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Dealing with Mixed Abilities in Standard Grade Mathematics Classes in South Africa

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ABSTRACT

This thesis reports an exploratory study of factors that influence schools to offer mathematics only at standard grade level and dealing with mixed ability grouping in classrooms. Case studies were conducted at two senior secondary schools in rural areas. The sample comprised 18 learners, 5 teachers, 2 principals and a deputy who were interviewed. A snapshot of 3 classroom observations and school records analysis was also done.

The aim of the study was not to provide a representative picture, but more in-depth analysis. The results indicated that schools might have problems in dealing with mixed ability groups. One of the factors for choosing SG mathematics was related to teachers' qualifications. Possible explanations and implications for new curriculum implementation are discussed.

CHAPTER 1

About this study

This chapter introduces the study on how senior secondary schools in North West Province (NWP) in South Africa offering only standard grade (SG) mathematics deal with individual differences between learners, particularly learners with mixed abilities in mathematics. The background to the study is dealt with in 1.1, the aim and significance of the study in 1.2, and the research approach in 1, 3. Finally section 1.4 outlines the subsequent chapters.

1.1 Context description

Education and training under apartheid were characterized by the underdevelopment of human potential, particularly that of blacks. Vast disparities existed between blacks and whites in accessing educational opportunities. The extent of exclusion was much greater in learning and teaching of mathematics and science (National Education, 2001).

The Reconstruction and Development Programme (RDP) of the first democratic government identified the country's human resources as key and central to the growth and reconstruction of society. President Thabo Mbeki, in his State of the Nation address during the opening of Parliament in 2000 and 2001, emphasized the centrality of mathematics and science as part of our human development strategy.

The ability of all learners to succeed in today's technically oriented work environment is increasingly dependent on their understanding of mathematics and computational sciences and their application in practical situations. In fact, these sciences have become essential for all learners, including those preparing to become technicians, engineers, educators, leaders in business and government, and more generally, for developing scientifically, mathematically and technologically literate citizens

The TIMSS 1995 and 1999 studies show that achievement in mathematics and science in South Africa is below international average and lags considerably behind most countries. It is against this background that in the year 2000 the South African National Department of Education introduced a National Strategy for Mathematics, Science and Technology Education (now called DINALEDI project). The North West Department of Education (NW DoE) responded to that by establishing a Mathematics, Science and Technology Unit (MSTU) to implement a provincial strategy to improve achievement in mathematics, science and technology at all levels of schooling system, but mainly in general and further education and training (GET and FET), using appropriate curricula, teaching methodologies and learning support materials. In the South African context, GET means grade 1-9 (or primary and junior secondary levels) and FET means grade 10- 12 (or senior secondary level).

Objectives of the strategy are;

(i) To raise participation and performance by historically disadvantaged learners in mathematics, science and technology at all levels of the school system but particularly at the Senior Certificate (grade 12).

(ii) To provide high quality mathematics, science and technology education for all learners throughout their schooling, especially at the level of GET and FET

(iii) To increase and enhance the human resource capacity to deliver mathematics, science and technology education.

Educational reform has been a central part of the country's reconstruction and development in order to overcome the devastation of apartheid. Gradual implementation of the new so-called, curriculum 2005 (C2005) began in 1998 with Grade1.This was followed by Grade 2 in 1999, Grade 3 and 7 in 2000, Grade 4 and 8 in 2001, and was supposed to be followed by Grade 5 and 9 in 2001. Simultaneously, programmes in teacher education and classroom support were implemented. The process was hampered by imperfections in the system and the complexity of changing so many aspects at once, as well as by weaknesses in the documents. A Review Committee was appointed and released its findings in 2001.

Following the criticisms or shortfalls in C2005, a new set of Revised National Curriculum Statements (RNCS) was published in July 2001. The revisions were to simplify structure, redefine the outcomes, and provide more guidance on progression and content. The implementation plan of the new Revised Curriculum Statements (RNCS) was planned to be phased in grade 10,11and 12 in 2004, 2005, and 2006 respectively, but the implementation plan is still to be realised.

Main features of the new revised curriculum statement (RNCS):

- Outcomes-based education: It strives to enable all learners to reach their maximum learning potential. The outcomes encourage a learner-centred and activity-based approach to education.

- Opportunities for all: Education should cater for all learners of different abilities, interests and motivation. FET subjects should, therefore, provide knowledge and skills for all, as well as for expanded opportunities and attainment. This should be done in terms of learner' interests, aptitudes and competencies. However, the current system of Higher, Standard, and Lower Grades should be replaced by new alternative method of providing for knowledge and skills for all, as well as for expanded opportunities and attainment in FET assessment. This implies subjects will be offered at one level leading to mixed ability classes.

- All learners should have access to the same official curricula. However, in terms of actual attainment, there should be different levels of achievement. Learners should, therefore, be exposed to the full spectrum of all subjects they select. This access should be based on the principle of equality of educational opportunities.

- Integration and applied competencies: Integration is achieved within and across subjects and fields. The integration of knowledge and skills across subjects and terrains of practice is crucial for achieving applied competencies.

According to the RNCS mathematics is described as an essential element in the curriculum of any learner who intends to pursue a career in the physical, mathematical, computer, life, earth, space, and environmental sciences or technology. Mathematics also has an important role in economic, management and social sciences. It is an important tool for creating, exploring and expressing theoretical and applied aspects of the sciences. Mathematics is also important for personal development of any learner. Hence every learner emerging from FET level must be mathematically literate, implying mathematics to be compulsory for all learners. Because of the centrality and importance of mathematics viewed by the government, hence this study focused on mathematics.

Currently when learners start the senior secondary school (Grade 10 -12) they can choose to study subjects at higher grade (HG), Standard grade (SG) or lower grade, hence differentiating learners by ability. With the new curriculum, this will no longer be the case once it is finally implemented in 2006.

Phasing out of higher and standard grade in subjects will lead to a combined syllabus and classes of mixed abilities. This means the new syllabus could be an average between the present higher grade and standard grade syllabi. Schools offering SG only have to adjust upwards to the new level, whereas those that have been offering HG will probably lower their standards. In the classroom this will inevitably leads to teaching of mixed ability group.

There is a real concern that even this version of the curriculum will meet mammoth implementation problems because of lack of capacity and rushed time frames, lack of resources and basic facilities with poorly prepared teachers and managers. An estimated 8.000 mathematics and 8.200 science educators nationally (South Africa) need in-service training to address the lack of subject knowledge (National Education, 2001).

Mathematics will be compulsory for all FET learners in the new curriculum, but North-West Province statistics show that most schools currently enrol only learners for SG. From a total of 19604 learners enrolled for mathematics in 2003, only 1813(6%) mathematics at HG and 17791(91%) mathematics at SG.

We can also hypothesise from this data that some schools are offering both SG and HG mathematics, but more learners are enrolled for standard grade and very few for higher grade. There is currently no clear policy at national level or provincial level to guide schools in dealing with ability grouping and schools are given the latitude to make decisions. However, the National Strategy for mathematics, science and technology states that schools are encouraged to enrol more learners at higher grade level.

The majority of schools that offer mathematics and science have a serious problem with regard to facilities such as laboratories, and equipment to promote effective learning and teaching. It is not surprising when the results are so poor. In the North-West province, of the 17791 learners who wrote mathematics SG, 6574(37%) passed, and 1813 who wrote HG, 1309(72%) passed.

Further from the analysis of North-West data, it is striking that almost half of the secondary schools (48%, i.e. 184 out of 384), are only enrolling students in mathematics and at the SG. This further emphasises the problem schools might be facing in dealing with mixed ability teaching in mathematics. Table 1, shows the break down according to the five regions in North West Province.

Table 1.1 Analysis of Matric results 2003. North-West Province (South Africa)

Region	Secondary schools total	Mathematics SG	Percentage %
Bophirima	62	43	69%
Central	105	60	57%
Bojanala west	55	21	38%
Bojanala east	90	36	40%
Southern	72	24	33%
Total	384	184	48%(Average)

Mathematics HG is used as a yard stick for admission at University. SG mathematics is sufficient for technikon or technical college study. The low output of HG has resulted in some Universities introducing foundation programs to target students who have acquired good marks in mathematics at SG.

Mathematics is the key subject in economics and technological advancement. Acceptance at universities is based on a pass in mathematics higher grade. The low output of learners taking HG mathematics has direct implications for teacher training. Teaching in mixed ability classes is also hypothesised as a contributory factor on the poor performance of learners in mathematics.

This low level of output, particularly in mathematics HG, has also direct implications on the capacity of system to produce qualified teachers in mathematics. With recent reforms, teacher education is offered at Universities for all levels of schooling. Hence there are implications for admission of prospective student teachers because of low enrolments in mathematics HG.

1.2 Aim and purpose of the study

Various studies of curriculum implementation in many countries have revealed many potential problems that affected the implementation (Fullan, 2001). The problems result from the way a curriculum is being interpreted, practiced and experienced. The most operational definition of curriculum is that it is a plan for learning (Van den Akker, 2003). This definition puts learning as the central activity. Curricula can also be represented in various forms. Clarification of those forms is especially useful when trying to understand the problematic efforts to change the curriculum. These representations can be elaborated as

- *ideal* curriculum: the original vision underlying a curriculum(basic philosophy, rationale o mission
- the *formal* curriculum: the vision elaborated in a curriculum document (with either a prescribed/obligatory or exemplary/voluntary status)
- the *perceived* curriculum: the curriculum as interpreted by its users(especially teachers)
- the *operational* curriculum: the actual instructional process in the classroom, as guided by representations (also often referred to as the curriculum-in-action or enacted curriculum
- the *experienced* curriculum: the actual learning experiences of the students
- the *learned* curriculum: the resulting outcomes of the students.

The study focused on the four representations, the formal, perceived, operational and experiential curriculum. Most evaluation studies tend to compare the intended and attained curriculum without insight into the perceived and operational curriculum. The questions for example, what do teachers think about the curriculum? How is it put in action in the classroom? How do students experience the curriculum in the classroom are typical questions at the implemented level.

Problems in curriculum change effort manifest themselves in gaps between the intended curriculum (policies), the implemented (real life in school and classroom practices), and the attained curriculum (learner experiences and outcomes). The typical consequence of those tensions is that various frustrated groups of participants blame each other for the failure of reform or improvement activities.

Accordingly the aim of the study is to inform policy makers in NWP about how senior secondary schools deal with differences between learners and learners with mixed abilities in mathematics in the context of implementation of RNCS. Also to provide some suggestions and recommendations to curriculum developers in the North-West Education Department and teachers in relation to the implementation of the new revised curriculum.

Following the discussions presented thus far, the main research question was formulated as follows:

How do senior secondary schools offering only SG mathematics in the North-West Province (NWP) in South Africa deal with individual differences between learners, particularly learners with mixed abilities in mathematics?

The study was guided by the following sub-questions, based on the four curriculum representations:

1. What is the formal school curriculum?
2. What is the perceived curriculum (why only SG mathematics)?
3. What is the operational curriculum?

4. What is the experiential curriculum?

1.4 Research approach

The research approach was a small scale qualitative study, by applying a case study approach. Not intended to provide representative picture, but more in-depth analysis on how a small number of schools deal with differences in learners, particularly mathematics in mixed ability classes.

1.5 Overview of the following chapters

Chapter 2 discusses the context of South Africa, education system and mathematics reforms in South Africa
Chapter 3 will review literature on ability grouping in secondary school, particularly looking at teachers' attitudes and perceptions, school policies and students attitudes and perceptions and finally at attainment with regard to ability grouping
Chapter 4, elaboration on the research methodology followed.
Chapter 5 report of the results of the study
Chapter 6 entail summary of the results, discussions, conclusions and recommendations.

CHAPTER 2

The schooling system in South Africa

This chapter describes the context of the study. It elaborates on country background information in 2.1, the education system in South Africa (2.2), mathematics education in South Africa (2.3), Mathematics reform in Southern Africa (2.4), conclusion (2.5)

2.1 Country background information

South Africa has a vast interior plateau rimmed by rugged hills and a narrow coastal plain. South Africa completely surrounds Lesotho and partly Swaziland. It borders Botswana, Mozambique, Namibia, and Zimbabwe. The climate is mostly semiarid but subtropical along East Coast with sunny days and cool nights.

Following the first democratic elections in 1994, the country's borders were redefined into nine provinces, the Western Cape, Eastern Cape, Northern Cape, Kwazulu Natal, Free State, Gauteng, North-West, Mpumalanga and Limpopo.

South Africa's population is estimated at 43 686 million. There are 11 official languages. North-West Province, where the study is conducted has about 3.4 million people. The human resource development levels in North-West are low, with 22.7% of adult never having received any education. The province has only two universities.

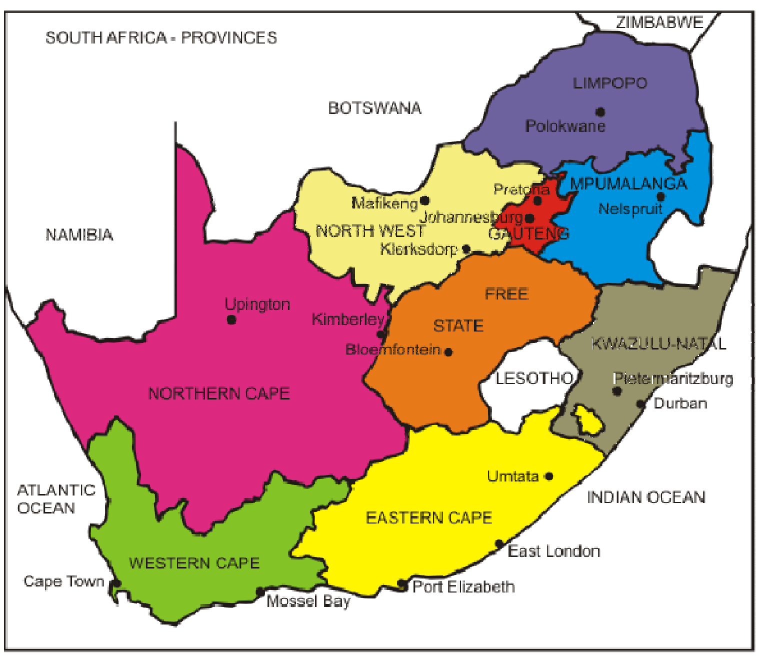

Figure 2.1: South African map showing provinces.

The people of North West Province are predominantly BaTswana in origin and their language is Setswana. They can trace their origins for many centuries through a turbulent history of war and migration across the plains and valleys of the province to the borders of the Kalahari. Other groups touching on the North West are the Ndebele in the east and the Sotho to the south

The North-West is one of the most important food baskets of South Africa. Mining plays a dominant role in the economy of the province, contributing some 55% of its GGP and employing a quarter of the labour force.

2.2 The education system

The central government provides a national framework for school policy, but administrative responsibility lies with the nine provinces, which must decide how to spend their education budgets. Power is further devolved to grassroots level via elected school governing bodies. They have a significant say in the running of their schools, and many now employ their own teachers to improve teacher/pupil ratios and keep class sizes manageable.

Compared with most developing countries, education gets a really big slice of the pie - usually at least 20% of the total budget. Although it sounds like a lot, it never seems to be enough to go around. More money is always needed to address the terrible backlogs left by 40 years of apartheid education, where money was pumped into white education at the expense of black schools in the townships and rural areas.

