one one ... sometimes you also find ... I experienced once when I tutored a new group, no it was an organisation here in



Wynberg, And we had learners from all over. And I could see, ... the learners gave me a question, ... because obviously you come, you start afresh,

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**Code: higher order questions {1-0}**

**P 1: Teacher 1 interview.docx - 1:45 [If you deal with depth and con..] (100:100) (Super)**

Codes: [higher order questions - Families (4): Artefacts, Beyond school Mission, Innovations, Teacher influence] [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

If you deal with depth and connect that to our problem solving, you know our higher order questions that (School X and School Y) is speaking about, they know the notion of higher order questioning.

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**Code: importance of testing {2-0}**

**P 1: Teacher 1 interview.docx - 1:1 [I did it wth the training uhm ..] (6:6) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [importance of testing - Families (2): Artefacts, Teacher influence]

I did it wth the training uhm what we need from principals is to communicate wth the departement. to give us clear assessments. It is all about assessments.

**P 1: Teacher 1 interview.docx - 1:2 [A: You know the concern of any..] (22:22) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [importance of testing - Families (2): Artefacts, Teacher influence]

A: You know the concern of any teacher when it comes to ANAS and systemic tests. I mean we don't have any insight into what will happen with the systemics. Now sometimes if you not certain as to how the departement set up the exam and how they set up the testing etc, and and basically working in the dark, in a sense., I might teach number patterns and I might think of and research and find questions that's innovative etc, and now you spend lots and lots of time, and thinking that they might give you this type of question, now you get to the systemic tests, and now you find that it is not actualy being tested. It was not tested. And you might have

concentrated and put all your weighting on that type of question. And at the end of the day that is what will measure you as a successful teacher.

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**Code: Innovation {9-0}**

**P 1: Teacher 1 interview.docx - 1:12 [At the moment when you stand o..] (40:40) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [quality learning - Families (2):

Innovations, Leadership role]

At the moment when you stand on this side and you look at Maths, as a difficult subject, you only will see that barrier, but if start to climb slowly and slowly, you will fall at times and you climb again to the top, you will see the fish on the other side. But those of them, those learners who decide, no no, it is difficult for me, I won't go this barrier will be forever on this side will not see what is on the other side. You have to use some sort of psychology in a sense. Some sort of life lesson for them

**P 1: Teacher 1 interview.docx - 1:13 [Sometimes you have to move awa..] (40:40) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [quality teaching - Family: Teacher influence]

Sometimes you have to move away and say, ok, let's look at life outside. Let's speak about examples of other learners like yourself, in more trying circumstances who make it, who made it . This is one thing, you have to connect life to ... I believe that Maths is not, ... yes it is a science, but it is a life science also. It is clearly connected to life. And you need to show the learners that.

**P 1: Teacher 1 interview.docx - 1:17 [what i found at that point whe..] (48:48) (Super)**

Codes: [Innovation - Family: Beyond school Mission]

what i found at that point when you are alone with them, then you can enhance them, .. further exercises. They'll do it gladly. They'll really do it gladly.

**P 1: Teacher 1 interview.docx - 1:19 [What I am saying, as a teacher..] (57:57) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [students become teachers - Families (2):

Innovations, Teacher influence]

What I am saying, as a teacher I would pre-select. Some learners have the knowledge of the content. But they don't have the capacity to carry it over to others.

**P 1: Teacher 1 interview.docx - 1:20 [ot all learners lean themselve..] (57:57) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [students become teachers - Families (2): Innovations, Teacher influence]

not all learners lean themselves towards, teaching others. Some of them have depending on their personality, and as teachers you need to discern, I know we made a mistake with one learner, I forgot his name, but he was a total, he was a loner, he would present the work, he would do the work on paper. But ask him to explain it to someone else, how he arrived at a certain answer, he could not do that. As teachers we need to select and say, ... Even sometimes you have an average learner who scores on average 48%, 42% but he is the most excellent motivator most excellent teacher of certain topics.

**P 1: Teacher 1 interview.docx - 1:21 [A: With learners assisting one..] (61:61) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [students become teachers - Families (2): Innovations, Teacher influence]

A: With learners assisting one another? [Q: learners assisting one another, assisting and a sense of development of learners who does that assisting] with Khanyo Bavuma, he was a top learner in a group, Or I would rather say the hardest worker in a group, and because he is the hardest worker he attains certain marks etc And I noticed something very interesting, I think we were busy with Calculus at the time, calculus tend to be a subject where you get a few who you carry forward, but then you have a tail of learners who are totally lost in Calculaus, And they tyend to drag behind, I know there was one lesson where I had to stop the lesson, and reteach certain topics, to individuals etc. And at that point Khanya went forward and he explained to thelearners in their own Lnaguage, Xhosa. Because he saw the gap being created of some learners who understand the work and some learners totally totally lost. And he went he went even the bell rang and it was interval, and he was directing them in xhosa there. I could understand because he was writing the notes down, And, he would basically transcribed what I told them in class and explain it in xhosa, I could see even the slowest learners, the learners who did not understand initially they started to smile, they started to understand. So there was another vantage point over

there, that I picked up. Sometimes it might not be the topic per se, but the language of instruction. Sometimes I find that Calculus, if you can get. I mean it wasn't done ... it was done voluntary in his case. I didn't ask him. I did not direct him. I just saw. [ Q: so he just realized that there was a need. ] Ja, I think he identified that need. They spoke... I heard them speaking here, they speak to one another, they speak in their own language. Isixhosa and that, ... Somehow I picked up that the slower learners, they were struggling with a certain concept, I think it was the tangent concept. The tangent point concept, etc. and he started explaining it in their own language. And then they got it. They got it and he ... then after that I asked him if he was prepared to do this with them and he said yes, ... Khanyo,

**P 1: Teacher 1 interview.docx - 1:26 [And then I will always relate ..] (67:67) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [quality teaching - Family: Teacher influence]

And then I will always relate it to their experience, to their domain in a sense. Because sometimes the modeling question is not, because sometimes the modeling question is a problem to them because, it is not written in their context, in their in their field of experience. For example, if a learner has never been exposed to basketball for instance, and the problem deals with basketball, then it is clearly difficult for them to model that question because there is no inkling no idea of the sort of basketball, but if I change that same question and I change the basketball to soccer, or to netball which is closer to home, somehow they feel more motivated to attempt their question like that. Or attempt at modeling

**P 1: Teacher 1 interview.docx - 1:27 [A: You see Mr Fortune, many ... ..] (69:69) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [Innovation - Family: Beyond school Mission]

A: You see Mr Fortune, many ... I know a lot of Maths teachers, etc. And many is of the notion that they will rather concentrate, on those sure questions, that will take the learner over like 60% and 50%. That sure questions where only algorithms are involved. Where they know there is an equation there is a calculator and there is a solution. Those questions. Questions that's easy to spot and easy to practice, etc. And somehow the education department when they set up questions, they give us the weighting the weighting questions, they tell us clearly as maths

teachers, listen here, its only about 15 Marks in the final examination, its only about 7,5% of your examination, etc.

