University of Venda
Creating Future Leaders

UNIVERSITY OF VENDA
LIBRARY
CALL No
ACC No

THE ROLE OF SUBJECT ADVISORS IN SUPPORTING MATHEMATICS EDUCATORS IN THE FURTHER EDUCATION AND TRAINING BAND WITH REGARDS TO PEDAGOGICAL CONTENT KNOWLEDGE

BY

MAUDU MUKHETHELWA ISAAC

STUDENT NUMBER: 8400056

DISSERTATION SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF

MASTER OF EDUCATION

IN THE

DEPARTMENT OF CURRICULUM STUDIES AND EDUCATION MANAGEMENT

SCHOOL OF EDUCATION

UNIVERSITY OF VENDA

SUPERVISOR

Dr. N.F LITSHANI

CO-SUPERVISOR

Mr. SJM KAHERU

JANUARY 2014

© University of Venda

University of Venda
Creating Future Leaders

DECLARATION

I, the undersigned, declare that THE ROLE OF SUBJECT ADVISORS IN SUPPORTING MATHEMATICS EDUCATORS IN THE FURTHER EDUCATION AND TRAINING BAND WITH REGARDS TO PEDAGOGICAL CONTENT KNOWLEDGE is my own independent work and has not been previously submitted to another University.

MI Maudu

MAUDU MUKHETHELWA ISAAC

.....

DATE: 30 JANUARY 2014

© University of Venda

DEDICATION

This work is dedicated to my parents, Vhavend̩a Vho Tshamano and Vho Mukond̩eleli Maudu, who played their parental role well in bringing up their children with love and caring, and always reminding them that faith can move mountains.

© University of Venda

University of Venda
Creating Future Leaders

ACKNOWLEDGEMENTS

Special thanks and praises to the good Lord above, the Almighty, for giving me strength and courage to complete this study.

I extend my sincere gratitude and appreciation to the following persons:

1. Dr N.F Litshani, my supervisor and Mr SJM Kaheru, my co-supervisor, for their patience, expert guidance and encouragement throughout this project.

2. Dr I. Ndlovu for language editing.

3. My wife Fulufhelo and our wonderful sons, Rokhethwa and Phaṱhutshedzo for their love, understanding and allowing me to give them divided attention during this study.

4. My younger brother, Mpho, for assisting with the scanning of items and graphical representations of data.

5. Principals of the thirteen secondary schools, for their support, and the teachers who participated in the study.

6. Further Education and Training Band Mathematics subject advisors for providing valuable information.

7. My friends, Mudau Sondaha, Lukhwa Robert and Ratshivhaḓelo Alex for motivation, encouragement and support.

© University of Venda

University of Venda
Creating Future Leaders

ABSTRACT

Learners' poor performance in Mathematics is a serious cause for concern in South Africa. To address this concern the Department of Education has appointed subject advisors. While the pass rate in other subjects has improved, performance in Mathematics is still low. This study sought to establish the impact of Mathematics subject advisors' support on educators. The study culminated in the identification of relevant intervention strategies to improve the Mathematics pass rate in grades 10 to 12. The study followed a mixed approach. Relevant information was gathered through the use of both quantitative and qualitative approaches. Questionnaires were issued to Mathematics teachers. These were followed by focus group interviews. Qualitative data was analysed through content analysis. After transcribing, the researcher applied coding, in order to discover the patterns and themes resulting from the data. For Quantitative data a Statistical Package for the Social Sciences (SPSS) was used to analyse data.

The study recommends that while provision of materials and other items is taking place, support on individual development of educators should not be neglected. It is also recommended that University-District partnership with regard to the teaching of school Mathematics and teacher development should be established.

***Key words**: Constructivism, pedagogical content knowledge, Realistic Mathematics Education, Subject Advisor.*

© University of Venda

University of Venda
Creating Future Leaders

TABLE OF CONTENTS

		PAGE
Title page		i
Declaration		ii
Dedication		iii
Acknowledgement		iv
Abstract		v
CHAPTER : INTRODUCTION		1
1.1.	Background to the study	1
1.2.	Problem statement	5
1.3.	Purpose of the study	5
1.4.	Research Questions	6
1.5.	Literature Review	6
1.5.1.	Role of the Subject Advisors	7
1.5.2.	Curriculum perspectives	9
1.5.3.	Strategies to enhance effective teaching and learning in Mathematics	10
1.6.	Definition of concepts	14
1.7.	Research Design and Methodology	16
1.7.1.	Research Design	16
1.7.2.	Research Methodology	17
1.8.	Population, sampling procedure and sample	17
1.8.1.	Population	17
1.8.2.	Sampling procedure.	18
1.8.3.	Sample	18
1.9.	Data collection procedure and data collection instruments	18
1.9.1.	Data collection	18
1.9.2.	Data collection procedure	19
1.9.3.	Data collection instruments	19
1.10.	Data analysis and interpretation.	20
1.10.1.	Quantitative Data	20
1.10.2.	Qualitative Data	20
1.11.	Delimitation of the study	20