School life spans 13 years - or grades - although the first year of education, grade 0 or "reception year", and the last three years, grade 10, 11 and grade 12 or "matric" are not compulsory. Many primary schools offer grade 0, although this pre-school year may also be completed at nursery school

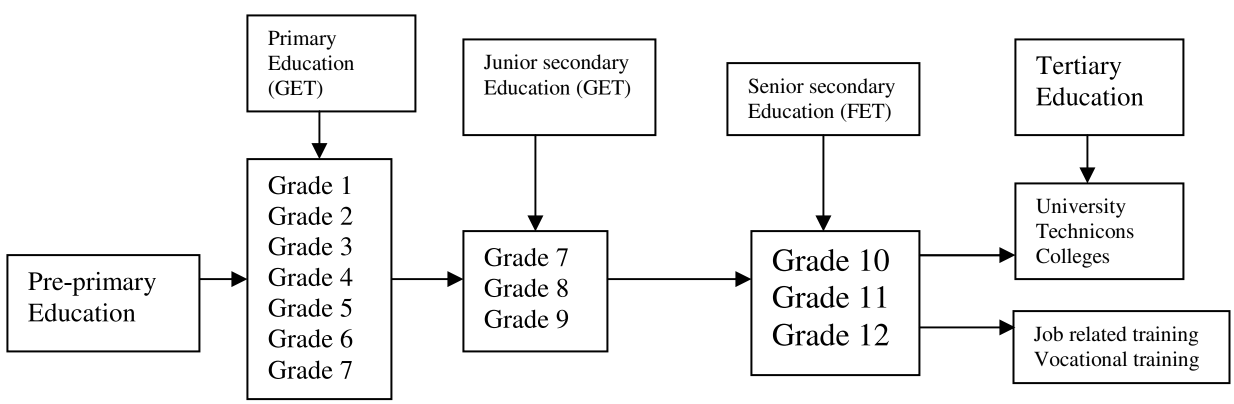

Figure 2.2: Formal Education structure

Pre-primary education which is called reception year in South Africa is at present predominantly offered at early learning centres but gradually it is planned by policymakers to be incorporated into primary school phase. Grade 1-9 constitutes what is called General Education Training (GET) and grade 10–12 is called Further Education Training (FET). From grade 12 learners, depending on their results they can proceed to a university or college.

The education system is characterised by diversity: schools and universities vary greatly in terms of quality, financial resources, ethos and size. Top quality schools and universities are to be found in both the state and the private education sector.

Most schools fall under the auspices of the state, but due to an emphasis on local or community-based governance, and a strong and growing private school, the educational landscape is colourful. Most state schools are state-aided to some extent: the government provides the minimum, and parents contribute to basics and extras in the form of school fees. Fees vary considerably, depending on factors such as class size, facilities and the quality of teaching offered.

The "liberation now, education later" stance taken during the years of the anti-apartheid struggle severely damaged the culture of learning and teaching in schools and universities in black communities. Instead of places of learning, they became sites of protest. Redressing the resource imbalances, rebuilding the educational environment and retraining teachers are a slow and difficult process, but significant inroads have been made.

A considerable number of schools in South Africa suffer serious shortcomings, ranging from poor access to water, telephones and electricity, to poor conditions of many school buildings. Furthermore, few schools have well-equipped libraries and many communities are without community libraries leaving the majority of people with no little access to reading materials. Most basic books are unaffordable for most people and most homes have few books and other reading materials.

2.3 Mathematics education in South Africa

2.3.1 Teaching staff in secondary schools

50% mathematics teachers have no formal qualification in mathematics (Howie, 2001). A study in KwaZulu Natal by Khubeka (1989) revealed that in an area where the matriculation (grade 12) results were low in mathematics, the teachers were not qualified, had no extensive experience teaching mathematics and had to teach two or more subjects as well in addition to mathematics.

Black colleges of education, earlier known as teacher training colleges, were established in accordance with Verwoerd' vision. "What *is the use of teaching Bantu child mathematics when it cannot use it in life? That is absurd*."(Hirson, 1979, p.45) They had an inferior and separate curriculum from their counterparts who belonged to other races. Mathematics teachers in these colleges were mainly white Afrikaners who in most cases were not adequately qualified to teach mathematics in their own schools.

Black academic staff taught vernacular only and the majority were unskilled labourers. Hence, mathematics teacher educators had little understanding of black schools, the lives of teachers and their plight. They had little concern and/or ability to improve mathematics teaching practice as this would undermine the rules and the system of the day.

When political changes took effect in the early nineties, more black teacher trainers were introduced into colleges but the curriculum was still centrally controlled. According to the findings of National Teacher Audit on Teacher Education (1995), the quality of mathematics education in the majority of colleges was such that their graduate teachers were under-prepared to teach mathematics effectively. Hence, the regular high rate of failure for black grade 12 in mathematics.

2.3.2 Mathematics syllabus

The mathematics syllabus in FET is divided into standard grade and higher grade. The syllabus stipulates the content in detail and examinations are also set according to the syllabus. It is divided into distinct topics for example: algebra, differential calculus, trigonometry, Euclidean geometry and analytical geometry with detailed content. The subject policy specifies the breakdown of the final examination paper.

Mathematics HG syllabus as contrasted to mathematics SG is very broad and specify general objectives. In practice some topics are covered meant for HG mathematics only and these might in some instances be the whole chapter. This difference is very striking at grade 11 to grade 12. The examinations are also very distinct for mathematics HG and SG. The main differences are depicted in Table 2.1 below.

Table 2.1 Summary of difference between HG and SG mathematics syllabus grade 11-12

GRADE 11

SG and HG	HG Only
1.ALGEBRA	
1.2 Functions	Absolute value, Inverse of functions
1.3 Quadratic equations	Quadratic equations and inequalities
-----------------------------------	Linear programming
1.4 The remainder and factor theorem	
1.5 Systems or equations	Quadratic equations and inequalities
1.6 Exponents	
2. TRIGONOMETRY	
2.1 Definitions of trig. Functions [0^o;360^o]	For any angle in terms of co-ordinates
2.4 Functions values for 0^o,30^o,45^o and multiples thereof over [0^o ; 360^o]	Without use of calculators
2.5 Identities- reciprocal functions	Mutual relationships between functions
2.6 Formulae- sine rule, cosine rule	
Area of a triangle and application of formulae in two dimensions	Applications of formulae in three dimensions
3. EUCLIDEAN GEOMETRY	
3.1 Theorem of Pythagoras(without proof	
3.2-3.10 Theorems	3.11.1 Bisectors of a triangle and perpendicular bisector of sides of triangle theorems
-------------------------------------	3.11.2 The medians and altitudes of triangle theorems

GRADE 12

SG and HG	HG Only
1. ALGEBRA	
1.1.1 Logarithms- definitions	The power function of $y = a^x$, a>0; its graphs and deductions from graph
1.1.2 The conversion of exponential form to logarithmic form and conversely	The logarithmic function $y = \log_a x$, a>0 and a≠0 , its graph and deductions from graph
1.1.3 Basic laws of logarithms(proofs not required for examinations)	Basic properties of logarithms (with proofs)
1.1.4 Applications of above in the solutions of simple equations example $5^x = 17$; $4.3^{x+2} = 15$	1.4 Simple logarithmic equations and inequalities
	Change of base of a logarithm
1.3 Sequence and series	Convergence of a geometric series and its sum to infinity
2. DIFFERENTIAL CALCULUS	
2.2.2 Determination of limits using first principle of: k, ax, ax + b, ax^2	Determination of ax^3
2.3 $D_x[x^n] = nx^{n-1}$; n real (without proof)	
2.4 Rules of differentiation(without proofs)	With proofs
2.5 Applications	
2.5.1 Turning-points and sketches of polynomials of at most the third degree	The equations of tangents to graphs
2.5.2 Simple practical problems in connection with maxima and minima	
3. TRIGONOMETRY	
	Function values for –θ and (θ+360.n), where n is an integer, expressed in function values for θ, θ € [0° ; 90°]
3.1 The sine, cosine and tangent functions	
3.1.1 Description of the range with the domain within [0° ; 360°]	Description of domain and range
	Maximum and minimum function values and period
3.1.2 Sketches of curves of the following types: y = a sinx, y = a cosx, y = a tanx; y = sinax, y = cosax; (a an integer and ax € [0° ; 360°]	Sketches of the curves of the following types; y = a sinθ, y = a cosθ, y = a tanθ, y = sin aθ, y = cos aθ, y = tan aθ; y = a + sin nθ, y = a + cosθ, y = a + tanθ ; y = sin(α + θ) , y = cos (α + θ); where n is an integer or a fraction of the form 1\n)
3.2 Solving elementary trigonometric equations as stated in 3.1.2	Equations of the type a sinx + b cosx = c with c± 0 excluded)
	3.3 Cos (A-B) = Cos A Cos B + SinA Sin B identities for ; Cos (A + B), Sin (A ± B), Tan (A ± B) , Sin 2θ , Cos 2θ, Tan 2θ
4. EUCLIDEAN GEOMETRY	
4.4 Equiangular triangles theorem	
--	4.5 The perpendicular drawn from the vertex of a right angled triangle to the hypotenuse, …(theorem)
---	4.6 Theorem of Pythagoras and its converse.
5. ANALYTICAL GEOMETRY IN A PLANE	
5.7 Intercepts made by a line on the axes	
5.8 Equations of circle with (0;0) and given radius	Equations of circles with any given centre and given radius
5.9 Points of interaction of lines and circles	
5.10 Other simple loci with respect to straight lines and circles	5.10 Other loci with respect to straight lines and circles
---	5.11 Equations of the tangent to a circle at a given point on the circle

The new mathematics curriculum for FET contained in the so-called RNCS (revised new curriculum statements) does not specify the syllabus in detail but only states four learning outcomes. These are number and number relationships, functions and algebra, space, shape and measurement, data handling and probability. The topic on data handling and probability is new addition into the current syllabus. For each learning outcome an assessment standard, suggested content and context is specified. Assessment standards are criteria that collectively describe what a learner should know and able to demonstrate.

The most important is that it describes the kind of teacher and learner envisaged and the scope covered in mathematics:

"Teacher and other educators are key contributors to the transformation of education in South Africa. The National Curriculum statement Grades 10-12 visualise teachers who are qualified, competent, dedicated and caring. They will be able to fulfil the various roles outlined in the norms and standards for educators. These include being mediators of learning, interpreters and designers of learning programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors, and subject specialists" And

"*The kind of learner… is one who will be imbued with the values and act in the interests of a society based on respect for democracy, equality, human dignity and social justice as promoted in the Constitution…learners emerging from Further Education and Training band must…have access to, and succeed in, lifelong education and training of good quality; demonstrate an ability to think logically and analytically, as well as holistically and laterally; and be able to transfer skills from familiar to unfamiliar solutions*"(RNCS,2003, p.5)

According to the RNCS, learners in FET band who are interested in the subject or who intend to follow a career path requiring mathematics will, while ensuring that they are mathematically literate, work towards being able to;

- competently use mathematical process skills such as making conjectures, providing assertions and modelling situations;
- calculate confidently and competently with and without calculators, and use rational and irrational numbers with understanding;
- competently produce useful equivalents for algebraic expressions, and use such equivalents appropriately and with confidence;
- use mathematics to critically investigate and monitor the financial aspects of personal and community life and political decisions;
- work with a wide range of patterns and transformations (translations, rotations, reflections) of functions and solve related problems;
- describe, represent and analyse shape and space in two and three dimensions using various approaches in geometry (synthetic, analytic transformation) and trigonometry in an interrelated or connected manner;
- collect and use data to establish basic statistical and probability models, solve related problems, and critically consider representations provided or conclusions reached;

- use and understand the principles of differential calculus to determine the rate of change of a range of simple, non-linear functions and solve simple optimisation problems;
- solve problems involving sequences and series in real-life and mathematical situations;
- solve non-routine, unseen problems using mathematical principles and processes;
- investigate historical aspects of the development and use of mathematics in various cultures; and
- use available technology (the minimum being a modern scientific calculator) in calculations and in the development of models.

These statements summarises in general terms the content to be covered by learners in FET. This is very different from the current mathematics syllabus that describes in detail the content to be covered and the year plans to go with it. Also what the examination will look like at the end and areas that needs emphasis on, particularly with regards to the SG mathematics syllabus. The most distinct between the new syllabus and HG mathematics is the new topic, data handling and probability. This topic was not part of any teacher training college syllabus and it will be the major challenge for implementation of the new curriculum.

2.3.3 Mathematics teaching in secondary schools

Mathematics teaching is mostly teacher-centred with an emphasis on lecturing, question and answer exchange, written exercises, notes and tests. Emphasis is on learning memorization and recall rather than on problem solving and creativity. Also students' involvement is minimised. Teachers talk, while students listen, copy notes, answer when called upon and silently work on whole-class assignments. Students rarely ask questions. Teacher questions focus on factual information. Incorrect answers are largely ignored. These practices are largely confirmed by classroom observations. Various explanations are given for this practices as highlighted by, Thijs (1999), Howie (2002) and Motswiri (2004). These include the following:

- Teachers' lack of confidence and mastery of subject matter content and basic teaching skills.
- Lack of material facilities and large class sizes.
- Language problems for both teachers and students.
- Examinations often do not reflect the innovative curricular aims.
- Examinations have a dominant influence on classroom instruction. Teachers often consider examinations success the top priority in teaching, perceive teaching methods as dysfunctional when they are not directly related to the passing of examinations.
- Tension between African culture (traditions, values) and life outside the school environment and culture of inquiry required in the classroom in view of more meaningful teaching. Consequently, a good teacher is perceived to be authoritarian in controlling the class lesson activities.

These practices show that for a learner-centred approach to be effected, the practice and context of teaching would need to be changed and aligned with the intended teaching approaches. The National Audit on Teacher Education (1995), found that not only do college teachers go through the curriculum with sharp divide between theories and practices, but one that is out of step with current international advances in knowledge and methodologies. Teachers seem to lack the knowledge of the approaches that enhances their students' learning.

From an analysis of demand and supply in science and mathematics teacher education in North-West Province done by de Feiter (2004), it is concluded that for teaching at senior secondary level, a 3-year diploma level qualification should be considered insufficient, at least in some academic subjects. The 3 year diploma in the past did in many instances not go beyond matric (grade 12) subject content knowledge, if even that. The content mastery of these teachers may be insufficient to cope with teaching at grade 12 level. The grade 12 results might be reflecting this lack of competencies as depicted from results depicted in Table 2.1 below. Table 2.1 shows that performance in mathematics standard grade is very low at 28% and at higher grade perform at average 48%. Reasons described are some of the contributing factors in North West Province.

Table 2.2: Analysis of North-West Province grade 12 results

Subject description	Average % Pass		Written		Pass written	
	2003	2004	2003	2004	2003	2004
MATHEMATICS SG	28.6	28.2	17791	18969	6574	7142
MATHEMATICS HG	45.7	49.5	1813	1853	1309	1314

Further, there will be a shortfall of 318 mathematics teachers in North-West if mathematics literacy is compulsory for all learners at FET level, according to the new curriculum aspiration to be implemented by 2006. This shortage might also exist in GET level. Therefore, a special in-service teacher education programme will be needed to re-orient serving teachers for teaching in mathematics. But the new curriculum brings new topics unfamiliar for teachers. The extent of this problem needs to be investigated.