**P 1: Teacher 1 interview.docx - 1:29 [But he would spend the time. H..] (69:69) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [Innovation - Family: Beyond school Mission] [quality learning - Families (2): Innovations, Leadership role]

But he would spend the time. He would be independent, sit down and he would come back to you , also to work with you through the questions, etc. But even also from the learners side this idea that, and sometimes it also comes from the teachers, and sometimes it comes also from their reading also , that the higher order questions is not for them. They not, they not expected to know that question. That is for the A student, that is for the A plus student

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**Code: leadership's role {2-0}**

**P 1: Teacher 1 interview.docx - 1:43 [So basically management must h..] (103:103)**

**(Super)**

Codes: [leadership's role - Family: Leadership role]

So basically management must have the structure, so we should set-up a structure where we identify number 1 our possible GEMs, right, yes we can go to past, report cards, primary schools etc.

**P 1: Teacher 1 interview.docx - 1:44 [And have a conversation with p..] (103:103) (Super)**

Codes: [leadership's role - Family: Leadership role]

And have a conversation with primary school teachers, they will tell you, that is a gem, that's a gem, that's a gem.

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**Code: problem solving skills {8-0}**

**P 1: Teacher 1 interview.docx - 1:24 [A: Problem solving is a conten..] (67:67) (Super)**

Codes: [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

A: Problem solving is a contentious issue, first of all. I found that problem solving questions and modeling questions for that matter, ... in most cases our students can do simple algorithms, ...

**P 1: Teacher 1 interview.docx - 1:25 [I think the majority of learne..] (67:67) (Super)**

Codes: [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

I think the majority of learners can be brought to that point, where they can do algorithms, where they can work through basic algorithms showing them basic steps. That's easy, .. When you turn that question around and you give that same question in words, and you ask them to model, ... our learners are very weak in that sense. They are very weak in modeling questions.

**P 1: Teacher 1 interview.docx - 1:30 [When we get to that modeling q..] (69:69) (Super)**

Codes: [beyond school mission - Families (3): Beyond school Mission, Innovations, Leadership role] [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

When we get to that modeling question he simply, turn the page and say and pass on.

**P 1: Teacher 1 interview.docx - 1:34 [So that they can score that My..] (77:77) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

So that they can score that My advice to them is one mark per minute. One Mark per minute.

When you do a question – check your marks. That is what I sell to them. One Mark per minute.

So when they write their final examination, out of 150 Marks, it is a three hour paper, and three times 60 is 180. So if you follow that pace of 1 mark per minute, you end up saving yourself, 30

minutes at the end. Because if you just try to do your paper in 150 minutes, you have 180

minutes to do the paper. Now that extra 30 minutes, is part of strategy, now you go back to that

question, so then you change your path. So if 20 minutes part of 30 minutes part or 50 minutes

part, took you nowhere, scratch it out and start over again. That is one one ... sometimes you

also find ... I experienced once when I tutored a new group, no it was an organisation here in

Wynberg, And we had learners from all over. And I could see, ... the learners gave me a

question, ... because obviously you come, you start afresh,

**P 1: Teacher 1 interview.docx - 1:35 [A: Or a question like that que..] (79:79) (Super)**

Codes: [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

A: Or a question like that question: they say ok, three variables, a is equal to this and b is equal to this. Expecially in trigonometry, now find the solution etc. And I also teach learners that follow through, there is always a measure of any question like that it actually say you, say they give you a follow up questions, you miht not get the first answer, But in the second follow up question they might say, if the x is equal to a certain value, and y is equal to a certain value, the thing you did not prove you can apply now. You can actually apply, etc.

**P 1: Teacher 1 interview.docx - 1:36 [A: Baiscally I sold he idea of..] (81:81) (Super)**

Codes: [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

A: Baiscally I sold he idea of algorithms, and problem solving, I basically see Math as in the past we did not get those opportunities, or they come from backgrounds, where, parents did not get those opportunities,

**P 1: Teacher 1 interview.docx - 1:39 [A: Remember we have ... The poin..] (88:88)**

**(Super)**

Codes: [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

A: Remember we have ... The point that I would like to make is that uh we have a learner that ... we taught the linear pattern, where there was a first difference between, consecutive terms, and the quadratic pattern, where there was a second difference between terms etc. that learner came back and somehow and the other, I said that there is a pattern even in the sense that what we are saying now by definition, first difference second difference, The learner went as far as fifth difference between ... and he actually bought himself a hardcover book, and after a month he came back and said sir, I sat with this now and I got stuck, man. What happens if there is a third difference what kind of pattern do you get?

**P 1: Teacher 1 interview.docx - 1:45 [If you deal with depth and con..] (100:100) (Super)**

Codes: [higher order questions - Families (4): Artefacts, Beyond school Mission, Innovations, Teacher influence] [problem solving skills - Families (3): Beyond school Mission, Innovations, Teacher influence]

If you deal with depth and connect that to our problem solving, you know our higher order, questions that (School X and School Y) is speaking about, they know the notion of higher order questioning.

**Code: quality learning {2-0}**

**P 1: Teacher 1 interview.docx - 1:12 [At the moment when you stand o..] (40:40) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [quality learning - Families (2):

Innovations, Leadership role]

At the moment when you stand on this side and you look at Maths, as a difficult subject, you only will see that barrier, but if start to climb slowly and slowly, you will fall at times and you climb again to tyhe top, you will see the fish on the othyer side. But those of them, those learners who decide, no no, it is difficult for me, I won't go this barrier will be forever on this side will not see what is on the other side. You have to use some sort of psychology in a sense. Some sort of life lesson for them

**P 1: Teacher 1 interview.docx - 1:29 [But he would spend the time. H..] (69:69) (Super)**

Codes: [exam focus - Families (2): Artefacts, Teacher influence] [Innovation - Family: Beyond school Mission] [quality learning - Families (2): Innovations, Leadership role]

But he would spend the time. He would be independent, sit down and he would come back to you , also to work with you through the questions, etc. But even also from the learners side this idea that, and sometimes it also comes from the teachers, and sometimes it cmes also from their reading also , that the higher order questions is not for them. They not, they not expected to know that question. That is for the A student, that is for the A plus student

**Code: quality teaching {15-0}**

**P 1: Teacher 1 interview.docx - 1:7 [A: Outstanding good quality st..] (30:30) (Super)**

Codes: [quality teaching - Family: Teacher influence]

A: Outstanding good quality students ja whereas we could have diverted those learners to normal vocational things like things that are lacking here. Many of our learners.....Normal welding, uhm artisanship.....that that should come back honestly. Then our learners will go back into Maths if



they know that if I can (21:18) say I have my grade 12, I know I can't afford University, right. Even if I get a bursary, the travelling the food the lodging and all that ...

**P 1: Teacher 1 interview.docx - 1:8 [A: A high quality learner, I c..] (38:38) (Super)**

Codes: [quality teaching - Family: Teacher influence]

A: A high quality learner, I can name, examples, basically as a teacher it will fit in my hands (lifting up his ten fingers). It is a minority of learners basically. The one work is independence. It is an independent learner. It is a learner that knows there is a future after the matric point. They know it. And they also know that the subject that they are studying, Maths, as a subject is a key to their further future after matric. They know it.