© University of Venda

University of Venda
Creating Future Leaders

1.12. Ethical considerations 21
1.13. Significance of the study 22
1.14. Chapter division 22

CHAPTER 2: LITERATURE REVIEW 24
2.1 Introduction 24
2.2 Constructivism 27
2.2.1 Social constructivism 28
2.2.2 Radical constructivism 28
2.2.3 Role of Mathematics teachers and learners in a constructivist Classroom 28
2.3 Pedagogical content knowledge 30
2.4 Roles and responsibilities of subject advisors 33
2.4.1 Provision of overall leadership 33
2.4.2 Supporting teachers in delivering curriculum in the classroom 34
2.4.3 Supporting novice educators 45
2.4.4 Creation of collaboration teams 47
2.4.5 Organising professional development for Mathematics Teachers 53
2.4.6 Monitoring and supporting the implementation of curriculum in Mathematics 55
2.4.7 Provision of resources and assessment documents 57
2.4.8 Support on assessment 59
2.5 Conclusion 66

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY 67
3.1 Introduction 67
3.2 Research design 67
3.3 Triangulation design 70
3.3.1 Data source triangulation 71
3.3.2 Investigator triangulation 71
3.3.3 Theory Triangulation 71
3.3.4 Methodological triangulation 71
3.3.5 Member Triangulation 71

© University of Venda

University of Venda
Creating Future Leaders

3.4 Population 72
3.5 Sampling 72
3.6 Sample 72
3.7 Organisation of the study 72
3.7.1 Phase 1: Quantitative approach 73
3.7.2 Phase 2 Quantitative approach 75
3.8 Reliability, Validity and Generalisability 81
3.8.1 Reliability 81
3.8.2 Validity 81
3.8.3 Generalisability 81
3.9 Ethical considerations 83
3.9.1 Permission 84
3.9.2 Voluntary participation 84
3.9.3 Harm to experimental subjects 84
3.9.4 Confidentiality 84
3.10 Conclusion 84

CHAPTER 4: ANALYSIS AND INTERPRETATIONS OF RESEARCH RESULTS

4.1 Introduction 85
4.2 Quantitative data 85
4.3 Qualitative data 105
4.3.1. Focus group interviews 105
4.3.2. Individual interviews 131
4.4 Conclusions 147

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIOS 148

5.1 Introduction 148
5.2 Summary of the study 148
5.3 Findings pertaining to the research questions 149
5.4 Recommendations 158
5.6 Limitations of the study 160
5.7 Suggestions for further study 161
5.8 Conclusion 161

© University of Venda

University of Venda
Creating Future Leaders

REFERENCES 163

FIGURES

Figure 2.1 The network of pedagogical content knowledge 32

Figure 2.2 Diagram of the investigative approach 41

Figure 2.3 A cycle of planning assessing 62

Figure 3.1 Steps for conducting a mixed methods study 69

TABLES

Table 1.1: Limpopo Province and National Grade 12 Mathematics Average % (2008-2011) 4

Table 1.2 Traditional Classroom and a Constructivist Classroom 11

Table 2.1 Intervention strategies for school support 35

Table 2,2 Assessment goals 61

APPENDICES 189

APPENDIX 1 190

1. Schedule A: SURVEY QUESTIONNAIRE 191
2. Schedule B: FOCUS GROUP INTERVIEW QUESTIONS 197
3. Schedule C: INDIVIDUAL INTERVIEW QUESTIONS 198

APPENDIX 2: Permission letters 199

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER 1

INTRODUCTION

1.1. BACKGROUND TO THE STUDY

South Africa participated in the Trends in International Mathematics and Science Study (TIMSS) in 1995, 1999 and 2003. The study measured grade eight learning achievement in Mathematics and Science. In 1995 South Africa participated with forty other countries, however South African Mathematics learners obtained the least average score of 354 which was lower than the international benchmark of 513 (Beaton, Mullis, Martin, Gonzalez, Kelly & Smith, 1996:22; Howie, 2004:158). In 1999 and 2003 TIMSS studies, South Africa's performances were again disappointing as learners attained the lowest average test scores in both Mathematics and Science when compared to all the other participating countries including African countries that participated. Thirty eight countries took part in 1999 and fifty in 2003, South Africa's mean scores for Mathematics were significantly lower than the international average scores. Out of a maximum of 800, the average South African Mathematics scores were 275 and 264, and the international average were 487 and 467 for TIMSS 1999 and 2003, respectively (Howie, 2005:128; Reddy, 2006:112; DoE, 2009b:87). In the light of these results, it is crucial for this study to investigate the role of subject advisors in supporting Mathematics educators in the Further Education and Training (FET) band. This is in cognizance of their pedagogic content knowledge of Mathematics. According to Adedoyin (2011: 289), improving educators' pedagogical content knowledge is key to upgrading learners' mathematical achievement.