2.4 Mathematics reform in secondary education in Southern Africa

In line with developments in the western world, most curriculum innovations in developing countries include a shift from teacher-centred teaching methodology to a more student-centred approach. The prevailing model, whereby teachers talk and students listen and copy notes from the blackboard, should be replaced by activities in which students are actively involved in the learning process. Students must also be engaged in group work, carry out small investigations, and should be generally responsible for their own learning, and that of their fellow students.

Apart from the question whether such new teaching methods are desirable, there is also the question of how much change a teacher, a school or a school system can absorb. In addition to adequately resourced schools, the new teaching methods require well-qualified teachers with a firm grasp on content, pedagogy, and who are able to execute it in the classroom (SMICT report, in press).

However, in developing countries, teachers often teach classes for which they are not qualified. The extent to which these intentions could be realised in various countries will depend on many factors (current situation, time, school conditions, pupils' characteristics, policy measures, external support, and etcetera). The issues raised above all have to do with curriculum.

Many curriculum reform efforts are characterized by overtly big innovation ambitions within unrealistically short timelines and with limited investment in teachers (de Feiter, 1995). Second, there is lack of coherence between the intended curriculum changes with other system components (especially teacher education and assessment/ examinations).The seesaw mode of initiation and implementation of educational reform is related to the changing balance between the power of individuals and other forces. Lastly, timely and authentic involvement of all stakeholders is often neglected.

Science and mathematics are compulsory subjects at junior secondary level in all Sub-Saharan African countries. At senior level mathematics is compulsory in Burkina Faso, Botswana, Ghana, Nigeria, Senegal, and recently South Africa. This policy led to a growing and diverse student population, creating problems of mixed ability teaching in most countries. In South Africa the problem is compounded by the fact that mathematics will be offered at only one level, as stated in the policy.

In most schools, the most qualified teacher is allocated higher grade classes, and less qualified allocated to lower grade classes. Actually this practice is common even in developed countries (Hallam & Ireson, 2001). The consequence of this policy of education for all, led to teachers having to deal with mixed ability in the classes.

Philosophy of education for all features on policy agendas in developing countries as a means to address past educational imbalances. Problems of mixed ability teaching are present in developing countries, and the examination results show that the curriculum aims are not within reach of the majority of students (SMICT report, in press).

Most countries mention variety of problems that leads to poor performance including language problems, automatic promotion, poor base provided at primary and junior secondary level, ambitious content of curriculum and problems with mixed ability teaching as most important.

In both mathematics and science learner-centred approach is being encouraged. In other developing countries equivalent terms used in curriculum policy documents are, participatory teaching, inquiry-based learning, problem solving and critical thinking. In mathematics, ethno-mathematics continues to receive support, while striving to teach 'maths in context' or 'real-life' mathematics (Howie, 2004). The intended teaching methodology for mathematics education is strongly rooted in constructivist learning theory.

Learner-centeredness is also the methodological intention of all the sub-Saharan countries. Weimer (2002) describes five keys changes to practice that are required to successfully implement learner-centred teaching. They are the balance of power, the function of content, the role of the teacher, the responsibility for learning and the purpose and processes of evaluation.

Most teachers in developing and also developed countries are still grappling with how to successfully implement learner-centred teaching practices. From TIMSS 1999 studies report, teacher-centred approach is very prevalent in most countries, even top performing countries. Hence it looks very idealistic and ambitious project that developing countries are imposing on their teaching cops.

The realities on the ground are that the gap between intended and implemented curriculum in the classroom is very huge. This is brought about by the following in most developing countries;

- Overload of curriculum; with the new curriculum, there is more content additions into syllabus, than taking or less content. Hence this creates a curriculum overload, more and above having to complete the syllabus for national examinations.
- Lack of teacher confidence with subject matter prevents teachers from using a more learner-centred teaching pedagogy.
- Lack of teaching materials and other resources. This situation is very much pronounced in South Africa, because of lack of resources in many schools, the teacher is the only resource to learning.

The lack of clarity about what is expected from teachers is a major factor contributing to the limited implementation of learner-centred approaches in all countries. (SMICT report, in press). Although the learner-centred philosophy advocates the utilization of flexible learning support materials, most teachers are still very dependent on textbooks for the presentation of their learning activities. In many cases textbooks are the main resource upon which the learning activity is centred. Many schools remain under-resourced in terms of textbooks and many of the historically disadvantaged schools are still utilizing textbooks.

The teacher is obviously one of the key factors in addressing the needs and challenges in the new curriculum. Curriculum changes, promotion of different teaching methods and other educational reforms fail if they are introduced without a very substantial teacher education (SMICT report, in press.) In most developing countries the poor quality of teaching and teachers is considered as one of the principal causes for poor student performance in mathematics and science.

According to Carpenter, Blanton, Cobb, Franke, Kaput, and McCain (2004) to help students learn mathematics or science with understanding; teachers need to know how to help students:

- connect knowledge they are learning to what they already know,

- construct a coherent structure for knowledge they are acquiring rather than learning a collection of isolated bits of information and disconnected skills,
- engage students in inquiry and problem solving, and
- takes responsibility for validating their ideas and procedures.

Further, this kind of teaching requires that teachers have a coherent vision of
- the mathematical or scientific ideas and practices they are teaching,
- the conceptions, misconceptions, and problem-solving strategies that students are likely to bring to learning those ideas and where they are likely to struggle in learning them,
- the learning trajectories that students are likely to follow,
- the tasks and tools that likely to provide a window into students' thinking and support,
- their learning and problem solving,
- the kinds of scaffolding that can support students to engage in sense making and problem-solving,
- the class norms and activity structures that support learning.

This kind of knowledge cannot be embedded in curriculum materials or translated into instructional routines. Teachers need flexible knowledge that they can adapt to their students and demands of situations that arise in their classes. Acquiring this kind of knowledge, need a reflection into teacher training programs and professional teacher development.

Variables presumed to be indicative of teachers' competence and examined for their relationship to student learning include measures of academic ability, years of education, years of teaching experience, measures of subject matter and teaching knowledge, certification status, and teaching behaviours in the classroom.

2.4 Conclusions

The aim of the context information was to describe the current education system to gain some insights into what is happening in schools and therefore create a global picture that might inform the study.

Some important aspects are that, the quality of mathematics education in the majority of colleges was such that their graduate teachers were under-prepared to teach mathematics effectively. The 3 year diploma the teachers did in many instances did not go beyond matric (grade 12) subject content knowledge. The grade 12 results might be reflecting this lack of competencies.

There is a very striking difference in the mathematics syllabus at grade 11 to grade 12. The examinations are also very distinct for mathematics HG and SG. The new mathematics curriculum for FET contained in the so-called RNCS (revised new curriculum statements) does not specify the syllabus in detail as the current syllabus and also contain new additional topics.

Some problems that might hamper the implementation of the new curriculum are; teachers' lack of confidence and mastery of subject matter content and basic teaching skills; lack of material facilities and large class sizes; and language problems for both teachers and students.

The policies on equal opportunities, redress and access to schools led to a growing and diverse student population in senior secondary schools, creating problems of mixed ability teaching in most countries.

Many curriculum reform efforts are characterized by overtly big innovation ambitions within unrealistically short timelines and with limited investment in teachers. The teacher is obviously one of the key factors in addressing the needs and challenges in the new curriculum. Curriculum changes, promotion of different teaching methods and other educational reforms fail if they are introduced without a very substantial teacher education and professional teacher development.

CHAPTER 3

ABILITY GROUPING IN SECONDARY EDUCATION

This chapter reviews literature on ability grouping in secondary schools. The aim is to gain insights into ability grouping and their effects on students' achievement in mathematics .It comprises the following section; types of ability grouping (3.1), teachers' attitudes (3.2) ,teacher classroom practices (3.3), students' perspectives (3.4), and school policies with regard to ability grouping (3.5). Finally ability grouping and attainment (3.6), followed by the conclusions (3.7).

3.1 Ability grouping

In today's era of equal educational opportunities, many condemn grouping as a practice that denies quality education to students from disadvantaged backgrounds. Ability grouping is common in both developed and developing countries and the type of ability grouping depends in the context within which it is used. Researchers and administrators of schools praise ability grouping as a way of ensuring quality education for the nation's gifted. Ability grouping is influenced by the ethos, aims and policy of the school, but can also be propagated by the countries educational policies.

There is a clear demarcation between those who see mixed ability as demonstration of equality and those who see ability grouping as a reflection of society at large. Between these two extremes are those who have a mixed philosophy and adopt a combination of grouping systems. Their approach to ability grouping is more pragmatic and allows them to accommodate a variety of practices in different subject departments. Mixed ability teaching seems to be an inevitable result of the new reform process in developing countries that schools have to battle with.

Ability grouping has been a key feature in South African Education System. Almost all the subjects had higher grade and lower grade. These had been rigorously applied with schools taking initiatives in how they group their learners. Until recently with the reform in curriculum, all the subjects will be offered at one level, except languages. This will place schools at great pressure to adjust their teaching strategies to deal with mixed abilities learners in the classrooms.

There are several ability grouping that exist in schools. Table 3.1 serves to summarise the main common types for clarity.

Table3.1. Types of ability grouping (Adapted from Ireson & Hallam, 2001)

Types of ability grouping	
Streaming (tracking)	Pupils are placed in classes on the basis of a test of their general ability. They remain in their stream class for most subjects.
Banding	Pupils are placed in two, three or four bands on the basis of a test of their general ability. Each band contains a number of classes and pupils may be regrouped within the band for some subjects.
Setting(regrouping)	Pupils are grouped according to their attainment in a particular

	subject. Setting may be imposed across a whole year group, across timetable halves, within a band or across mixed age classes. Sets may be serially ordered or there may be parallel sets.
Mixed ability (heterogeneous grouping)	There is no attempt to group together pupils of similar ability. Pupils may be grouped in such a way as to achieve a range of abilities within class. Other factors, such as social relationships, gender or ethnic composition, may form the basis for grouping.
Within class ability grouping	Pupils are grouped within the class on the basis of ability. They may be regrouped within the class for different subjects.
Cross-age grouping (Cross-grade grouping)	Pupils in two or more year groups are placed in the same class. They may be regrouped by setting or within class grouping or taught as a mixed class.

Streaming is based on the assumption that individuals have fixed level of general intelligence, which predicts their performance across all subjects, and can be measured using objective tests. Banding is a form of streaming, with learners allocated to bands on the basis of a measure of general ability. It may be less rigid than streaming, especially when there are fewer bands in a school and each band includes several classes, which may be regrouped for different subjects.

Setting offers a more flexible way of grouping pupils on the basis of their attainment in particular curriculum subjects. It is consistent with a differentiated view of abilities, and allows for higher attainment of pupils in some subjects than others. In most schools in South Africa setting is the ability grouping which is mostly applied. As, with streaming, the aim of setting is to reduce the heterogeneity within classes and enable teachers to match their teaching to pupils needs. Its advantage over streaming is that it reduces the negative effects associated with streaming in that pupils are not in the same class all the time.

Within class grouping is common in primary schools. Groups may be formed on the basis of abilities, or on attainment in a particular subject, or may be based on working relationships. The advantage of within class grouping over streaming and setting is that it reduces the chances of pupils becoming labelled.

Mixed ability classes may be composed on a random basis, by taking the first child on the register and placing him/her in one class, the second in another class and so on. Alternatively, schools may attempt to achieve a balance in each class, using available test scores. Mixed ability grouping is based on the recognition that children have different strengths and weaknesses and develop at different rates. It also provides equal opportunity to learn for all pupils, who follow the same curriculum and be provided with the same instruction, resources and learning activities. Mixed ability teaching places greater demands on the teacher and requires good curriculum resources.

3.2 Teacher attitudes to ability grouping

At secondary level, there appear to be differences in teachers' attitude towards mixed ability teaching depending on the subject they teach. Where subjects are structured in such a way that learning builds on previous knowledge, for example mathematics and science, teachers seem to favour streaming. Teachers generally hold positive attitudes towards classes where pupils are grouped by ability, although variations have been reported based on teachers' prior experience and the subject that they teach (Hallam & Ireson, 2003)

Ireson and Hallam (2001) had earlier reported that the advantages of mixed ability were seen largely in social terms, while the disadvantage was perceived to be difficulty in providing appropriate work for pupils of high and low ability in the same class. Those who were critical of mixed-ability teaching suggested that it failed to motivate and increase the achievement of the highly able, although the less able were perceived to benefit. Experienced teachers appeared to be more supportive of mixed ability teaching, but they often found it more difficult to put into practice than those who had been recently trained to adopt such practices (Hallam & Ireson, 2003).

Humanities have been reported by Hallam & Ireson (2003) to be perceived to be suitable for mixed ability teaching, whereas mathematics and modern foreign languages have tended to be perceived as inappropriate. Scientists occupy the middle position. Teachers have shown to interact with high ability groups more frequently and positively than they do with low ability groups. However, where the ethos is supportive of all abilities, there is some evidence that teachers of low stream students do view them positively.

From a survey of 1,500 secondary school teachers, Hallam & Ireson (2003) found that there was an overall agreement that setting ensures that brighter children make maximum progress. Teachers from mixed ability schools felt that higher ability pupils are held back and cannot be stretched to their full potential in a mixed ability class, particularly in mathematics classes. Mixed ability in general enhances self-esteem, overcome disaffection and disciplinary problems. There is also a strong indication that mixed ability teaching in reality only benefited the less able academically at the expense of the more able.

There is an overall agreement that teaching and classroom management are easier for teachers when classes are set and that setting enables pupils' curriculum needs to be better matched. From a multiple regression analysis predicting attitudes towards ability grouping was undertaken separately for each school type (mixed ability, partially set and set school), it emerged that individual schools were an important force in determining teachers' beliefs. School ethos seemed to be an important force in determining teachers' beliefs (this point is elaborated furthering 3.5). Those teacher with higher degree (masters and PhD) in education expressed more negative attitudes towards ability grouping than those with lower level qualifications.

Betts and Shkolnik (2000) report that in schools that use ability grouping, teachers estimate that on average 82% of students in the classes identified by the teacher as being in the highest level are likely to graduate from college. In schools without grouping, teachers estimate that only 73% of students in these top classes are likely to graduate from college. In schools that use grouping, more students are likely to drop out in the lowest ability classes.

3.3 Teachers' classroom practices and ability grouping

The impact of ability grouping may be mediated through changes in teachers' classroom methods and practices with groups differing in ability. A survey of teachers in schools suggested that the ability composition of classes influences their practice (Hallam, Ireson & Hurley, 2003; Ireson & Hallam, 2001). Teaching methods differ in high and low ability groups, leading to a more stimulating environment, faster pace and more pressure for more able pupils and a reduction in the opportunity to learn for lower ability groups.

High ability groups in the streamed systems have tended to be taught by those teachers who were perceived as the 'best', usually the more experienced and better qualified (Betts & Shkolnik, 2000;William & Barthoomew,2004). Low streams have tended to be allocated the less experienced and less qualified teachers. Other scarce resources might be channelled towards high achievers.

There is often differentiated access to the curriculum, the top groups benefiting from enhanced opportunities. An informal syllabus may also operate, where for lower streams topics are omitted and there are different expectations. For them the knowledge on offer is generally low status and not suitable for gaining access to higher education (Ireson & Hallam, 2001). This point is very much peculiar or more pronounced in the current situation in South Africa.