**P 1: Teacher 1 interview.docx - 1:9 [quality learners i would say, t..] (38:38) (Super)**

Codes: [quality teaching - Family: Teacher influence]

quality learners i would say, they know that yes, reality is they don't have the funding for University, but they know that because Maths is, the key, they define Maths as the key, they become independent. They work hard at Mathematics, etc. Knowing that that key will give them a bursary.

**P 1: Teacher 1 interview.docx - 1:10 [They have a clear view on the ..] (38:38) (Super)**

Codes: [quality teaching - Family: Teacher influence]

They have a clear view on the future. You do get some learners, you can speak to them, you can remind them, etc. But sometimes they are immature, They don't see beyond the matric. I find learners with potential, but they don't have that vision as to see what goes on after matric. Or they come up with some sort of a barrier and they put the barrier in front of them. Where they themselves state because they do not have, money,

**P 1: Teacher 1 interview.docx - 1:11 [The maths, the maths teacher..] (40:40) (Super)**

Codes: [quality teaching - Family: Teacher influence]

The maths, the maths teacher if he really wants to take his learner a bit further, number 1 he needs to challenge those learners, uhm, instead of just teaching the curriculum, he must always remind his learners that there is a journey after school.

**P 1: Teacher 1 interview.docx - 1:13 [Sometimes you have to move awa..] (40:40) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [quality teaching - Family: Teacher influence]

Sometimes you have to move away and say, ok, lets look at life outside. Lets speak about examples of other learners like yourself, in more trying surcumstances who make it, who made it. This is one thing, you have to connect life to ... I believe that Maths is not, ... yes it is a science, but it is a life science also. It is clearly connected to life. And you need to show the learners that.

**P 1: Teacher 1 interview.docx - 1:14 [A: There is certain topics in ..] (44:44) (Super)**

Codes: [quality teaching - Family: Teacher influence]

A: There is certain topics in Maths, that lend itself to using life examples. Like financial Mathematics, Instead of speaking about, uhm, speaking about, questions in the textbook, you take it to their surroundings, you take it to their surrounds and talk about interest and how it triples communities, speaking about interest ... the lone sharks, etc. That is the time you can, connect to them and when you can show them i understand what you are going through, in your communities.

**P 1: Teacher 1 interview.docx - 1:15 [The child must feel, taht is t..] (48:48) (Super)**

Codes: [quality teaching - Family: Teacher influence]

The child must feel, taht is the one thing tht i want to impart, feel taht the teacher is genuinely, genuinely, interested in their well-being. And really interested in their success.

**P 1: Teacher 1 interview.docx - 1:16 [nd you can't do that very effe..] (48:48) (Super)**

Codes: [beyond school mission - Families (3): Beyond school Mission, Innovations, Leadership role] [quality teaching - Family: Teacher influence]

and you can't do that very effectively in a in a group, class group, etc, but if you meet them on a more one-to-one basis, that would be number 1, if you could tell them that you are prepared to sit with them during interval, what you actually tell them is that i am prepared to sacrifice my interval for you.

**P 1: Teacher 1 interview.docx - 1:26 [And then I will always relate ..] (67:67) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [quality teaching - Family: Teacher influence]

And then I will always relate it to their experience, to their domain in a sense. Because sometimes the modeling question is not, because sometimes the modeling question is a problem to them because, it is not written in their context, in their in their field of experience. For example, if a learner has never been exposed to basketball for instance, and the problem deals with basketball, then it is clearly difficult for them to model that question because there is no inkling no idea of the sort of basketball, but if I change that same question and I change the basketball to soccer, or to netball which is closer to home, somehow they feel more motivated to attempt their question like that. Or attempt at modeling

**P 1: Teacher 1 interview.docx - 1:31 [The first thing that you need ..] (75:75) (Super)**

Codes: [quality teaching - Family: Teacher influence]

The first thing that you need to make very clear to the learner is that as a teacher you must be open to learning from their side. And I always tell them that. I learn, more from you than you learn from me. And you have to show your humanist to them. Because in teaching you can't be rigid to make sense. You can't be rigid. You have to basically tell them, .. show them that if you could make a mistake as a teacher, you must be strong enough as a teacher and say, sorry guys lets work it again, and it is also part of their learning.

**P 1: Teacher 1 interview.docx - 1:37 [he sold to me was the fact tha..] (81:81) (Super)**

Codes: [quality teaching - Family: Teacher influence]

he sold to me was the fact that, if you are gonna be good at Math, if you gonna be good at something, you must persist. I will always remember the analogy, I did not understand it at the time. As to what he did. Obviously I am not going into his history of why he became what he was, Today I understand.

**P 1: Teacher 1 interview.docx - 1:38 [A: Baiscally I sold he idea of..] (81:81) (Super)**

Codes: [quality teaching - Family: Teacher influence]

A: Baiscally I sold he idea of algorithms, and problem solving, I basically see Math as in the past we did not get those opportunities, or they come from backgrounds, where, parents did not get those opportunities,

**P 1: Teacher 1 interview.docx - 1:40 [A: But as a teacher you have t..] (90:90) (Super)**

Codes: [quality teaching - Family: Teacher influence]

A: But as a teacher you have to initiate that ... Even if you ... he got to a point where there was no solution. NO solution, from his side. Now there is a kid who did something. When a kid stands up, he publicizes and it is easy to get a verbal publication.

**P 1: Teacher 1 interview.docx - 1:41 [A: High school teachers ja. Yo..] (93:94) (Super)**

Codes: [quality teaching - Family: Teacher influence]

A: High school teachers ja. You see what I did was to check it out with my subjects advisor, at the time. What I did was I had to give that learner the commitment and say, ok lets sit here during interval, and lets work through your, ... I spent some time with him, just to give some acknowledgements. That I appreciate what you were doing. He could not get to specific formulae.

Q: But the publication of it, you took it to the subject advisor ?

**Code: students become teachers {5-0}**

**P 1: Teacher 1 interview.docx - 1:18 [A: ja, the helping we refer to..] (57:57) (Super)**

Codes: [students become teachers - Families (2): Innovations, Teacher influence]

A: ja, the helping we refer to it as peer teaching in a sense. Ja peer teaching, it is an excellent [some kids are quite natural in it.] ja, natural in it. It is an excellent resource tool for teachers. But they need to use it effectively

**P 1: Teacher 1 interview.docx - 1:19 [What I am saying, as a teacher..] (57:57) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [students become teachers - Families (2): Innovations, Teacher influence]

What I am saying, as a teacher I would pre-select. Some learners have the knowledge of the content. But they don't have the capacity to carry it over to others.

**P 1: Teacher 1 interview.docx - 1:20 [ot all learners lean themselve..] (57:57) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [students become teachers - Families (2): Innovations, Teacher influence]

not all learners lean themselves towards, teaching others. Some of them have depending on their personality, and as teachers you need to discern, I know we made a mistake with one learner, I forgot his name, but he was a total, he was a loner, he would present the work, he would do the

work on paper. But ask him to explain it to someone else, how he arrived at a certain answer, he could not do that. As teachers we need to select and say, ... Even sometimes you have an average learner who scores on average 48%, 42% but he is the most excellent motivator most excellent teacher of certain topics.

**P 1: Teacher 1 interview.docx - 1:21 [A: With learners assisting one..] (61:61) (Super)**

Codes: [Innovation - Family: Beyond school Mission] [students become teachers - Families (2): Innovations, Teacher influence]

A: With learners assisting one another? [Q: learners assisting one another, assisting and a sense of development of learners who does that assisting] with Khanyo Bavuma, he was a top learner in a group, Or I would rather say the hardest worker in a group, and because he is the hardest worker he attains certain marks etc And I noticed something very interesting, I think we were busy with Calculus at the time, calculus tend to be a subject where you get a few who you carry forward, but then you have a tail of learners who are totally lost in Calculaus, And they tyend to drag behind, I know there was one lesson where I had to stop the lesson, and reteach certain topics, to individuals etc. And at that point Khanya went forward and he explained to thelearners in their own Lnaguage, Xhosa. Because he saw the gap being created of some learners who understand the work and some learners totally totally lost. And he went he went even the bell rang and it was interval, and he was directing them in xhosa there. I could understand because he was writing the notes down, And, he would basically transcribed what I told them in class and explain it in xhosa, I could see even the slowest learners, the learners who did not understand initially they started to smile, they started to understand. So there was another vantage point over there, that I picked up. Sometimes it might not be the topic per sa, but the language of instruction. Sometimes I find that Calculus, if you can get. I mean it wasn't done ... it was done voluntary in his case. I didn't ask him. I did not direct him. I just saw. [ Q: so he just realized that there was a need. ] Ja, I think he identified that need. They spolke... I heard them speaking here, they speak to one another, they speak in their own language. Isixhosa and that, ... Somehow I picked up that the slower learners, they were struggling with a certain concept, I think it was the tangent concept. The tangent point concept, etc. nd he started explaining it in

their own language. And then they got it. They got it and he ... then after that I asked him if he was prepared to do this with them and he said yes, ... Khanyo,

**P 1: Teacher 1 interview.docx - 1:23 [I out to them that this questi..] (63:63) (Super)**

Codes: [students become teachers - Families (2): Innovations, Teacher influence]

I out to them that this question will be tested in the following way. The following manner. They must get used to the wording of certain questions, That is my tale on things and that. But then the understanding of it can also be brought about to their own language, sometimes I will motivate them, go to that person. Go to .. or Shuab, I will always connect him to Sherwin. Because although I can explain to Sherwin in textbook language, Sherwin, might explain to them in their slang. The language that they speak outside. SOMETIMES mixed Afrikaans and Mixed English, etc. And I find that certain times you have to drop to that level, where they can get it better. Unfortunately I can't I can't do that and speak like they would speak. You see, but they find it more comfortable to speak in that sort of language to bring things across to each other.

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**Code: test students on intake {4-0}**

**P 1: Teacher 1 interview.docx - 1:46 [hey know that eventually it pr..] (100:100) (Super)**

Codes: [test students on intake - Families (3): Beyond school Mission, Innovations, Leadership role]

they know that eventually it produces a better student. But now, what they are not saying is that, they have a pre-selection. They have a gate that preselect the learner. On the grounds of their abilities. So they can expose their learners to higher order questioning etc. Where-as other schools, the majority of the schools, in the Western Cape do not have the luxury of preselecting learners. I have been involved with the pre-selecting of learners, for four years at Spine, and where we came up with a gate. We set out and we had our own gate in grade 8, ... and we set up a test, I set it up personally.

**P 1: Teacher 1 interview.docx - 1:47 [It was multiple choice etc. An..] (100:100) (Super)**

Codes: [test students on intake - Families (3): Beyond school Mission, Innovations, Leadership role]

It was multiple choice etc. And we could clearly gauge from there. It gives you a lot. Because we had learners from all over the Western Cape, to that selection test. We had at times, last year we had about 800 learners, and within four years we had 1500 learners. Because the parents also bought into the idea. I want to send my child to a school, where there is a clear gauge as to depth of understanding. Not the amount of work that they cover, but the depth of real understanding. Of mathematics understanding. And clear buy in from the parents' side. And also for teachers, for schools, etc, then for that few years, And then I knew what (School X and School Y) and those places (historically high performing schools in Mathematics) was about, you see. You can actually see the distinction, the clear difference between, what certain "good school" are doing and what the schools, the schools that's left behind, what they are forced to do...

**P 1: Teacher 1 interview.docx - 1:48 [A: Ja, Ja. In the so-calle nor..] (103:103) (Super)**

Codes: [test students on intake - Families (3): Beyond school Mission, Innovations, Leadership role]

A: Ja, Ja. In the so-called normal set-up, I am not referring to the pre-selection schools, where they can engineer or someone is guaranteed, ... Some schools can guaranteed that your child will get a 60% or a 80% in the school. Guaranteed provided you pay me this amount extra, of fees etc. If you go to our normal schools, which is the majority of learners, yes we will have percentage of GEMs in them also, and some learners don't know that they are Gems. So we have a percentage of natural thinkers out there, but they need to be idfentified, they need to be told. They need to be motivated to say that they are. You can, you see. And then we have our learners who have the potential, but they are lazy. So basically management must have the structure, so we shold set-up a structure where we identify number 1 our possible GEMs, right, yes we can go to past, report cards, primary schools etc.

**P 1: Teacher 1 interview.docx - 1:49 [A: No, I wouln't say engineeri..] (104:104) (Super)**

Codes: [test students on intake - Families (3): Beyond school Mission, Innovations, Leadership role]

A: No, I wouln't say engineering results, rather say [Q: I use that in inverted commas]. I would rather opt for a type of soul searching in a sense. We have the majority of the group, And in

many instances, schools are judged by their community that they serve. They are judged by the ... ja, especially by the community that they serve.

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**Appendix 13: School Mathematics Strategy****Mathematics Strategy****Grade 8 – 12 Mathematics**

**Grade 12 external (benchmarked) Goals:** The *Grade 10-12 Mathematics* program has the following objective:

- Ensure Grade 12 Mathematics students all (100%) pass Mathematics at the end of 2014 – Senior Certificate Examination.
- Ensure 80% of Mathematics students' marks are above 50% in order for them to achieve bachelor passes and also qualify to go to the Universities of their choice.
- The average, pass **mark** for Mathematics to be in excess of 40%.
- The bottom 5 students have more than 40%.
- Grade 10 and 11 internal examinations are about increasing the number of students doing Mathematics (not Mathematical Literacy) closer to 60%.