In mixed ability classes, teachers reported that pupils of all abilities have similar access to the curriculum, participate in the same activities and are taught in the same ways. In classes grouped by ability, teachers reported a tendency for lower ability classes to have less access to the curriculum and to be taught in more structured ways, with repetition, less discussion and greater use of practical activities. Observation of classroom teaching in mathematics tend to substantiate this account, Boaler, William & Brown (2000) found that science teachers altered their pedagogy when they moved from sets to mixed ability classes.

Ireson, Hallam, Hack, Clark, & Plewis (2002) found that with mixed ability classes, teachers provided a greater variety of activities and more differentiated work, whereas they tended to use more whole class instruction with sets. Several studies (Boaler et al., 2000; William & Bartholomew, 2004) reported similar patterns in pupils in sets and treating them as though they were identical in ability, preferred learning style and pace of working. All the pupils were given the same task and were required to complete them at the same speed.

Teachers of mathematics and modern languages were more likely to set homework varied according to ability, and also to set shorter homework for the less able group in mixed ability classes. Although most teachers reported that it was more difficult to differentiate homework in the mixed ability classes.

3.4 Students' perspectives on ability grouping

From data of over 6,000 secondary school pupils, Ireson and Hallam (2001) posed learners with the question "Which type of grouping do you think is best?", 62% indicated a preference to setting, 24% for mixed ability classes, and 2% for streaming, banding or unspecified. Pupils demonstrate sensitivity to the effects of structured ability grouping, in particular the stigmatisation that can occur in relation to pupils in the lower ability groups and the teasing which may have to be endured by those in the top set.

When pupils were asked whether they would want to change sets or classes and which classes or sets they would want to be in mathematics, of the 39% of pupils who wanted to change set, just over a quarter (28%) wanted to be in the top set and almost half(49%) in another higher set. Overall, 77% of those pupils who wanted to move set wanted to be in a higher set. Several main reasons for wanting to move to a higher set included status; to do harder work or easier work; aspirations; to be with friends; the poor behaviour of classmate; and the skills or personal qualities of the teacher.

According to Boaler, William & Brown (2000) setting not only limits expectations but sets very real limits on examination entry and possible attainment. Mixed ability classes are likely to have higher morale and place a higher value on learning than bottom sets, streams or tracks.
Pupils raised two issues in relation to the matching of work to needs, understanding and pace of work (Ireson & Hallam, 2001, p.71):

"Sets are best because if you put people into mixed classes some are going to be bright some dim…so the teacher is teaching a lesson the bright person might find it really easy and the dim person might find it really difficult so if you put them in different sets they are going to be able to understand"

School ethos plays a major role in regard to student's perceptions on different ability grouping. There are various factors that mediate towards students preferences, and this include, expectations, friendships, cohesion within the class and social cohesion within the school.

At secondary level, where the practice of setting is common, a key issue is the extent to which pupils actually are put in different set levels for different subjects. Most students felt that sets are good for mathematics and science, mixed abilities for arts, humanities, design and technology, and physical education. According to Ireson, Hallam & Plewis (2001), pupils' self-esteem and general school self-concepts are higher in schools with moderate levels of setting. The evidence indicates that pupils not only understand the rationale for different kinds of grouping but also perceive the complexity underlying decisions about how to group pupils.

Boaler et al. (2000) reported that the opposite effect in mathematics sets, highest ability groups were disadvantaged by their placement because of high expectations, fast-paced lessons and pressure to succeed. Teachers change their normal practices when they are given top-set classes, appearing to believe that being a 'top-set' student entails a qualitative and meaningful difference from other students. Top-set children, it seems, do not need help, time to think, or the space to make mistakes. Students in the low sets appear to experience the reverse, allocation of non-mathematics teachers, and continuous diet of low-level work that students found too easy.

The student's reports were consistent with classroom observations conducted by Boaler et al. (2000). The polarisation in the students' perceptions about mathematics questions in the setted schools probably reflects the polarisation in their experiences with mathematics. Students in low sets believed there to be little hope for moving to higher groups. In mixed-ability classes, teachers have to cater for a range of students whose previous attainment varies considerably. Most teachers respond to this challenge by providing work that is differentiated either by providing different tasks for different students within the same class (differentiated by task), or by giving all students a task that can be attempted in a variety of different levels (differentiated by outcome)

Teachers often let students in mixed-ability grouping work 'at their own pace' through differentiated books or worksheets. In set classes, students are brought together because they are believed to be similar 'ability'. In set classes students are given identical work, whether or not they have found it easy or difficult, and they have all been required to complete it at the same speed. This has been a considerable source of disaffection, both for students who find the pace of lessons too fast and those who find it too slow.

Being able to teach the whole class as a single unit is the main reason that teachers put students into 'ability' groups, and it was also the one of the main sources of students' disaffection. Ability groups create a set of expectations for teachers that overrides their awareness of individual capabilities. It also impacted upon the teachers' choice of pedagogy. A teacher who offered worksheets, investigations and practical activities to students in mixed ability groups concentrated upon chalk-board teaching and textbook work when teaching groups with a narrower range of attainment.

Analysis of data from the Second International Mathematics Study (SIMS) by Kifer and Burstein (1992) in Boaler, et al (2000), suggests that two factors that are most strongly associated with growth in students achievement in mathematics (indeed, the only two factors that are consistently associated with successful national education systems) are the opportunity to learn (i.e. the proportion of students who had been taught the material contained in the tests) and the degree of curricular homogeneity (i.e. the extent to which students are taught in mixed-ability, rather than set groups).

According to Boaler et al 2000, the strength of curricula polarisation, and the diminution of the opportunity to learn, if replicated across the country, could be the single source most important source of the low levels of achievement in mathematics.

3.5 School policies with regard to ability grouping

3.5.1 Introduction

In this section we look at the organisational issues concerned with ability grouping in schools. Also principles underpinning mixed ability grouping practices. Those who are strongly in favour of ability grouping argue on the grounds of equity, that educational system must value all individuals equally (Ireson & Hallam, 2001). We ask whether these principles are reflected in the aims and values espoused by the schools and how they translate into practical arrangement within the schools.

A number of factors influence the schools to operate ability grouping effectively. Although there are differences between schools, common themes included, staffing, room, curriculum and economic constraints. Some schools do place great importance on issues of ability grouping and decisions about grouping structures are based on strong educational values. However, in many schools, ability grouping is seen as a matter for each curriculum subject department to determine.

3.5.2 School aims and ethos

Researchers exploring the relationships between ethos and pupil learning have tended to focus on aspects of classroom climate (Ireson & Hallam, 2001). This measure of ethos was a combination of the extent to which pupils felt supported by their teachers, the extent to which they were encouraged to learn independently, the clarity of goals and the extent to which student felt they and the staff shared similar aims.

Aims are made explicitly through statements in the school prospectus or other documentation. Values are often more implicit and less tangible, becoming evident in the quality of the relationships between teachers, between teachers and pupils and between pupils. Schools with religious affiliations are very clear about their ethos in relation to religious beliefs and values.

Ireson & Hallam (2001) noted that Ramsden (1991) has demonstrated in his research links between ethos and pupils attainment. His analysis shows that students in high ethos schools achieve higher grades in school leaving examinations.

The interpretation of aims in relation to the school’s grouping policy reveal the different ethos of schools. This link was clearest in the schools with strongest beliefs in either mixed ability grouping or in setting or streaming (Ireson & Hallam, 2001). In the schools with less strongly held beliefs about ability grouping, a more pragmatic approach was evident.

An example of a head teacher in a school that grouped pupils by ability in every subject was quite clear about the link between the school's aims and ability grouping policy;

"Well if you look at the aims….'To prepare pupils for their future lives'…that's the first aim of the school…so I could argue…if I wanted to be ideological…that in real life people tend to get put together in ability groupings according to tasks…therefore, the school reflects that …I think that's pure debating point…more realistically though one of the things is that we're trying to get the maximum out of each child …and I don't believe you can do that …I do not believe you can do it in mixed ability." Ireson & Hallam, 2001, p.156)

The head of one of the mixed ability schools was equally clear;
"The aims of the school start off by saying that we will demonstrate that all members of the school community are equal value…I think all ability is vital to this…we can't demonstrate that people are equal value if we start to separate them out and say you are better than somebody else or you are worse…and no matter how schools try to disguise this, the message is very clear to youngster…that is our primary aim." Ireson & Hallam, 2001, p.156)

Mixed ability is also strongly favoured by religious schools. Catholic schools apply completely mixed ability, the Church of England school, partially set. Another "mixed ability philosophy" approach is ability grouping per subjects and this is viewed as the pragmatic approach to ability grouping.

It is clear from the statements of principals that educational values play a large role in ability grouping policy and practice. A clear demarcation exists between those who see mixed ability grouping as an essential means of demonstrating the equal value of all individuals and those who see ability grouping as an essential means of preparing pupils for a society structured on the basis of ability. According to Mason & Doepner III (2001) principals and teachers prefer grouping by ability because mixed ability creates extra planning and difficulty with classroom management and curriculum coverage.

3.5.3 Parent, leagues and attainment pressures to ability grouping

In current educational market, schools are in competition to attract pupils. Hence parents' preferences have a greater influence on schools. In 45 secondary schools, Ireson & Hallam (2001) one third of the principals mentioned that parents were in favour of setting. Venkatakrishnan & William (2004), interviewed school management team (SMT) who said that decision to impose some from of banding in mathematics was fuelled by letters from parents. Parents and some members of the SMT perceptions were that setting was the most 'natural' and 'effective' context in which to teach mathematics.

Some schools are under pressure to implement ability grouping even though their examinations results are good. The examination system was seen as an additional pressure to group by ability in the secondary schools. Principals mention tiered examination papers having an influence on their decisions to move towards setting, particularly in mathematics and science (Ireson & Hallam, 2001). Mathematics has three levels, and the principals state that it is problematic to teach a class of students who would be taking different level examination papers.

3.5.4 How are pupils allocated to classes?

At secondary schools in Wales and England, setting is used extensively. Mostly setting is introduced as pupils move up in the school. In South Africa the most common ability grouping is streaming. Resources may influence the decision to adopt a particular grouping pattern, such as timetable halves. According to Ireson, Clark & Hallam (2002), majority of schools used pupil's performance in internal assessment and examinations as the basis for grouping, but this varied from one curriculum subject to another. Over half the mathematics and science departments used internal assessment (24), against only 7 of the English departments. Internal assessments included end of year examination, module tests and end term tests.

Teacher opinion was also taken into account in forming groups (Ireson, Clark & Hallam (2002). Principals used phrases like 'teacher opinion as to the potential', teacher's own feel for the child' and staff recommendation (gut feeling)'. Also teachers made reference to pupils' attitudes, motivation, effort and self-esteem as having a bearing on placement into groups. Social factors, such as friendship groups or disruptive combinations of pupils, also influenced grouping, this was reported by 18 schools from 37 and mostly science heads of departments.

Greater use of mathematics scores in placement into groups is frequently stated by most schools, followed by science score and lastly English. Mathematics is the subject that seen as least suitable for mixed ability teaching (Hallam & Ireson, 2003; Ireson, Clark & Hallam, 2002).

3.5.5 Movement between groups?

Movement between groups occurred in the context of both mixed ability classes and sets. In most schools, when pupils were taught in mixed ability groups, the class was the tutor group. This meant that any movement of pupils from one class to another entailed moving to a different tutor group. Hence in mixed ability groups' movement occurred less frequently, than in sets. Ireson, Clark & Hallam (2002), report that if it did occur, the reasons were to do with social relationships, mainly friendships or occasionally a clash between a teacher and a pupil.

In schools with setting, the level of monitoring of movement varied considerably, with some keeping a close watch on pupils. Movement between sets was reported to occur frequently. Movements generally occurred after assessment and schools varied in the frequency with which these were carried out. Either half term or end year examinations.

Movement was restricted in certain subjects by the organisation of the curriculum. Practical constraints limit the capacity for movement between groups. These include available space in top sets and concerns about curriculum covered by different groups. Both of these are essentially issues of resources. In addition, members of staff in some schools face pressure from parents to move pupils into higher sets.

3.5.6 Achievement or Ability?

Curriculum managers spoke of difficulties they faced in distinguishing between pupils' potential achievement and their actual achievement (Ireson & Hallam, 1999). Potential was assessed through standardised tests, such as cognitive ability tests (CATs). But still there seems to be a debate that CATs measure ability or potential and not their attainment.

Ireson, Clark & Hallam (2002) say that the decision to group by ability or attainment brings with it a new set of problems associated with finding fair and accurate ways of placing pupils into groups. Further schools are grappling with problems whether motivational or attitudinal factors should be allowed to influence their decision, while others are concerned to find ways of distinguishing between ability and attainment.

Few schools keep systematic records of numbers of pupils moving between sets in different subjects. This information is necessary if schools are to monitor their practice and to evaluate its importance on pupils. If schools monitor the composition of groups, movement between groups and progress made by pupils in different groups then selection bias can be minimised.

Organisational structures vary in the instructional tradeoffs they create (e.g. time, appropriate curriculum, and quality of instruction) and that "understanding the terms of these tradeoffs is critical for and understanding of how to build effective models of classroom organisation (Mason & Doepner III, 2002)

3.6 Does ability grouping raise attainment?

The main argument put forward in favour of selecting and grouping pupils by ability is that ability grouping is effective in raising pupils' attainment. The main questions are whether ability grouping contributes to raising overall standards and whether it benefits particular pupils at the expense of the other.

The weight of evidence in literature shows that selection and ability grouping do not have a powerful impact on overall attainment of pupils. But there appears to be differential benefits for pupils in selective and unselective systems. Grouping by ability produces slightly better results for higher attaining students, whilst lowering the results of average and below-average achievers (Betts & Shkolnik 2000; Ventkatakrishnan & William, 2003).

Ireson & Hallam (2001) indicate that setting influences attainment in mathematics but not in other subjects. It benefits those entering school with higher attainment, whereas mixed-ability grouping benefits those entering with lower attainment in mathematics. Boaler, et al (2000), suggest that the poorer performance of students in set environments was due to the imposition of lower level content and reduced pace in lower sets, and an emphasis on speed in the top sets.

One of the most compelling evidence is that teachers use different teaching methods with mixed-ability grouping and classes grouped by ability. The impact of ability grouping may be mediated through changes in teachers' methods and practices with groups differing in ability. In mixed ability classes, pupils of all abilities have similar access to the curriculum, participate in the same activities and are taught in the same ways. In classes grouped by ability, lower ability classes have less access to the curriculum and are taught in more structured ways, with more repetition, less discussion and greater use of practical activities. The 'teacher effect' Ventkatakrishnan & William (2003), teachers' choice of pedagogy Boaler, et al (2000) and classroom pedagogy Ireson & Hallam (2001), has been found to influence attainment in schools with different ability grouping.

Ability grouping is not the only the solution to providing effectively students at different levels of attainment, but it affects attainment indirectly. It may produce its effects on the lower groups by influencing the teachers' and pupils' expectations of attainment, by affecting the opportunity to learn, by influencing pedagogy with groups of differing ability and by offering differential access to resources.

"Unless a school can demonstrate that it is getting better than expected results through a different approach, we do make the presumption that mixed-ability grouping should be the norm in secondary schools" (Ventkatakrishnan & William, 2003, p. 202).