**Grade 9 external (benchmarked) Goals:** The *grade 8 and 9 Mathematics* program has the following objective:

- Ensure 60% (2013 results was 48%) of Grade 9 Mathematics students pass (i.e. pass % is 50%). Mathematics in the 2014 Annual National Assessment Examination (written in September 2014),
- Ensure 60% (2013 result was 38%) of Grade 9 Mathematics students pass Mathematics in the 2014 Systemic test (written in October 2014).
- Ensure 100% of grade 9s are ready to take Mathematics (instead of Mathematical literacy) as a subject at the school.
- 

**Rationale:**

In order to achieve such a multi-leveled goal we decided to put together a program for 2014 that would really allow us to have multiple approaches. We also realize that it is very easy to just fall into a remedial mind-set if you remediate the entire school. The multi-leveled

program should allow for remediation, maintenance as well as extension. Furthermore it is also important for us to create a level of tension within the school, a tension within the child and a tension within the teachers to ensure they sustain the program to the end (in 2013 the Anas written in September 2013 (results 48%) dropped by 10% in the systemic test (only 38% passed). Mathematics results in Grade 12 also dropped slightly from September to final examination, where one would expect the students to become more focused and improve. This strategy should definitely create a need within the children, i.e. a “tension” for success.

**Challenges for grade 12s – however the same for the entire school:**

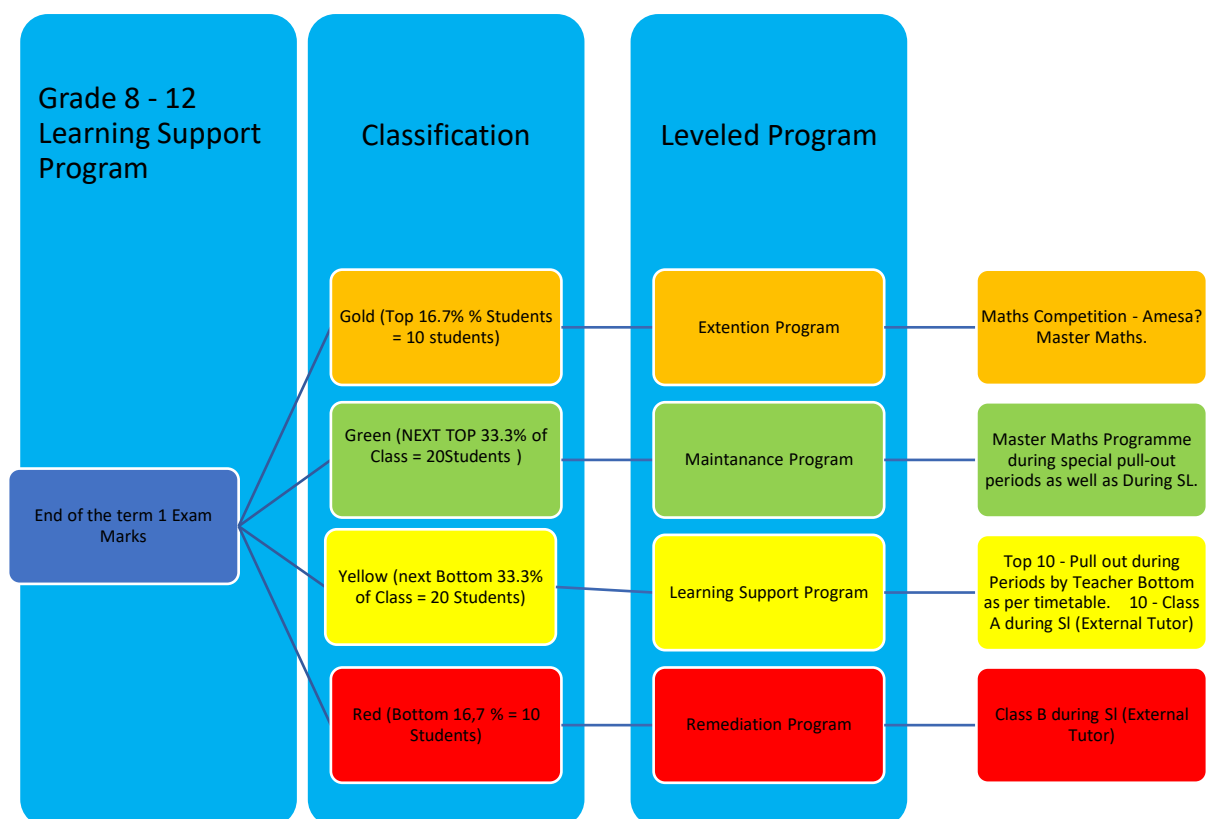
- CHSA has 18/44 grade 12 students who do not have study capacity at home. A social worker’s home visit report is available with photographic evidence to justify this statistic.
- The other 26/44 students might have an obvious study “capacity” at home, however CHSA students tend to drop their guard and tension over weekend examination sessions, i.e. on Mondays. This is also according to the photographs and discussions with the school teacher and students themselves.
- Many CHSA parents have no sensitivity or experience in dealing with students doing Mathematics where the students are required to spend some time honing some valuable Mathematical skills, hence the facility at home might seem in order but the students are not given a fair chance to do well and really translate what they’ve been taught at school into something they can learn to love at home.
- The 2013 remedial program did not give children the opportunity to really get into “the meat” of the subject. The program was run over Saturdays, when so many of our CHSA children (especially girls) had chores, necessary casual jobs and babysitting duties to attend to.
- As a charity the CHSA students are not generally seeing school activity (or their Mathematics) as a primary need. Mathematics can suffer tremendously in this environment.

**Opportunities:**

- Remedial Program – Normally took place on Saturdays, because of the funding agreement with a sponsor. Fortunately this restriction was lifted, allowing for far greater freedom for the program to now also be operating on any day.
- The extra-mural (Student Life time) period of one hour ( – three days in the week.
- The additional time, i.e. approximately 5 Hours a week more than what WCED prescribes.
- Principal made a request to Master Maths who then donated 30 licenses to the value of R90000 for the school’s use. A huge concern even with Master maths is that student profiles were very unstable – a huge problem, which also took place in 2013.
- In 2013 the school used the Siyavula (everythingmath.com) program which was really not well supported by Siyavula themselves, as the students’ profiles on the computer system were very unstable.

### **Mathematics - Learning Support Program:**

Christel House program runs over four levels:



### **Remediation and Extension program Timetable:**

1. Period 6 and 7 – three days a week allow our students to get 6 Hours of Mathematics remediation.

**2. Grade 12 Learning Support - Timetable**

<b>Grade 12 Remedial and Learning Support Program</b>							
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
30 minute Am – Test Period	Maths test (Gr 8 – 12)	Maths test (Gr 8 – 12)	Maths test (Gr 8 – 12)	Maths test (Gr 8 – 12)	Maths test (Gr 8 – 12)		
Period 1	Eng Gr 2	Eng Gr 2	Eng Gr 2	Eng Gr 2	Eng Gr 2		
Period 2	Normal School Periods - Full-on Always Working					4 Hours Consumer Studies / Business Studies / Eng Gr 3/	The weekend Prior to Maths Paper 2
Period 3							
Period 4							
Period 5							
Period 6							
Period 7	Normal School Periods - Full-on Always Working	Maths 1/ Math Lit 1 / Eng Group 1	Maths 1/ Math Lit 1 / Eng Group 1	Maths 1/ Math Lit 1 / Eng Group 1	Normal School Periods - Full-on Always Working	The weekend Prior to Maths Paper 2 and Physics Paper 2	

Student Life	Early	Phys 1/	Phys 1/	Phys 1/	Early Dismissal		
	Dismissal	EGD 1 /	EGD 1 /	EGD 1 /			
		Ls 1	Ls 1	Ls 1			