The clearest effects on achievement are obtained in enrichment programs and accelerated (fast-tracked) classes, which involve the greatest curriculum adjustment (Ventkatakrishnan &William, 2003). According to William & Bartholomew (2004), in terms of mathematics attainment, it doesn't really matter very much which school you go to. However, it matters very much which set you get put into.

3.7 Conclusions

Ability grouping could be classified into several types including the following, streaming, banding, setting, mixed ability, within class, and cross-age groupings. Ability grouping brings with a number of practical issues, including the fair and accurate placement of pupils into groups, movement between groups and allocation of teachers to groups. From research, it appears that teachers with master degree are mostly allocated to higher ability classes.

Ability grouping is influenced firstly by the school policy and secondly by the teachers. Experienced teachers appear to be supportive of mixed ability grouping compared with newly graduated teachers who find it difficult to deal with mixed ability groups. Learners' perceptions and attitudes reflect the schools policy and relationship with teachers. Learners find that once placed in a lower group, movement to a higher group remain difficult, because of the increasing gap in curriculum covered.

Mixed ability in general enhances self-esteem of low ability students, overcome disaffection and disciplinary problems. Mathematics was found to be at least unsuitable to teach in mixed ability groups. Teachers found it too demanding to prepare differentiated homework and lessons in mixed ability classes. Successful mixed ability teaching relies heavily on teacher's skills. Also successful mixed ability teaching needs access to appropriate resources and facilities.

Despite the difficulties outlined in the text there are some advantages on adopting mixed ability teaching. These can be described as follows it:

- It provides a means of offering equal opportunities;
- It addresses the negative social consequences of structured ability grouping by encouraging co-operative behaviour and social integration;
- It can provide positive role models for the less able pupils;
- It can promote good relations between pupils;
- It can enhance pupils/teacher interactions;
- It can reduce some of the composition engendered by structured grouping;
- It can allow pupils to work to work at their own pace ;
- It can provide a sense of continuity and security for primary pupils when they transfer to secondary school;
- It forces teachers to acknowledge that the pupils in their class are not a homogeneous group;
- It encourages teachers to identity pupils' needs and match learning tasks to them.

CHAPTER 4

Research Design

This chapter describes the procedures and instruments that were used to collect data for this study. The sections that comprise this chapter include research approach (4.1), research design (4.2), selection of cases (4.3), data collection procedures and instruments (4.4), data analysis procedure (4.5) and study limitations (4.6).

4.1 Research Approach

An orientation to the study was conducted via secondary data analysis of 2003 grade 12 results of North-West Department of Education database. This analysis established how many schools offered only standard grade in mathematics in NWP.

In the main study the case study approach was chosen as appropriate since it would give insight of what happens in school context. Two schools with relatively good results in grade 12 mathematics SG no HG students at all and particularly rural were chosen in two regions of NWP, representing two cases. These two schools, Phakedi and Batleng secondary schools, were chosen to provide an in-depth picture of what happens at intended, implemented and attained curriculum levels. Hence, the intention of the main study was not to draw generalisations, but to elicit rich information in regard to the research questions posed in the first chapter. The conviction was that this could not be fully grasped by a survey type of approach because it will give only an over view of the situation.

Van den Akker (1999) describes that a case study should provide a thick description of the process-in-context that may increase the ‘ecological validity’ of the findings, so that others can estimate in what respects and to what extent transfer from the reported situation to their own is possible. ‘How’ and ‘Why’ questions are more explanatory and likely to lead to the use of case studies (Yin, 2003). If you wanted to know ‘why’ a particular activity or decision has been made you have to draw on a wider array of documentary information, in addition to conducting interviews. Also a case study is preferred in examining contemporary events, but when the relevant behaviours cannot be manipulated. The case study has its unique strength in its ability to deal with a full variety of evidence – documents, artefacts, interviews, and observations.

Thus, the case study as a research strategy comprises an all-encompassing method, covering the logic of design, data collection techniques, and specific approaches to data collection.

A multiple-case (embedded) design with multiple unit of analysis. This design is chosen because it is suitable to study schools, such as open classrooms in which independent innovations occur at different sites. The unit of analysis in this case is the school curriculum. Multiple- case studies can be used for comparative purposes. A case study involving a small number of teachers (5), principals (2), deputy principal and, students

(18) was conducted to yield information on formal, perceived, operational and experiential curriculum.

The evidence from multiple-cases is often considered more compelling, and the overall study is therefore regarded as being more robust (Yin, 2003). The important aim for multiple-case studies is that each case must be selected so that either it predicts similar results (a literal replication) or it produces contrasting results but for predictable reasons (a theoretical replication).

4.2 Data collection procedures and instruments

In line with the methodology of a case study approach, threads to construct validity, internal validity, external validity and reliability had to be satisfied.

To account for construct validity, multiple sources of evidence were applied, in a manner encouraging convergent lines of enquiry. Hence interviews, analysis of school records and classroom observations were conducted. Also a second tactic is to establish a chain of evidence and finally draft case study report being reviewed by key informants. Maintaining a chain of evidence relate to the case study report having sufficient citation to the relevant portions of the case study data base. In this regard the researcher elaborated on the instruments used and information sort from each.

Review of the draft case report by key informants of the schools involved was not possible because of time constraints of the study.

Internal validity is concerned with causal relationship. In case studies, it involves inference every time an event cannot be directly observed. Threads to internal validity can be dealt with by an analytical technique of pattern matching, or explanation building and addressing rival hypothesis. In this study thread to internal validity was addressed by within case analysis and across case analysis to aid in drawing of conclusions.

External validity deals with knowing whether a study’s findings are generalisable beyond the immediate case study. Survey case studies rely on statistical generalisations, whereas case studies rely on analytical generalisation. In analytical generalisation, the investigator is striving to generalise a particular set of results to some broader theory. The intention of this study was not at generalisation but at in-depth analysis of phenomenon for further study.

Reliability is concerned with whether the results can be replicated. To deal with thread to reliability, a case study protocol was followed. Reliability was addressed by development of the research plan.

4.2.1 Overview

Two schools were visited between the periods April and May 2005 and a variety of methods use for data collection. Triangulation of methods and data sources was used to enhance corroboration. Table: 4.1 Summaries the research activities, instruments used in the two schools and curriculum representations.

Table 4.1 Research activities and curriculum representations

Instruments	Curriculum representations			
	Formal	Perceived	Operational	Experiential
Interviews Principals (n=2), deputy(n=1)	X			
Interviews Teachers (n=5)		X		
Focused Interviews Students(n=18)				X
Document Analysis	X			
Observations Teachers(n=3)			X	

4.2.2. Selection of cases

In first part, as an orientation to the study, data of grade 12, 2003 mathematics results of North-West Province were analysed. From the analysis two schools with relatively good results (achieving some distinctions) in mathematics SG but with no HG students and being in the rural area, were chosen to conduct a case study to explore factors related to intended (formal school curriculum), implemented (practices, perceptions and attitudes) and the attained (outcomes, experiences and attitudes) curriculum. These two schools were Phakedi and Batleng senior secondary schools.

4.2.3 Document analysis

District or school records often provide important evidence on organisational support and change (Guskey, 2000). Guskey also states that, an analysis of school policy documents, for example, can yield crucial information on the alignment of organisation policies with specific activity goals. Similarly, analysis of school budget statements offers valuable information on the provision of necessary materials and other resources. Although these documents are usually part of the public record, considerate evaluators always seek permission to use them as part of the evaluation process

School records, can also provide information on students' cognitive learning and specific descriptions of relevant criteria for each variable. Examples include more students being named to the honour roll, increased enrolment in advanced or honours classes, greater participation in science fairs or academic competitions ,more academic awards won or academic scholarships earned, and increased membership in academic clubs or honour societies. Also school records should indicate what requirements students must meet to be placed on honour roll earn a particular scholarship, or become members of an honour society. This allows for meaningful comparisons between classes, across schools, and over time.

Document analysis was used to corroborate information from interviews earlier conducted. School documents perused per case included: mathematics syllabi for HG and

SG, time-table, mathematics teacher allocation, grade 12 results for past two years, school policy and staff information. Documents from the regional office included: New curriculum for grade 10-12 mathematics, provincial grade 12 results 2004, and the national strategy for mathematics, science and technology education 2005-2009.

4.2.4 Interviews teachers and principals

The advantages of interviews are their flexibility in questioning process, control of the interview situation, high response rate and fuller and further information. If interviewee responses are brief or incomplete, for example, the interviewer can ask follow-up questions, pressing for more detail and to clarification in their meaning. Interviews are regarded as costly and lack anonymity. Interviewees can be biased and interviews are also perceived as time consuming. At the same time, the detail and richness of the information they provide is impossible to attain from a pencil-paper form. Interviews are also an excellent means of gathering information on learning errors, mistaken understandings, and unintended learning outcomes.

Teachers were interviewed with the aim of reflecting on their experiences and perceptions in dealing with mixed ability and their emphasis on SG syllabus. Sample of teacher interview scheme is given in appendix A1.
Main questions asked were:
What criteria do you use to allocate students in terms of ability?
Do you use differentiated methods in mixed ability classes?
Is mixed ability suitable for the teaching of mathematics?
What are the underlying reasons by offering only SG curriculum in mathematics?
With the new curriculum phasing out standard and higher grade, how do you feel about it?

Principal interviews sought information on school policies on ability grouping and school curriculum. Sample of principal interview scheme is given in appendix A3.

Main questions asked:

Is there a school policy in guiding teachers to allocate learners to different groups in terms of ability in mathematics?
Why is your school curriculum emphasising SG mathematics to grade 12?
What is your view on phasing out SG and HG?

4.2.5 Focused Group Interviews (students)

Focus groups bring together small groups of participants to share perspectives and offer insights. A facilitator usually guides the discussion by asking a series of probing questions related to the critical indicators. Group members respond to these questions and are given opportunities to raise new issues or bring up additional topics that they believe to be important. They are particularly well suited for answering important "why" questions that other form of data gathering may not be able to address.

Students are usually keenly aware of changes in the classroom practices or school policies, and they can provide important information on both levels of use and differences in practice. Advantage of student interviews is that they rarely solicit misleading information.

Students' interviews were intended to establish the experiential curriculum. The students (six per group) were asked to respond to some questions of the interview individually, and thereafter a conversational approach was adopted so that they could speak when they felt they had something to contribute. Semi-structured questions in the interview schedule were used to regulate the discussion to focus on specific issues at a time. The questions were not followed chronologically. Sample of learners' interview schedule is given in appendix A2. Total of 18 learners from grade 12 classes were interviewed.
Main questions asked to learners:

Do you think in mathematics being in mixed ability is fair for all students?
Why is your curriculum offering only mathematics SG?
With the new curriculum phasing out standard and higher grade, how do you feel about it?

4.2.6 Direct Observations

Direct observations, can provide valuable evidence on important aspects of what happens in the classroom. Direct observations are also particularly suitable for gathering information on levels of use of innovation.

The drawback of direct observation is their potential influence on the observed behaviours. The presence of an observer may cause the teachers or administrators being observed to alter what they do or to act in non-typical ways. Also the critical indicators of some changes or innovations may not be directly observable.

Three classroom observations were carried out with the help of a checklist. This was meant to establish an additional 'snap shots' at what is really happening in the classroom. This checklist was to establish the activities and behaviour of teachers during the observed lessons. The checklist was divided into four sections that mirrored the lesson phases; introduction (basic teaching skills), body of lesson (teaching skills reflecting mixed ability and learner-centred orientation) and conclusion (general impression of the lesson). Sample of checklist is given in appendix A4.

4.3 Data processing and data analysis

Data processing per case involved data reduction and creating emergent themes in relation to conceptual framework developed in line with the research questions.

Second data was analysed per case, this would be reports of teacher interviews reflected as perceived curriculum; principal interviews reflected in the formal curriculum; students interview results represented by experiential curriculum; classroom observation data(operational curriculum); and school document analysis.

Interviews with students conducted in Setswana and translated into English immediately after the interviews. Interviews were not audio taped as interviewees were not comfortable with audio taping. In each case the researcher made notes, which were elaborate and typed immediately after each interview.

Since only three classes were observed, responses from classroom observation were not put into tabular form. A checklist was used for the classroom observations and a general impression of the lessons was generated from it. Documents analysis data was used to corroborate information from interviews.

Finally to aid in drawing conclusions and capture a general emergent pattern per case, a within-case analysis was developed. In aiding with pattern matching and aggregating findings across cases, cross-case analysis was developed.

4.4 Limitation of the study.

Only two cases were conducted, therefore no generalisations are possible. The intention was to get an in-depth picture of what practices happen in the two schools. The decision of how many schools to use were determined partly by the constraints of available time for the study and the cost of travelling. Distance between schools can also be great, in this study the school were two hundred kilometres apart. This meant spending a week at least in one school and travelling the following week to the other. School time table offered constraints in terms of classroom observations, particularly in Phakedi were two teachers had concurrent lessons in grade 12 mathematics.

Initially teachers' attitude towards participating in this study was also limiting, as they were sceptical about the intention of the research. This was also partly that the researcher's visit coincided with the visit by departments' whole school evaluation unit.

CHAPTER 5

RESULTS

This chapter reports the results of the two case studies. The format used to present the case descriptions is generally as follows: Background information, formal school curriculum, perceived curriculum, experienced curriculum, classroom observation (operational curriculum), within case analysis, finally cross-case analysis and conclusion.

5.1 Phakedi High School

5.1.1 Context information

Phakedi High school is a public school under the Department of Education, North West Province. The school is situated in a rural village of Leeufontein, about 30km from the nearest town of Zeerust. Total enrolment is about 812 learners from grades 10-12. Most of the learners are staying with grand parents and 30% are over 18 years of age in grade 12.

The school compound is fenced and planned layout buildings contain 14 classrooms, administration block, an under-resourced library, laboratory with few apparatus, a home economics room with cooking facilities and a small house for the caretaker. The motto of the school is "Hard work conquers all".

The vision of the school is producing well-developed, self reliant people, with knowledge, skills and attitudes, who can excel in higher institutions of learning and in the corporate world, continually contributing to the society.

The mission is to provide quality education accessible to all members of the community through knowledge, skills, vibrant teaching methods and hard work of a well qualified staff by:

- maintaining, developing and optimizing physical and human resources;
- designing a curriculum incorporating various co-curricular activities that will create an environment in which the educators and learners relate to each other without fear or pressure;
- forging partnerships among all stakeholders;
- upholding the norms and values of the community acceptable within the framework of the constitution of the Republic of South Africa and the dictates of the department of education;
- ensuring overall development of the personality of every learner by enhancing opportunities for independent thinking and development of intellectual, physical and moral faculties.

This is in line with the mission in the corporate plan of the Department of Education to ensure that all South Africans receive flexible life long education and training of high quality. The school has mostly young educators who come from diverse backgrounds, with varied experience and commitment to the profession.

Table 5.1: Characteristics of mathematics teachers at Phakedi High School

	Nationality	Qualification	Teaching experience	Years at Phakedi	Allocation (Mathematics)
Teacher A (HOD)	South African	Degree	25	10	Grade 12C(23)
Teacher B	South African	Diploma	8	3	Grade12A(50),10A(48), B(23)&D(52)
Teacher C	South African	Diploma	9	3	Grade11A(61),B(57), D(61)

5.1.2 Formal curriculum

The formal curriculum is described in school policy and information from an interview with the principal.