### 3. Staffing During Maths – Learning Support, Periods:

Group	Description	Staffing	Internal / External
Red Group	Students who achieved under 30% in the last examination.	Mr Faizel	External tutor
Yellow Group	Students who Achieved 31 – 49% in the last examination.	Mr Rushdeen Singlee	Internal tutor – the teacher of the students.
Green Group	Students who achieved 50-60 %	Computer Lab – individualized	Teacher ensuring the students sit on
Gold Group	Students who achieved 61 – 100%	teaching.	Master maths program

4. **Winter School and summer school 10 Days (9 – 13h00).** This program allows the teacher to be in contact with the students after a full-on June 2014 examination and also ensures that the children are immediately given feedback on their Mathematics examination. Students can almost go home and rewrite the examination again after this week-long session.
5. **Weekend Mathematics Camp.** CHSA children do not optimize their weekends, especially when they write the second paper in Mathematics (this is the most difficult paper in Mathematics). At the stage when this paper is also written, exam fatigue steps in

and we get an almost mediocre mark from the children. It is for this reason that we take the children on a Camp following the following program:

### **Friday**

*The Friday Evening – Students are expected to prepare for the first 6*

*Questions!*

### **Saturday**

08h00 – 08h30	Pick-up
09h00 – 09h30	Arrival at Chrysalis
09h30 – 10h30	Accommodation
10h30 – 11h00	Test 1 (1 & 2)
11:00 – 13h00	Revision and Tutoring Session 1
13h00 – 14h00	Lunch
14h00-14h30	Test 3 (3 & 4)
14h30 – 16h00	Revision and Tutoring Session 3
16h00 – 16h15	Short Break
16h15 – 16h45	Test 3 (5 & 6)
16h45 – 18h00	Revision and Tutoring Session 3
18h00-20h00	Supper
20h00 – 24h00	Individual Study Session. Teacher available for one-on-one consultation and also help students who get stuck.

### **Sunday**

07:00	Wake-up Call!
08:00 – 08:30	Breakfast
8h30 – 10h00	Wrap-up (Question 7, 8, 9 & 10)
11:00	Students on their way home!

13h00 – 24:00            Students are expected to now put their final touches to their preparations.

**Monday**

08h00-10h30            We make the Mathematics teacher available to meet with the mathematics students – until they write at 11h00

11h00-14h00            Students write Mathematics paper 2.

**Appendix 14:** Transcribed data of pilot school student focus group discussions

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HU: New Hermeneutic Unit

File: No file

Edited by: Super

Date/Time: 2014-10-21 15:06:45

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**P 1: Discussion Group focus school.docx - 1:1 [I: So you went over the time? ..] (64:65)**

**(Super)**

**Codes:[Cultural Tension]**

I: So you went over the time? So the school gave you a basic time that you needed to sit with your Maths for at least two hours per day, and you went over the time?

**P 1: Discussion Group focus school.docx - 1:2 [S4: Yes sir. You see, I wasn't..] (59:62)**

**(Super)**

Codes: [Centrifugal Momentum]

S4: Yes sir. You see, I wasn't really a good Mathematics student. At all sir. Uhm, I never really liked maths sir. I found it tough, and draining. Sir. But, once the school gave me more chance to like do Maths, uhm, I started to enjoy it, sir.

S9: I found it tough but, its just practicing till you get it. The more I practiced the more it becomes easy.

S2: There was a lot of times when I was frustrated, because I could not like get the solution. I tried like hard. I didn't want to like put the book down, because it was challenging. And it bothered me and I thought about it the whole time. And every time I went back to the book. I tried, it the whole time. This was at home, because I could not ask the teachers. And I tried, tried tried. And then something clicked and I got it. I found like a way to get to the solution. And when I came back to school, it was right.

S5: I also want to know. Yes, sir like we want to now know how you do it. We don't just want to ok this some is very hard I am going to leave it for the best people. You now also want to



know how to get there. So you try harder and harder harder and harder. If it means to go to the back of the book. And see what the answer is, and try it for yourself, until you get to that answer. You do it like that every time?

**P 1: Discussion Group focus school.docx - 1:3 [S9: Yor it was like, countless..] (56:57)**

**(Super)**

Codes: [Multiplier Tension]

S9: Yor it was like, countless hours of studying. 2 hours a day, was ... for me it was a lot. But I still had to do more, I don't think like two hours is enough. So I did more.

S5: Well, the program, (scratching her head), it really uhm, tries to like bring out the best in us.

It tries to create Maths students. Mathematicians and all things. And, we really, really, really did not take it well at first, but now that we like getting used to it we much more happier with it.

Even though, we did not like it at all. Like as for me when I started with two hours, I really really got tired. And I would be like, "no man, I can't do this. I don't want to do it anymore. But then the next day I would do it, I would do it again and again, and again, and then I got used to it. And now I really, .. I was happy with 50%. But now that I've done this Maths, I want something more. I want something really higher than that. (I: ok, ok, ok) Ja.

**P 1: Discussion Group focus school.docx - 1:4 [S3: When you start working and..] (54:54)**

**(Super)**

Codes: [Student Pull]

S3: When you start working and you like proud to do something new, because the answers are at the back of the book, then you like go to the answers and you say, then you like try to figure out how did the book get to that. Then you go check everything twice. Then ok, you try multiply? No, divide? Maybe. And then, you get your answer.

**P 1: Discussion Group focus school.docx - 1:5 [S6: Mr Ives (the teacher) was ..] (52:52)**

**(Super)**

Codes: [Teacher Pull]

S6: Mr Ives (the teacher) was like writing something on the board, And I was like: "Sir why is it like that?" And he would tell me why it is like that. And I am like "why sir, why?" All the time.

And he said: “Thando can you stop with your, “why””. I want something more. That, All the time.

**P 1: Discussion Group focus school.docx - 1:6 [S4: Yes sir. You see, I wasn't..] (13:13)**

**(Super)**

Codes: [Multiplier Tension]

S4: Yes sir. You see, I wasn't really a good Mathematics student. At all sir. Uhm, I never really liked maths sir. I found it tough, and draining. Sir. But, once the school, gave me more chance to like do Maths, uhm, I started to enjoy it, sir.

**P 1: Discussion Group focus school.docx - 1:7 [S3: Sir in my entire life, I've..] (15:15)**

**(Super)**

Codes: [Student Pull]

S3: Sir in my entire life, I've never, ever studied for Mathematics. Or any other subject. Because normally I just know what to do. But now it is like, a lot of stuff that they put into your brain, sir. Its like, ... but what .. its like (showing hand movement which indicates up), like pushed me up, sir. Its easier to understand now.

**P 1: Discussion Group focus school.docx - 1:8 [S3: When you start working and..] (17:17)**

**(Super)**

Codes: [Multiplier Tension]

S3: When you start working and you like proud to do something new, because the answers are at the back of the book, then you like go to the answers and you say, then you like try to figure out how did the book get to that. Then you go check everything twice. Then ok, you try multiply? No, divide? Maybe. And then, you get your answer.

**P 1: Discussion Group focus school.docx - 1:9 [S9: I found it tough but, its ..] (19:19)**

**(Super)**

Codes: [Student Pull]

S9: I found it tough but, its just practicing till you get it. The more I practiced the more it becomes easy.

**P 1: Discussion Group focus school.docx - 1:10 [S9: Yor it was like, countless..] (21:21)**

**(Super)**

Codes: [Multiplier Tension]

S9: Yor it was like, countless hours of studying. 2 hours a day, was ... for me it was a lot. But I still had to do more, I don't think like two hours is enough. So I did more.

**P 1: Discussion Group focus school.docx - 1:11 [S9: I think it was the Saturda..] (23:23)**

**(Super)**

Codes: [Centrifugal Momentum]

S9: I think it was the Saturday (a few weeks ago) ... no it was in the week – I think it was on Monday. So I came home and sat with my books. I did my chores but then I sat with my books ... I think it was for until about 10 O'clock. (I: So ho many hours was that?) Yor, I don't know but it was long. (I: You just did not put the time down?) Ok. Lets go back, where did we stop? Mr Keeno, you muist have a story to tell as well? Is saw a level of excitement in you. Do you want to tell your story?

**P 1: Discussion Group focus school.docx - 1:12 [S2: The last month, it was ver..] (26:26)**

**(Super)**

Codes: [Multiplier Tension]

S2: The last month, it was very difficult. At first, like when you introduced the programme we ll took it ligtly, and I did not realize how important it was until I got close to the end when we all started to get low marks for the morning tests, where I also got low marks. I admit I did not take it too seriously. And then like later in the programme, I realized that it is Maths and it is important and I pulled up my socks and I worked hard and I started to achieve high marks

**P 1: Discussion Group focus school.docx - 1:13 [S1: Sir it was not very easy t..] (27:29)**

**(Super)**

Codes: [Multiplier Tension]

S1: Sir it was not very easy to study for Maths because, you my may be going through 30 minutes, then yuou look at the time, then you say "O my gosh have I only been sitting for 30 minutes?" And then you know you still have an hour and a half to go. So at first it wasn't easy, but as it went on I like "O, the two hours is already over." Then you wouldn't believe that two hours is already passed, like that. (I: So you got used to it, sitting like that with Mathematics?) yes, when someone speaks Maths to you, my brain would tense up, and wouldn't be able to

think, but now when they say we writing a test, I say: “lets go. (I: you are accepting it?) Yes, I do.

I: And do you feel you are a better Maths student now, than what you used to be?

S1: Yes! Sir. I am because, I have never gotten 70 something percent for Maths. Like in all my studying years. (I: Since you started schooling?) Yes! (Shaking her head with pride – affirmatively).

**P 1: Discussion Group focus school.docx - 1:14 [2: Sir do you want me to expla..] (33:33)**

**(Super)**

Codes: [Cultural Tension]

S2: Sir do you want me to explain the programme, the Math programme in detail? (I: Yes? Tell me) k the programme that our principal set up for us, was like, it first started with every morning for a half and hour we do a test. That test was really hard, because it was like new stuff we were exposed to. (: New types of questions?) Yes, new types of questions. More difficult, like hard. And then later in the program, we started doing afternoon tests. And then like the principal called some tutors, for the benefit of the students. And I think we like we did well with it. They made us understand because, it wasn't like a big class. It was smaller sections of children. And later in the programme, closer to the ANAs, we did like a whole day maths. Like a full school day. Where we like a section was taken out, a section was taken out where we had to understand each question. And then we did a test at the end of the day. A Big test.

**P 1: Discussion Group focus school.docx - 1:15 [S2: There was a lot of times w..] (35:35)**

**(Super)**

Codes: [Multiplier Tension] [S2: There was a lot of times w..]

S2: There was a lot of times when I was frustrated, because I could not like get the solution. I tried like hard. I didn't want to like put the book down, because it was challenging. And it bothered me and I thought about it the whole time. And every time I went back to the book. I tried, it the whole time. This was at home, because I could not ask the teachers. And I tried, tried tried. And then something clicked and I got it. I found like a way to get to the solution. And when I came back to school, it was right.

**P 1: Discussion Group focus school.docx - 1:16 [S5: I also want to know. Yes, ..] (38:38)****(Super)**

Codes: [Multiplier Tension]

S5: I also want to know. Yes, sir like we want to now know how you do it. We don't just want to ok this some is very hard I am going to leave it for the best people. You now also want to know how to get there. So you try harder and harder harder and harder. If it means to go to the back of the book. And see what the answer is, and try it for yourself, until you get to that answer. You do it like that every time. (15:35) (I: So you had an attitudinal change? Because of what you've gone through. Ok)

**P 1: Discussion Group focus school.docx - 1:17 [S6: I've actually asked myself..] (40:40)****(Super)**

Codes: [Centrifugal Momentum]

S6: I've actually asked myself now, what are the possibilities of me now becoming a Mathematician? And I am like, I want to become that. But no, that is too hard. But I love Maths. To say that I love Maths and I want to become an archeologist. And I am also considering to be a Mathematician. I love maths,

**P 1: Discussion Group focus school.docx - 1:18 [S9: Firstly I hated Maths and ..] (50:50)****(Super)**

Codes: [Multiplier Tension]

S9: Firstly I hated Maths and I wanted to give up. (I: You wanted to give up on Maths?) Yes. It was just too much for me. But then now I realized that if I don't do Maths, I can't go to University. I tell myself: "You gonna work hard and get your 70% for Mathematcis. And it comes with working hard.

**Appendix 15:** Transcribed data of focus school's semi-structured interview

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HU: New Hermeneutic Unit

File: No file

Edited by: Super

Date/Time: 2014-10-21 14:40:07

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**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:1 [A: I can also gauge that this ..]**

**(10:10) (Super)**

Codes: [Teacher pull]

A: I can also gauge that this test, is difficult. Next time I wil make it easier. I also learn now strategy in a sense. I learnt a lot. Because I see things in the testing. That will also lead to them moving forward. Like the one thing that i've implemented, I've put in almost like a step, in the test, where I can make sure that all of them, ...

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:2 [A: What I found was taht the p..]**

**(11:12) (Super)**

Codes: [Student's Pull]

A: What I found was taht the pupils are very proud of the award .. that yellow award. the principal .. yoh. They come in and they stand in front of me. I can see it in there face. I can see it in there eyes. They are proud, proud, proud.

You know the nice part of this, you addressed it. The immediate feedback to studnts. They come into the room. And they stand in the door. Sir do you have the marks? They need that.

You know, that sense of confirmation. The immediate feedback is important for confidence, for discipline in a sense. He'l feel now I scored 100%, in retrospect. What did i do last night? Then he would say, I didn't watch tv last night. I put my phone down. I disciplined myself with my work. And I worked through a certain graph, etc.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:3 [A: "The interval classes are f..]**

**(14:14) (Super)**

Codes: [Multiplier tension]

A: “The interval classes are fuller. And also that autonomy is growing in a sense that usually they would come to me, ... I told them i am just a person, if there is a big stone in your road in your journey, yu call me and I will .. but then after that, you journey on your own. And like ... Lorenzo, he just gets in here. Greets. Goes in the corner there and works. When he is done, he packs up, greets, and goes out. There was a time now, where, ... if I have to count the number of times I have to assist him, I would count it on one hand. And he would stop me, sir that is enough. I can. The other girl also, Sandlana, she also. They at that point also, ... Initially when they came for assistance, you had to show everything to them. But now they are at that point where they will tell you. Don’t show me the full thing. ...