Phakedi High School prepares learners for the National Senior Certificate examination administered by the Department of Education. The curriculum is designed to give the learners a maximum scope for further education. Equally important are co-curricular activities.

The school offers the following streams in Grade 12:

- Natural sciences : Mathematics SG, Physical science, Biology
- Commercial : Mathematics SG, Business economics, Accounting
- Humanities : Geography/Business economics, Biology, Agricultural Science/ Home economics

The above three streams reflect a particular class combination of subjects. The number of classes per particular stream will depend on the number of learners enrolled in that stream. An ideal class can accommodate 35 learners, but the number of classes per stream is dependent on availability of teachers. For example, some classes have more than 35 as reflected in Table 5.1.

The language of instruction is English, which is taught as a second language. Setswana is taught as a first language and Afrikaans is another second language. Learners enrol for a minimum six subjects and should obtain a minimum of 40% average for a pass. The promotion criteria are determined by the Department of Education.

The principal explained that the school curriculum is mostly dependent on the availability of the teacher to teach a particular subject. Learners are placed into streams based on their results from grade 9. Teachers are very much involved in advising learners which stream they fit into. Parents are seldom involved in decisions of which subject combination they take, because most parents are semi-literate. The school policies only describe subject' combinations learners can take but do not specify the criteria for any particular choice.

Mathematics is used to stream learners. Learners doing mathematics are not separated according to ability but thought as a whole class which implies mixed ability grouping. Mathematics is offered at SG because of learners' poor background from primary school but teacher' advice plays a crucial role in final placement into mathematics class. Support from the regional offices, in terms of allocation of equipment and finance is minimal. School fees as the main source of income.

The principal has lot of confidence in his teachers to handle the new curriculum when it is implemented.

5.1.3 Perceived curriculum

Teachers' perceptions were explored by analysing data from interviews. The perceived curriculum was analysed by focusing on the teachers' perceived teaching of mixed ability grouping and how SG mathematics makes this possible by reflecting on their teaching practice.

The teachers explained that the syllabus is their guide and the textbook is very much the content that the learner must be exposed to. They also indicated that the syllabus has not changed since 1989. Teacher A actually showed the researcher the copy of the subject policy to substantiate his claim. Even with the new syllabus looming, they feel pressure to change.

Teachers feel that all learners need to be treated the same. The difference in ability is mostly not emphasised by teachers. They give the same work to the whole class and the good students will always finish first and do extra work on their own. Teachers also choose to do standard grade as they perceive HG as too demanding for the learners. They have the attitude that HG mathematics syllabus is very broad to be completed within the given time in the timetable. (Refer to appendix A5 for comparison between mathematics HG and SG) Hence, in most cases learners will fail due to the fact that they only covered a fraction of the required syllabus if they take HG.

The other fact given for all learners doing the standard grade is the lack of proper grounding in the mathematics from senior primary school. The school has established a good track record in producing good passes in standard grade for sometime now. Teachers indicated that they follow the guide according to the requirement of the examination and use past question papers for tests and assignments. They feel that learners work well within the same syllabus, for quick remediation and emphasis on important sections.

Furthermore teachers feel that subject advisers are not helping in terms of content knowledge or pedagogic issues. They receive only the supply of subject policy documents and year plans. With the syllabus being streamlined, teachers feel that more learners are not capable to do mathematics at a higher level unless mathematics competencies of senior primary teachers are improved.

When asked about the new curriculum phasing out HG and SG, Teacher A bluntly said it is not implementable and Teacher B felt that it will disadvantage many learners. This means that many learners will not enrol for mathematics since high failure rate will be experienced

5.1.4 Operational curriculum

The operational curriculum is focused on lesson execution by teachers in their classes. Two classes at grade 12 mathematics were observed to explore how their lessons reflect mixed ability teaching. Also general characteristics of the lesson execution in terms of check list (Appendix A4).

Basic teaching skills were demonstrated by both teachers. The teacher-centred approach is the predominant mode of lesson delivery in class whereas the learner- centred approach is not visible. Learners are given the same problems to solve. There is no emphasis on group work or any encouragement within the classroom. One class had 50 learners and crammed to the extent that the teacher was restricted to move about let alone attempt to group learners. The lessons are also prepared in relation of the amount of time needed to complete the syllabus.

The researcher observed that teachers did not acknowledge difference learners' ability in class. There was no differentiation of work in dealing with mixed ability in class. In one class only one learner out of a total of 50 learners was interacting with the teacher B and asking questions. It later came in an interview that the learner was the only one having entered mathematics at a higher grade level. The teachers met with him after normal classes to give him extra work and deal with sections that cannot be dealt with in class because it is excluded from SG syllabus and cannot be taught in class as 49 students do only SG.

As the researcher moved about in one class that had 23 learners taught by teacher A, it was evident that learners were battling to do basic mathematical operations (factorising, multiplication and addition). The teacher later explained that this was due to the introduction of the calculator early in primary school without allowing learners to have a grasp of basic mathematical operations. This makes them unable to intuitively estimate or guess the answer.

5.1.5 Experiential curriculum

Data for the experiential curriculum was obtained through student interviews, which were carried out at the end of the lessons. Students were asked about their learning experiences within the SG curriculum and their perceptions of mixed ability classes.

Students described their classes as having bright and average learners and some are very capable of doing HG in mathematics. They explained that the school curriculum is very much based on standard grade because many learners are able to attain distinctions and mostly manage to pass. "*The fact that from grade 11 SG mathematics is already being* *taught makes it difficult to change to HG even if you have the potential to do so*" one learner said. The mode of assessment is written tests and rarely projects because completion of the syllabus is of paramount importance.

Learners feel that mixed ability grouping is beneficial for group work and slow learners are supported by the brighter students. The disadvantage in mixed ability class was that the teacher does not provide challenging work for the brighter learners. Some students particularly from science class felt they are held back by weak students and pace of work. Learners perceive that teachers do not cope when the class show two extreme groups of good and weak students.

Most learners find geometry the difficult section in mathematics. Learners in commercial class find geometry and drawing graphs difficult. Learners feel that if only one uniform syllabus is offered with no distinction between HG and SG, it will work to the disadvantage of majority of students. At the same time they acknowledge that mathematics by its nature cannot be done by all learners at equal competence. Hence this distinction should be maintained for the benefit of all learners. The commercial group felt that they will not cope with HG mathematics

Learners are very much aware of the limitations in admission to Universities but they feel that the school track record of good passes in SG mathematics is a good indication of them achieving good passes in mathematics.

5.1.6 Within case analysis

The type of grouping in the school is streaming and based on mathematics achievement from primary school. The formal standard grade curriculum is very short in relation to higher grade mathematics. There is general agreement among teachers and learners that working in groups and having different ability learners creates positive competition. But the opposite also hold that the pace of bright learners is held back and a compromise has to be made. Doing the same syllabus levels the playing field and boasts the morale of everyone. Everyone learns the same but achieves differently. Teachers are comfortable as they focus on same content.

It is also very clear that the teacher-centred approach is also practiced without questions and learners see no problem with it. Apart from the fact that learners do SG mathematics due to poor mathematics background, from school records it is established that teachers themselves did mathematics at standard grade hence it makes perfect sense to teach what you are good at. This is recognised by management and teachers are supported from this background knowledge. Teachers also choose to do standard grade as they perceive HG as too demanding for the learners. They have the attitude that HG mathematics syllabus is very broad to be completed within the given time in the timetable. Hence, in most cases learners will fail due to the fact that they only covered a fraction of the required syllabus if they take HG.

From observation and interviews the concept of mixed ability teaching is not well understood by teachers. Teachers know that learners are different but they make no attempt to differentiate problems to reach and motivate the bright students. It is taken for granted that the bright students will do extra problems on their own. The importance in satisfying all learners and reaching out and fulfilling their potential is underestimated. Teachers think of mixed ability in terms of HG and SG mathematics and not in terms of students different IQs.

5.2 Batleng High School

5.2.1 Context information

Batleng High School is a senior secondary school situated about 20km from Sun City and 70 km from the nearest town of Rustenburg. The school is in a rural village and very poor setting. There are 9 functional classrooms and five extra classrooms in need of repairs. These could be converted into laboratories as there is no science laboratory or a library. Total enrolment is about 305 learners from grade 10 to grade 12.Payment of school fees and parental involvement is very minimal.

The vision of Batleng High School is to produce results and responsible citizens and promote the spirit of hard work and determination among our learners.

The mission of the school is to strive towards a culture of learning and teaching and advocacy for loyalty and honesty. The school motto “Thuto boswa” or “Education is the future”

The school has young educators who come from mostly the village, with varied experience and commitment to the profession.

Table 5.2: Characteristics of mathematics teachers at Batleng High School

	Nationality	Qualification	Teaching experience	Years at Batleng school	Allocation (Mathematics)
Teacher D	South African	Diploma	10	10	Grade10A(36),10B(37),11A(41) ,12A(19)
Teacher E	South African	Diploma	5	4	Science;grade10A(36)10B(37) ,11A(41),12A(26)

5.2.2 Formal curriculum

The formal curriculum is described in school policy and with information from the interview with the principal and deputy principal.

Batleng High School prepares learners for the National Senior Certificate examination administered by the department of Education. The school offers the following streams in Grade 12:

- Natural sciences: Mathematics, Physical science, Biology, Accounting

- Humanities 1 :Business economics, Biology, Geography, History / H. Economics
- Humanities 2 :Geography, Biblical studies, History/ H.economics, Biology

The above three streams reflect a particular class combination of subjects. Natural science is the only stream reflecting mathematics in grade 12 with about 19 learners as reflected in Table 5.2.

The medium of instruction is English, which is taught as a second language. Setswana is taught as a first language and Afrikaans is another second language. Learners enrol for minimum six subjects and should obtain a minimum of 40% average for a pass. The promotion criteria are determined by the Department of Education

Interview with the principal revealed that learners are streamed into different subject groupings based on their grade 9 results and performance in mathematics. Learners are given first option to choose a particular subject grouping but teachers give advice particularly for science stream. There is no school policy to give a clear breakdown in how learners follow certain streams. Parental involvement is minimal and efforts are been made to improve this.

SG mathematics curriculum for grade 11 and 12 is offered based on learner performance their grade 10 results. The learners are given an opportunity to demonstrate if they are capable to attain good marks in grade 10 to enrol for HG in grade 11 and subsequently grade 12. This has been a yardstick to offer curriculum based on their performance and aspiration. The researcher found out that record of the school shows consistent enrolment for SG in grade 12.

The deputy principal alluded to the fact that from his experience teachers with a diploma cannot handle HG syllabus, hence they are inclined to offer SG instead. Hence he felt that the new curriculum will do more harm than good in relation to grade 12 results.

Resources are not in good supply either. There are no laboratory materials and mathematics teaching aids. Photocopy machines not repaired on time and this constraint the photocopying of worksheets for learners.

5.2.3 Perceived curriculum

Teacher perceptions were explored by analysing data from interviews. The perceived curriculum was analysed by focusing on the teacher's perceived teaching of mixed ability grouping and how SG mathematics makes this possible by reflecting on their teaching practice.

Teacher D explained that learners from senior primary school enrolling in their school lack basic mathematical skills. He blames the OBE approach for teaching with no defined syllabus and content in mathematics in primary school. This has proved to lead to them being very weak at mathematics. He therefore feels that SG syllabus is suitable for them. He indicated that the record of his teaching reflect this as the best choice. Mathematics standard grade syllabus at least guarantees learners a chance to pass mathematics at grade 12.

In dealing with mixed ability teacher the feels that the textbook has graded problems for different learners. He perceives that mathematics SG works because the learners do the same syllabus attains the same objectives and is expected to achieve good levels of competencies. In terms of HG and SG in the same class, teachers feel this would be difficult to teach them because the two syllabi are very different in terms of expectations, content to be covered, and examination setting style.

The teacher feels that SG allows the pace to be varied, remedial work to be done efficiently and group work is possible as the work is the same. The teacher expressed concern about the workload if they try to provide enrichment activities for learners. He acknowledges that learners easily support each other in groups. HG syllabus is very big and cannot be completed in the time allocated in the school curriculum (refer appendix A5 for comparison between HG and SG). Hence results are generally disastrous for learners and teachers. The teacher perceives that mathematics is taught well in a setting arrangement without mixed ability groupings due to different syllabi in terms of HG and SG. When asked about the new mathematics curriculum the teacher shows some uneasiness and feels that students will suffer more.

5.2.4 Operational curriculum

The operational curriculum focused on the lesson execution by teacher D. Two observations were done at grade 12 mathematics class to explore how the lessons reflect mixed ability teaching. The general characteristics of the lesson execution in terms of check list see Appendix A4.

The teaching approach was teacher centred and the use of the chalk board is the central mode of lesson presentation. No work sheets are ever used in class. The methodology was almost monotonous. All learners are treated as being the same because they are doing the same syllabus. But by observation there are learners who work faster than others and voluntarily help the slow ones. The teacher had an awareness of different learner abilities but made no attempt to give or prepare in advance exercises to deal with bright learners.

According to school time-table mathematics has five periods of 40 minutes each. This is not sufficient time in relation to subject policy from Department of Education. It is almost forgotten that before any lesson it is informative to establish the learner’s prior knowledge. This was certainly done in the pursuit of finishing the syllabus in time for the final examinations. Exercises are followed chronologically in an attempt to move from simple to most difficult. Textbook was the source of tasks for homework and class-work.

This class with 19 learners doing mathematics offers the teacher the opportunity for group work but no attempt was made by the teacher.

5.2.5 Experiential curriculum

Data for the experiential curriculum was obtained through student interviews, which were carried out at the end of the lessons. Students were asked about their learning experiences within the SG curriculum and their perceptions of mixed ability classes.

Students revealed that mathematics SG starts from grade 11 and based on the teacher advice. Some indicated that they feel trapped in standard grade mathematics. Working in groups was easy because the mathematics class had only 17 students but learners indicated that they mostly work in groups in the afternoon not during the normal period. They feel that the teacher's focus was finishing the syllabus. They perceive mathematics in standard grade makes the content the same, hence the same assignment, and homework. Brighter learners usually help weaker learners in groups. Learners felt this encouragement and support for each other in mixed ability groups.

When asked if they can attempt mathematics at higher grade most learners felt it will demand too much from them. "*Doing standard grade gives you a chance of getting good grades as long as you work hard"* one learner said. With the new curriculum phasing HG and SG leading to one syllabus, learners felt that it will disadvantage many of them.

5.2.6 Within case analysis

In this case, the teacher teaches mathematics in grade11 and 12 alone. Students are streamed from grade 10.This has great influence on the learners as they are only exposed to his style of teaching. The textbook was the sole guide of the syllabus to be completed as it also demarcated or clearly indicated what sections are examinable. The teacher has been teaching mathematics SG for ten years now, to introduce HG will be an uphill struggle. With the introduction of a uniform syllabus, it will mean an increased number of failure rates.

Reasons for doing mathematics at standard grade are based on the learners' poor background in mathematics, the teachers qualifications in dealing with mathematics SG, their own content exposure is limited as they have diplomas. Related factors could be the lack of support from subject advisors, the lack of teaching aids and the OBE approach introduced in senior primary school.

The teacher does not differentiate learners according to ability but gave them the same exercises. All learners doing mathematics SG actually disguise the teachers' competency in dealing with high ability learners.

Students revealed that mathematics SG starts from grade 11. Learners in the mixed ability class felt the encouragement and support for each other. Some indicated that they felt trapped in standard grade mathematics.

Mathematics SG is very concise and short to finish within the time given in the year plan. HG mathematics very broad and has extra chapters not covered in mathematics SG, hence it was perceived as difficult to finish within the time allocated in the time-table.

5.3 Cross-Case Analysis

Formal curriculum

Both schools show streaming as a form of grouping learners. The kind of grouping of subjects depends largely on the availability of staff teaching for such subjects. Common was that science learners had to take mathematics, but learners doing commercial subjects in Batleng high school do not necessarily indicate taking mathematics, which is an anomaly. Standard grade curriculum in mathematics is offered in both schools and the reasons put forward for this decision are mostly similar. Both schools put emphasis on learner background performance in mathematics. Batleng secondary also blamed the introduction of OBE (Outcomes-Based Education) in senior primary for the poor background of learners in mathematics and Phakedi blamed teachers' content knowledge in primary schools. The deputy principal of Batleng School suggested that another factor could be that teachers did their grade 12 mathematics at standard grade level.

School policies in both cases do not specify criteria for streaming, hence this decision is left to teachers and learners to a lesser extend. Parental support is minimal and school fees due is not paid by majority of parents because of lack of employment. Hence the resources are not sufficient in the schools.

Perceived curriculum

Teachers choose to do standard grade as they perceive HG as too demanding for the learners. They have the attitude that HG mathematics syllabus is very broad to be completed within the given time in the time-table. Hence in most cases learners will fail due to the fact that they only covered a fraction of the required syllabus.

In dealing with mixed ability teachers felt that mathematics SG offers the possibility since the syllabus is short. Teachers perceived that learners work well within the same syllabus, for quick remediation and support. Teachers perceive that the textbook has graded exercises for dealing with learners in mixed ability classes.

Operational curriculum

Classroom practices are dominated by the teacher-centred approach, which is driven by the pressure to finish the syllabus. In both cases, teachers use past question papers as a guide for what is expected at the end of the year examinations. Standard grade suits this strategy very well since the syllabus is very narrow and easily doable in the time available. The HG syllabus is very broad and thus perceived by teachers as too demanding and impossible to complete in the given time on the time-table.

Teachers give learners the same problems to solve and no differentiated homework. Teachers did not attempt group work in their classroom practices. Hence teacher practices related to dealing with mixed ability grouping are absent. School time-table in Phakedi has 6 periods of 40 minutes as compared to 5 periods in Batleng. Hence in Batleng, mathematics is 40 minutes less than the stipulated time allocation for mathematics. Work sheets are not common in both cases. The lack of resources is cited as a problem for this approach. Teachers are made to talk and use the chalk-board as the sole teaching aid. Most learners are discouraged from taking mathematics at HG as it will spell doom for the progress in school.

Experiential curriculum

Students felt trapped in the Standard grade syllabus as this is started in grade 11 and is impossible to change in grade 12. The situation is regarded as normal because in both schools as learners feel that it is possible to achieve good marks in standard grade and almost impossible to achieve the same in HG. School records show no entries for HG and almost exclusively SG. Batleng shows this consistency for the last 2 years, and Phakedi shows occasionally one student enrolling for HG and getting poor results i.e. below 50%.

Overall there is no marked improvement of the overall student performance in mathematics SG. At least there will be one or more students consistently achieving a distinction(s) in mathematics at SG level. This is the driving force behind doing standard grade syllabus, as getting at least one distinction in mathematics in a school seen as an achievement.

Mixed ability is recognised by students and they feel being in the same class boasts the weaker students. The uniform syllabus also gives them the same opportunity to compete equally without degrading each other. In Phakedi, one learner who showed exceptional talent found himself trapped in a slowly paced class and had to be given extra tuition and extra work after normal classes.

5.4 Conclusions

In both school learners are streamed. Schools' policies do not advise learners enough about the decision they make in grade 10 streaming choices (subject combinations) and their future goals. Not enough attention was put into mathematics teaching aids and other resources to facilitate the improvement in the overall pass in mathematics. Subject advisors support schools only in terms of issuing policy documents and year plans to schools. No pedagogical support is given. The teachers are still doing the talking and learners passively listen. Mathematics is still portrayed as most difficult and only standard grade give the guarantee for a possible pass.

It is important to note that reasons advanced by the school and teacher for doing mathematics at standard grade are common. The school aims at achieving overall good grade 12 passes, to be among the top in the league. Learners' poor background from primary school in mathematics was a result of automatic promotion. Outcomes Based Education does not stipulate content to be taught at primary level.

Other reasons are lack of proper pedagogical support from mathematics subject advisors and lack of resources, for example photocopy paper for worksheet development. From school records, teachers do not want to expose their incompetence in dealing with HG syllabus as they themselves did their grade 12 examinations in standard grade. Particularly those with College diploma as the college mathematics did not fill the gap sufficiently to make them confident to teach at HG level.

Importantly, regardless of either teaching at HG or SG, learners are different and they will perform at different levels. Teachers acknowledge this difference but do not prepare their lessons to harness this difference in abilities. It could be hypothesised that if teachers prepare sufficiently for these differences, learners within the class will be motivated to raise their work rate at the level of excellence in mathematics. This challenge will be positive competition as they are exposed to the same syllabus, hence the same opportunity to learn. Mixed ability in dealing with different syllabi is very difficult for teachers to cope within class, as this demands having to prepare completely different content as this is the situation in South African mathematics syllabus. Mathematics at higher grade level contains additional topics that are not covered in standard grade.

The lack of resources was very much visible in rural schools. Poor communities cannot pay school fees or donate anything to the schools. Educational resources are not only seriously limited, but also unequally distributed.

Learners' perception about mathematics was that it is the worst curricular villain in driving them to failure in schools. When mathematics acts as a filter, it not only filters students out of careers, but frequently out of school itself. Sustained, incremental progress calls for the availability of high quality curricula, for the stable, knowledgeable, and professional teaching community.

CHAPTER 6

DISCUSSION

This final chapter discusses the findings and recommendations of the study. It will recapitulate the research problem and approach (6.1), summarise the main research findings (6.2), discuss (6.3), draw conclusions (6.4) and finally outline the recommendations (6.5)

6.1 Recapitulation of the research problem and approach

Widening access to schools and automatic promotion has led to an increasing number of students in junior secondary education in North-West, South Africa. The increasing number of students in junior and senior secondary education has led to a large degree of heterogeneity in the student population. Problems of mixed ability teaching are present in all of South Africa, and the examination results show that the curriculum aims are not within reach of the majority of students (SMICT report, in press).

Some cited problems that led to poor performance include: language problems, automatic promotion, poor base provided at primary and junior secondary level and an ambitious content of curriculum.

From a grand total of 384 secondary schools in North-West Province, 184(48%) schools offer mathematics only at standard grade. This has implications for admission at universities and the implementation of the new curriculum. Universities base their admission on a pass in mathematics higher grade. Learners with a pass in standard grade are waitlisted and their admission is dependent on an opening arising. Most universities even introduced foundation programs for students with a pass in mathematics standard grade.

The problem schools are facing with dealing with mixed ability teaching can be reflected in the fact that most schools enrol learners in mathematics SG. Mathematics standard grade is short and can be completed within the time allocated in the time-table and year plan, hence teachers cope well with it. Mathematics HG is wide and very long to be completed within the allocated time.

The study was guided by the following research question:

How do senior secondary schools in the North-West Province (NWP) in South Africa offering only standard grade deal with individual differences between learners, particularly learners with mixed abilities in mathematics?

Sub-questions:

1. What is the formal school curriculum?
2. What is the perceived curriculum (why only SG mathematics)?

3. What is the operational curriculum?
4. What is the experiential curriculum?

Schools offering only mathematics at standard grade were selected from 2003 North West Province's results data base. Two schools with relatively good SG results, but with no HG students and being rural schools were selected for an in-depth analysis via a case approach. Three data collection procedures were applied. Principal interviews yielded information about school policy and formal curriculum. Teacher interviews and classroom observations (using checklist) yielded information on the perceived and operational curriculum. Student interviews gave information on the experiential curriculum. Document analysis was used to corroborate information gathered from all of the above.

6.2 Summary of the main research findings

The summary will be based on the most relevant data from chapter 5 in addressing the main research question.

Why the schools are offering standard grade in mathematics?

- Introduction of Outcomes based education(OBE) in primary schools contributed to the poor background of learners in mathematics
- Learners from GET enrolling in senior secondary lack basic mathematical skills
- SG syllabus is very concise and short to finish within the time frames of the year plan and end of the year examinations.
- Schools achieving good passes in grade 12 final examinations, easier to fulfil with mathematics SG.
- The HG syllabus is very broad and thus perceived by teachers as too demanding and impossible to complete in the given time on the time-table.
- Mathematics HG has extra chapters not covered in mathematic SG
- Qualifications of teachers, for example teachers with diploma are not competent to teach higher grade mathematics
- Teachers did mathematics at standard grade during their schooling.
- Learners also feel that it is possible to achieve good marks in standard grade as compared to achieving the same grades in HG
- Lack of support from subject advisors in pedagogic and content subject support for teachers
- Lack of resources, including teaching aids.

Teachers' classroom practices and perceptions in mixed ability classes

- Streaming of learners in schools
- Teacher-centred approach is very much prevalent in the classroom.
- Teachers are not addressing the difference in learners adequately. There is no differentiation of homework or extra problems for bright learners.

- Teachers expressed the concern about the workload if they try to provide enrichment activities for learners.
- Mathematics has also been perceived as an unsuitable subject for mixed ability groups.

Learners’ experiences with mixed ability classes

- Learners feel that mixed ability grouping is beneficial for group work and slow learners are supported by the brighter students.
- Some indicated that they feel trapped in standard grade mathematics.

6.3 Discussion

The introduction of Outcomes based education (OBE) primary schools contributed to the poor background of learners in mathematics. The outcomes outlined learning areas more broadly than in traditional ‘subjects’ and in doing so created links from subject knowledge to social, economic and personal dimensions of learning. Also due to the attention drawn to integrating learning areas, the progression of concept development from grade to grade was also often lost. Integration meant teachers focused on the content they master and pay little attention to other parts they are not comfortable teaching. More important is the philosophy that all learners can achieve, hence this led to almost automatic promotion.

Teachers in secondary schools content that learners from GET are not well grounded in mathematics and lack basic knowledge and skills. This aspect seems to be supported from a finding of grade 8 teachers characteristics in a study by Howie (2001) based on TIMMS-R of 1998 data on South Africa. According to Howie (2001), approximately one in four mathematics teachers in grade 8 classes were not formally qualified to teach mathematics and not completed education beyond secondary school. It is not surprising therefore that many teachers lacked the confidence to teach mathematics. Also that pupil are at least two or three years behind in their content knowledge and skills by the time they reach grade 8 and this result in tremendous pressure on secondary school teachers.

Enrolment in standard grade mathematics contributed to schools achieving better results overall. This is the important consideration as schools are scrutinised in terms of their overall grade 12 performance. This fact of leagues underscores the offering of mathematics at higher grade. Data shows an increased enrolment of learners taking mathematics standard grade in 2004 as compared to 2003. This has implications at universities and directly affects the number of learners enrolling for teacher training in mathematics and science. Most universities have introduced foundation programs to close the gap in content in relation to doing standard grade in mathematics.

The HG syllabus is very broad and thus perceived by teachers as too demanding and impossible to complete in the given time on the time-table. Comparing the amount of content covered in standard grade mathematics and higher grade as depicted in appendix A5, this reason can be valid. Standard grade mathematics has a very narrow and precise content to be covered by teachers and examination requirements are well defined. Higher grade syllabus describes content to be covered in very general and open terms. So it is understandable that teachers stick to mathematics SG. The question that could be posed is why learners are still failing mathematics even at standard grade level? This has implications for the introduction of the new curriculum in mathematics. The new curriculum has a strong emphasis on higher grade mathematics, in addition to new topics also introduced.

Teacher qualifications also play a role in mathematics teaching, for example teachers with a diploma are not competent to teach higher grade mathematics. According to the analysis of supply and demand in science and mathematics teacher education in the North-West Province done by de Feiter in 2004, he concludes that for teaching at senior secondary level, a 3-year diploma level qualification should be considered insufficient, at least in some academic subjects, particularly mathematics and science. Further since 1948 government policy for white teacher training stipulated that for teaching in secondary schools teachers should be trained at university. The new mathematics curriculum does not acknowledge the knowledge deficiency in black teachers and this will lead to disastrous effects, particularly among majority of college trained teachers.

From school records, it appears that teachers teach SG mathematics because they themselves did mathematics SG in their grade 12 certificates. Hence it is safe to teach the level in which you have demonstrated competence. This brings the question of teacher training and aims in terms of what kind of teacher is produced to teach grade 10-12 learners. Is the philosophy of RPL (recognition of prior knowledge of learner) only done at school level teaching and not at teacher training?

The college syllabus in former black teacher training colleges did not recognise this prior learning deficiency or was it intended by the former apartheid government? The famous Verwoerd's quote states:
"*What is the use of teaching the Bantu child mathematics when it cannot use it in life? That is absurd. (Hirson, 1979, p.45)-* Quoted from Mkhize, 2000.

Looking into school records no learner seems to venture into the unknown. The schools had been offering standard grade for a long time. Thus learners also feel that it is easier to achieve good marks in standard grade as compared to achieving the same grades in higher grade. Few exceptions could be picked up during interviews, as some learners who show competence to attempt higher grade mathematics feel they are denied that opportunity to demonstrate their abilities.

Teachers expressed that there was lack of support in pedagogical and content knowledge from subject advisors. Teachers explained that they are always given year plans indicating what topics to cover to finish the syllabus on time for examinations. Pedagogical support on how to achieve these plans is not forthcoming except being given assessment policies in conjunction with the year programs. When teachers do not experience conflict between their teacher-centred practice and the intended learner-centred practice, opportunities to change their practice are diminished (Motswiri, 2004).

Hence providing teachers with relevant pedagogical content knowledge support is regarded as being crucial to promoting teacher change.

The lack of resources led to monotonous lessons. Teachers are made to talk and use the chalk-board as the sole teaching aid. The irony is that with the introduction of a more outcome-based curriculum, which tends to be a more resourced-based approach, it is the private or independent schools that are in fact more advantaged as they can afford the necessary resources more easily (Howie et al., 2004).

Teachers are not addressing the difference in learners adequately. There was no differentiation of homework or extra problems for bright learners. In their findings Ireson, Hallam, Hack, Clark, and Plewis 2002, found that with mixed ability classes, teachers provided a greater variety of activities and more differentiated work, whereas they tended to use more whole class instruction with sets. Hallam and Ireson 2003 found that experienced teachers appeared to be more supportive of mixed ability teaching, but they often found it more difficult to put it into practice than those who had been recently trained to adopt such practices.

The curriculum is dominated by the teacher-centred approach. This is driven by the pressure to finish the syllabus. In both schools teachers used past question papers as a guide for what was expected at the end of the year examinations. Teachers expressed a concern about the workload if they try to provide enrichment activities for learners. This could be because of some classes having more than 35 learners, were it will be impossible to provide individual assistance and even group work.