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:4 [A: Certain systems have been p..]  
(15:16) (Super)**

Codes: [Centrifugal Momentum]

A: Certain systems have been put in place, like our testings. This is driven, you can see it is driven. And learners are excited about it. I have learners in grade 11 that never ever spoke in class. Like Avile, she would sit there quietly in the corner. But the change in her that i see. She is confident. She came to me like in the last two weeks. She actually speaks to me, now. She actually speaks about mathematics. This is a girl that never ever spoke about mathematics.

Her friend Sive also. Not very, uhm. She is not excellent in Maths. But they will manage to pass. I can see that confidence when they get that speed test. A quick test. They see taht semblance of success. Some of them are now also getting 70%, 80%.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:5 [A: We will reach it sooner tha..]  
(17:17) (Super)**

Codes: [Cultural Tension]

A: We will reach it sooner than late. You know that Ethos. If they start believing that we have it then

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:6 [A: Mr Fortune, I believe that ..]  
(3:3) (Super)**

Codes: [Multiplier tension]

A: Mr Fortune, I believe that uhm, quality is the end product not a by product of commitment by learners, commitment by schools and basically we get a merging a merging point between the principal, teacher and learners, the end product of all of that is “quality”. The principal, teacher and learners. The end product of all of that is quality. Tangible quality. One example of tangible quality is a a result that will speak for itself.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:7 [If you turn back and look at t..]**

**(3:3) (Super)**

Codes: [Centrifugal Momentum]

If you turn back and look at the starting point of all that, there is lots and lots of hard work in all that. And uhm it needs to come from a leadership position. It must be sold in that manner. To teachers, students and fellow teachers and all of that. Everyone, must be certain that this comes from the leadership. Because I believe leadership is the driving force in any educational venture.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:8 [In a subject for that matter. ..]**

**(3:3) (Super)**

Codes: [Multiplier tension]

In a subject for that matter. Because ultimately if the drive is there, there is a buy-in from teachers and even from parents, children students etc. And we have to acknowledge that uhm, 100% of learners don't work as hard, and most learners can't define, the reason for doing what they are doing.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:9 [Many of them they study becaus..]**

**(3:3) (Super)**

Codes: [Multiplier tension]

Many of them they study because they get an exam timetable. They study because the teachers make a fuss of it. To study etc. but I find that many learners just go through the motions. I find that many learners at school exams for them is waiting on a timetable. If I get my timetable, and a very good thing for them is, if I get my guideline the teacher must give me a framework, I must study this this and that. Then they are basically uhm, switched on. Now I have to study, etc. But uhm, in many cases that is where learners, miss the boat, in a sense, because they feel it



is a short term venture, and when the exam date is done and the hour is done, then they get their study is done.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:10 [But for me building quality is..]**

**(3:3) (Super)**

Codes: [Centrifugal Momentum]

But for me building quality is a long term thing. Long term is the learner showing that quality (4:35). On a daily basis, not only just at school, but also at home. It needs to go over into their behaviour

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:11 [Provided that the community se..] (3:3) (Super)**

Codes: [Cultural Tension]

Provided that the community see that it is structured, and guided by leadership. In other words it is like they are pulling their part. And uhm, we are pulling these learners to a point where we can say at release the strings etc, and you move. You move autonomous. Uhm, that would be a defining point in quality for me.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:12 [Yes, I can clearly see there i..]**

**(5:5) (Super)**

Codes: [Cultural Tension]

Yes, I can clearly see there is a vehicle of change in the school. There is a model that has been presented to our learners to our teachers also. A model that we are prepared to support them, the learners also know that it comes from management, that it comes from the top. And that is important. I always tell them that uhm, for me in an institution like this, the leader is important. The leader is important. The leader must give learner and teachers that motivation, motivation to follow where he leads. In a sense. And that trust that this person will take us to that point. And and and also there is ... and that point of success need to be defined.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:13 [And and and also there is ... an..]**

**(5:5) (Super)**

Codes: [Cultural Tension]

And and and also there is ... and that point of success need to be defined. It needs to be defined short-term and it needs to be defined long term. Like short term aim is like you always say 100%. That is a short term aim. And I believe that as teachers we are moving towards that. Learners are given this opportunity it is a vehicle of change. The support is there and I can feel ... I always ask them, just one question, I just want a response from them, like I asked taariq now, Does it help you, the weeks of studying, did it help you? They said surely, but they get home sick. That surely for me, is important. Uhm, I want to see whether they also recognise that vehicle was given to them. To move towards success etc.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:14 [And also very importantly that..]**

**(5:5) (Super)**

Codes: [Multiplier tension]

And also very importantly that they offer reciprocation. I believe learners and even teachers are like that, If they know our end point is success, our endpoint is 100%. Is there buy-in and certain system has been put in place then it is driven. You can see it is driven for them. And learners are excited about it. I have learners in grade 11 that never even spoke in class, like Avile, sitting still in the corner. But the change in her, that I have seen, she is confident. She came to me in the last two weeks and she actually speaks to me, now. She actually speaks about mathematics. This is a girl that never ever spoke about mathematics. She would sit there quietly uh trying to get her 40% etc. She is not weak, she is weak, but he needs more time, that push that shove uh, learners like that. Her friend Sive also. Uhm, not very uhm, they not excellent in Maths but they would manage to pass. I can see that confidence at times when they get that speed test or quick test.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:15 [Next time I'll make it easier ..]**

**(5:5) (Super)**

Codes: [Teacher pull]

Next time I'll make it easier but I will also I will work on a strategy. I am also learning strategy in a sense, ... I learn a lot, beasue I see sense in these testing. That will also leave to them moving forward. The one thing that I've implemented is that I put in a ... almost like a step, where I can assure that all of them get 30%, all of them will get 60%, etc. It is like giving the same question for one week and changing the letters around.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:16 [They see the semblance of succ..]**

**(5:5) (Super)**

Codes: [Student's Pull]

They see the semblance of success sometimes it is 70%, 80%. Then I can also gauge and see that ok, this test, was difficult

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:17 [, a culture inherent to a cert..]**

**(7:7) (Super)**

Codes: [Cultural Tension]

, a culture inherent to a certain school. Like uhm, certain schools have that. Like the school where I come from they selected a colour, now everyone in that area who see that colour they know that is the school. They have different names for what the colour represents. Some call it the red army. With the notion that we fighting a war. A war against gangsterism or poverty, It can be a move into a success.

**P 1: Semi\_structured\_interview\_pilot\_school.docx - 1:18 [It is that idea that it belong..]**

**(8:8) (Super)**

Codes: [Cultural Tension]

It is that idea that it belongs to the school only. And out there the community will be aware of that. It is something that makes the learner proud. To be part of that ethos to be part of that school.