Mathematics lessons focus on rote procedures rather than conceptual understandings and problem solving. In a typical lesson in most classes, teacher instructs students in a concept or skill, he/she solves example problems with the class, and students practice on their own while he/she assists individual students. An exemplary lesson is were teacher poses a problem, students struggle with the problem, various students present ideas or solutions to the class, the class discusses the class's solutions and students practice similar problems. The dedication of teacher matters with regard to their pupils' achievement (Howie, 2002).

Mathematics has also been perceived as unsuitable subject for mixed ability groups.
This position is supported by report the by Hallam and Ireson(2003) that humanities have been perceived to be suitable for mixed ability teaching, whereas mathematics and modern foreign languages have tended to be perceived as inappropriate. Also from literature reviewed teachers from mixed ability schools felt that higher ability pupils are held back and cannot be stretched to their full potential in a mixed ability class, particularly in mathematics classes. Mixed ability in general enhances self-esteem, overcomes disaffection and disciplinary problems. There is also a strong indication that mixed ability teaching in reality only benefited the less able academically at the expense of the more able.

According to Bennie, Levinschi and Oliver (1999) equality in learning environments can be achieved by the pursuit of two apparently contradictory goals, for diversity (mathematical diversity) is both “acknowledged” and “ignored”. By acknowledging diversity all learners are given the opportunity to fulfil their mathematical potential (acknowledging that different learners will learn at different levels). By ignoring diversity we recognise that certain mathematical knowledge is required by all learners if meaningful interaction in heterogeneous groups is to take place and allow access into future mathematical activity. In this way a diverse and productive mathematical community can be created for there is sufficient space for meaningful sharing of mathematical knowledge as well as enough space for learners to express their mathematical diversity.

6.4 Conclusions

The main research question in this study was how schools offering SG mathematics deal with differences in learners, in mixed ability groups. The results shows that teachers' classroom practices reflect that teachers are treating learners as being the same and not dealing effectively with various abilities in the classroom. Also the system of streaming is used in schools to classify learners into different tracks based on their mathematics achievement or scores from grade 9. Mathematics is used as a yardstick to allocating learners into different classes. This is represented in school curriculum in both schools were some learners are enrolled in mathematics classes and others not.

Schools in South Africa use the system of streaming learners from grade 10. The subject combination offered depends on the availability of staff. This is done as advertising and filling of posts is a very slow process controlled by the government. This particularly affects rural school that do not have sufficient funds to hire temporary teachers

As described in chapter one, the problem of mixed ability arose as a result of more enrolments in junior secondary and automatic promotion to achieve equal opportunity to learn. The teachers interviewed indicated that they have limited resources and pedagogical knowledge to deal effectively with mixed ability groups. In an indirect way of addressing this problem intuitively teachers resort to offering standard grade mathematics as the syllabus is manageable within the time-table and time constraints.

The teaching of standard grade by 50% of the total schools in the Province, poses a serious challenge for the implementation of new curriculum in 2006. The new curriculum as previously highlighted is more overloaded than the present higher grade syllabus, schools are dreading to teach.

Another important factor brought by producing standard grade mathematics high school leavers is reflected on many teachers having been trained at colleges, as they would not qualify for admission at universities. This impact is what is reflected in terms of mathematics results at senior secondary level. The fact that teachers did mathematics standard grade and attended colleges means that they are at the level with the students they are teaching in terms of mathematical content knowledge. Based on the conclusions above the following section suggests some recommendations.

6.5 Recommendations

According to literature reviewed mixed ability teaching offers a better ability grouping as learners get motivated, get the equal opportunity to learn and perform better. It also helps the weaker students improve during their interaction with the bright students during group discussion. But also true is that advanced mathematics courses could also be done by only the few of the students. Hence a balancing act has to be done by schools, where particularly their policies should be explicit in this regard by offering the core curriculum to all students and by offering an advanced curriculum to able students. The methods of selection should be open and transparent to all learners.

Based on the overwhelming enrolment numbers in standard grade demonstrated by majority of schools in the North West Province, standard grade mathematics could be offered to all learners as the basic core that every learner could do. Mathematics HG or new mathematics curriculum is offered by schools that have competent, well qualified teachers (with degrees). The DINALEDI project initiated by the National Strategy for Mathematics, Science and Technology is the best example that we can build on.

Subject advisors should concentrate on pedagogical knowledge support for teachers. Implementation is a process of adapting the curriculum in such a way that it becomes part of the teacher's 'way of life' or 'way of being'. In adapting the curriculum in this way, teachers will change themselves and modify the curriculum. There is a doubt cast on the subject content of advanced certificates in mathematics, offered for teacher upgrading to fill the knowledge gap referred to earlier.

Resources should be distributed as a matter of urgency to rural schools. According to Howie (2002) the location of the school is further a predictor of South African pupils' achievement in mathematics.

The knowledge base required for effective teaching is substantial. There are issues of subject matter knowledge, knowledge of student understanding of subject matter (pedagogical content knowledge), of understanding curricular goals, of classroom management, and more. An aligned professional development program can contribute to the gradual strengthening of the teaching force and iterative improvement of curricula.

Presently teachers are exposed to three day once-off workshops that emphasise the understanding of OBE terminology and policies not the pedagogical aspects of OBE. A professional development program can be designed using researched models in developing countries, for example peer coaching and teacher support materials (Thijs, 1999, Ottevanger, 2001, Motswiri, 2004).

The use of the chalkboard could be improved as it is the major teaching aid for rural schools. According to Adler (1999), the chalkboard can be used effectively by the teacher. First, learners come up to the board to record a solution to a homework or class problem. Second, pupils display diverse responses to tasks or problems on the chalkboard. Thirdly, instead of learners copying examples and procedures written by the teacher, they are invited instead to scrutinise procedures and solutions written by others. Hence this extended use of the chalkboard demonstrates the learner-centred approach by increasing pupil activity and encouraging diversity (probing mathematical thinking).

Further research in the area of mixed ability teaching in South African context will be needed.

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APPENDIX A1

Teacher's Interview Scheme

1. Could you describe the composition of your student in the class in terms of abilities?

2. What criteria do you use to allocate students in terms of abilities?

3. Is there a policy in the school that gives guidelines in how to allocate learners to different classes or groups?

4. Do you use differentiated methods in mixed ability classes or treat them the same?

5. Do you give all the pupils in class the same work on the same topic?

6. Given a choice between mixed ability and setting which grouping would you prefer?

7. Is mixed ability suitable for the teaching of mathematics?

8. Why are you teaching only standard grade mathematics in grade 12?

9. What are the underlying reasons by offering only SG curriculum in mathematics?

10. What support do you get from the region in your subject?

11. With the new curriculum phasing out standard and higher grade, how do you feel about it?

APPENDIX A2

Students' Interview Scheme (Focus groups)

1. How are you classified in your class in terms of mathematics?

2. If you perceive that your class is mixed ability, what are feelings in terms of pace of work?

3. Do you think in mathematics being in mixed ability is fair for all students?

4. Who benefits in mixed ability groups?

5. If given a choice what different arrangement can you propose?

6. If you have a choice will you prefer same abilities together (i.e. SG)?

7. Why is your curriculum offering only mathematics SG?

8. Given the opportunity to choose between higher or lower ability in mathematics which will you choose?

9. What assessment practice are you exposed to most frequently, test, portfolio, group assignment, exams, etc?

10. Do you like working in groups or individual?

11. With the new curriculum phasing out standard and higher grade, how do you feel about it?

APPENDIX A3

Principal's Interview Scheme

1. How children are grouped in different mathematics classes?

2. Is there a school policy in guiding teacher to allocate learners to different groups in terms of ability in mathematics?

3. Is the decision to allocate students to different abilities done by individual subjects teachers or through departmental meetings?

4. Why is your school curriculum emphasizing SG mathematics to grade 12 learners?

5. Is the supply of resources equal for all ability groups?

6. Are parents in anyway involved in grouping of learners?

7. With the new curriculum phasing out different grades in mathematics what effect will it have on children?

8. What support do you get from the region in terms of resources?

APPENDIX A4
Checklist

Basic teaching skills	yes	No	N/a
1. Teacher relates activities to previous lessons	☐	☐	☐
2. Teacher introduces /explains key concepts	☐	☐	☐
3. Teacher explains the aim of the activity	☐	☐	☐
4. Teacher explains the procedure of the activity	☐	☐	☐
5. Teacher explains how students should report the outcomes of the activity	☐	☐	☐

Teaching skills: How lesson reflects mixed ability	Yes	No	N/a
1. Teacher groups learners according to ability for the activity	☐	☐	☐
2. All learners work on the same topic	☐	☐	☐
3. Teacher gives different activities according to ability	☐	☐	☐
4. Teacher use different resources to different groups	☐	☐	☐
5. Pupils work on the same task, work is differentiated by outcome	☐	☐	☐
6. Teacher tries to attend to all groups equally	☐	☐	☐
Learner-centred orientation			
7. Pupils explore the problem/topic in groups or individually	☐	☐	☐
8. Teacher allows learners 'room to choose' their own approach	☐	☐	☐
9. Teacher assists learners when necessary, but not immediately	☐	☐	☐
10. Teacher encourages learners to ask questions	☐	☐	☐
11. Teacher encourages learners to discuss with peers in their groups	☐	☐	☐

General impression of the lesson	Yes	No	N/a
1. Required materials are available before the lesson	☐	☐	☐
2. Teacher makes use of classroom aids	☐	☐	☐
3. Teacher has worksheets for learners	☐	☐	☐
4. Teacher listens to learners' answers	☐	☐	☐
5. Teacher responds positively to learner inquiry	☐	☐	☐
6. Teacher uses available time efficiently	☐	☐	☐
7. Teacher effectively handles timing difficulties	☐	☐	☐
8. Teacher successfully improvises when time runs short	☐	☐	☐
9. Teacher acknowledges learners' ideas (e.g. questions/answers)	☐	☐	☐
10. Teacher uses/discusses learners' ideas	☐	☐	☐
11. Teacher summarises learners' long questions	☐	☐	☐
12. Classroom atmosphere seems to encourage learners to ask/answer questions	☐	☐	☐

APPENDIX A5
COMPARISON BETWEEN HG & SG MATHEMATICS SYLLABUS GRADES 11-12

GRADE 11

SG and HG	HG Only
1.ALGEBRA	
1.2 Functions	Absolute value, Inverse of functions
1.3 Quadratic equations	Quadratic equations and inequalities
----------------------------------	Linear programming
1.4 The remainder and factor theorem	
1.5 Systems or equations	Quadratic equations and inequalities
1.6 Exponents	
2. TRIGONOMETRY	
2.1 Definitions of trig. Functions [0^o;360^o]	For any angle in terms of co-ordinates
2.2 Functions and values and 2.3 graphs	
2.4 Functions values for 0^o,30^o,45^o and multiples thereof over [0^o ; 360^o]	Without use of calculators
2.5 Identities- reciprocal functions	Mutual relationships between functions
2.6 Formulae- sine rule, cosine rule	
Area of a triangle and application of formulae in two dimensions	Applications of formulae in three dimensions
3. EUCLIDEAN GEOMETRY	
3.1 Theorem of Pythagoras(without proof	
3.2-3.10 Theorems	3.11.1 Bisectors of a triangle and perpendicular bisector of sides of triangle theorems
------------------------------------	3.11.2 The medians and altitudes of triangle theorems

GRADE 12

1. ALGEBRA	
1.1.1 Logarithms- definitions	The power function of $y = a^x$, a>0; its graphs and deductions from graph
1.1.2 The conversion of exponential form to logarithmic form and conversely	The logarithmic function $y = \log_a x$, a>0 and $a\neq 0$, its graph and deductions from graph
1.1.3 Basic laws of logarithms(proofs not required for examinations)	Basic properties of logarithms (with proofs)
1.1.4 Applications of above in the solutions of simple equations example $5^x = 17$; $4.3^{x+2} = 15$	1.4 Simple logarithmic equations and inequalities
	Change of base of a logarithm
1.2.1Determination of n in the compound interest formula, solutions	--
1.2.2 Compound decrease and increase	----------------------------------
1.3 Sequence and series	Convergence of a geometric series and its sum to infinity
2. DIFFERENTIAL CALCULUS	
2.1 The average gradient of a curve between two points	
2.2 Limits	
2.2.1 Intuitive approach to the concept limit	
2.2.2 Determination of limits using first principle of: k, ax, ax + b, ax^2	Determination of ax^3
2.2.3 Derivatives of a function; the notations: D_x;	

d/dx and f'(x)	
2.2.4 The gradient of a curve at any point on the curve	
2.3 $D_x[x^n] = nx^{n-1}$; n real (without proof)	
2.4 Rules of differentiation(without proofs)	With proofs
2.4.1 $D_x[f(x) \pm g(x)] = D_x[f(x)] \pm D_x[g(x)]$	
2.4.2 $D_x[k.f(x)] = k.D_x[f(x)]$	
2.5 Applications	
2.5.1 Turning-points and sketches of polynomials of at most the third degree	The equations of tangents to graphs
2.5.2 Simple practical problems in connection with maxima and minima	
3. TRIGONOMETRY	
	Function values for $-\theta$ and $(\theta+360.n)$, where n is an integer, expressed in function values for θ, θ Є $[0^o ; 90^o]$
3.1 The sine, cosine and tangent functions	
3.1.1 Description of the range with the domain within $[0^o ; 360^o]$	Description of domain and range
	Maximum and minimum function values and period
3.1.2 Sketches of curves of the following types: y = a sinx, y = a cosx, y = a tanx; y = sinax, y = cosax; (a an integer and ax Є $[0^o ; 360^o]$	Sketches of the curves of the following types; y = a sinθ, y = a cosθ, y = a tanθ, y = sin aθ, y = cos aθ, y = tan aθ; y = a + sin nθ, y = a + cosθ, y = a + tanθ ; y = sin(α + θ) , y = cos (α + θ); where n is an integer or a fraction of the form 1\n)
3.2 Solving elementary trigonometric equations as stated in 3.1.2	Equations of the type a sinx + b cosx = c with c± 0 excluded)
	3.3 Cos (A-B) = Cos A Cos B + SinA Sin B identities for ; Cos (A + B), Sin (A ± B), Tan (A ± B) , Sin 2θ , Cos 2θ, Tan 2θ
4. EUCLIDEAN GEOMETRY	
4.1. Theorem, proportionality	
4.2 Definition of similarity	
4.3 Equiangular theorem	
4.4 Equiangular triangles theorem	
---	4.5 The perpendicular drawn from the vertex of a right angled triangle to the hypotenuse, …(theorem)
--	4.6 Theorem of Pythagoras and its converse.
5. ANALYTICAL GEOMETRY IN A PLANE	
5.1 The distance between two points	
5.2 The mid-point of a line segment	
5.3 Gradient of a line	
5.4 Equations of a line and its sketches	
5.5 Perpendicular and parallel lines(no proofs)	
5.6 Collinear points and intersecting lines	
5.7 Intercepts made by a line on the axes	
5.8 Equations of circle with (0;0) and given radius	Equations of circles with any given centre and given radius
5.9 Points of interaction of lines and circles	
5.10 Other simple loci with respect to straight lines and circles	5.10 Other loci with respect to straight lines and circles
--	5.11 Equations of the tangent to a circle at a given point on the circle