The Monitoring Learning Achievement (MLA) Project was conducted in several African countries in 1999. It measured the competencies of grade four learners in Numeracy, Literacy and Life skills. South Africa did not fare well when compared to the other participating countries. Out of 12 participating countries, South Africa scored the lowest average in Numeracy. The average score achieved by South African participants in the

© University of Venda

Numeracy task was 30.2% with 44% of the learners scoring below 25%. Only 1.5% of the learners scored 75% higher in Numeracy (DoE, 2009b: 82).

The second Southern African Consortium for Monitoring Educational Quality (SACMEQ) Project, which was conducted between 2000 and 2002, assessed the reading and Mathematics competencies of grade six learners in 14 countries in east and southern Africa, including South Africa. South Africa's achievement in Mathematics was poor as it obtained the mean of 486.1, just under the mean SACMEQ score of 500 (DoE, 2009b: 85).

Since the inception of TIMSS, the East Asian countries, Singapore and Japan have always been among the top performing countries. According to Aun, Rilley, Atputhasamy and Subramaniam (2006:12), teachers in Singapore and Japan adopt inquiry techniques and are conscious of the importance of constructivist traditions to engage students in the learning process. Problem solving is the theme of Mathematics syllabi for these countries' primary and secondary schools (Lim-Teo, 2002:133; Ho & Hedberg, 2005:238; Fan, 2007:491; Koh, 2002:5; Schumer, 1999:402).

The problem solving approach implies that students are developed in their thinking skills and ability to solve non-routine problems. When planning and during the lesson, teachers consider the diversity of experience and knowledge students bring into the classroom (Shimuzu, 1999:107). In order to teach problem solving, teachers need a solid understanding of both Mathematical content and its pedagogy.

There is a whole range of professional development courses in Singapore and Japan, ranging from one session workshops, and whole day conferences, to long certification programmes (Yoong, Yee, Kaur, Yee & Fong, 2009:67; Collison & Ono, 2001:236). Teachers are also entitled to 100 hours of training and upgrading courses each year to keep abreast with knowledge and skills (Kaur, 2010:29; Yoong *et al,* 2009: 66; Ginsburg, Leinwand, Anstrom & Pollock, 2005:116). According to Ginsburg *et al*

© University of Venda

(2005:116), Singapore's Ministry of Education conceives of effective professional training as an integrated, planned programme that draws together a variety of different kinds of professional learning experiences to support teachers' continual improvement. They further state that Singapore's professional development programme offers sustained learning opportunities through a modularised approach that adjusts to teachers' learning needs and is integrated into a continual learning process that includes experiential training experiences in non-school settings.

Netherlands is one of the top achievers in TIMSS (Wang, Coleman, Coley & Phelps, 2003: 8). Over the years, Netherlands has adopted an approach to Mathematics education called Realistic Mathematics Education (RME). Students learn Mathematics by mathematising subject matter from real contexts and are given the opportunity to develop their own strategies for solving problems and to share their experiences with others (Uzel & Uyangor, 2006:1952; Wubbels, Korthagen & Broekman, 1999: 2; Zulkardi, 2002:11). According to Kerekes (2005:17), RME requires a special environment, and demands Mathematics teachers who are well prepared in every respect in subject matter, child psychology, and didactics as a true and scientific analysis and interpretation of the dynamics of teaching and learning. Textbooks play a critical role in the Netherlands Mathematics education as they are the most important tools guiding the teachers' teaching in terms of both content and teaching methods (Van den-Heuvel-Panhuizen, 2000:10).

Despite comparative results from international benchmarking studies that show a dismal performance by South African learners in Mathematics, the failure rate in Mathematics at schools remains unacceptably high (DoE, 2001:18; Howie, 1997:19; Maree, Aldous, Hattingh, Swanepoel & van der Linde, 2006:229; Mji & Makgato, 2006: 254; Louw, Muller & Tredoux, 2008: 41). Regardless of the fact that 85% of Mathematics educators were professionally qualified as educators, only 50% had specialised in Mathematics in their training (DoE, 2001: 12). According to a Report of the task team for the review of the implementation of the National Curriculum Statement (DoE, 2009a: 55), many

© University of Venda

newly qualified teachers have deficiencies in respect of their subject specialisations and it appears as if they have not been adequately prepared in respect of appropriate methodologies. In order to improve competence in Mathematics and other areas of specialisation, many universities developed Advanced Certificate in Education (ACE) programme to assist educators extend their knowledge and teaching in the classroom. Among other programmes the department of education has also introduced Dinaledi programme to improve performance and increase participation in Mathematics and other science subjects.

Since the introduction of the National Curriculum Statement (NSC), the Limpopo Province grade 12 average percentages in Mathematics has never reached 50% and it has always been below the National average percentage. Some of the most critical factors that contribute to poor learner performance in the province are teacher subject knowledge, teacher shortages, poor curriculum management, slow pacing and poor curriculum coverage, inappropriate assessment practices, poor school monitoring and support, and provisioning and utilisation of resources (Aldridge, Laugksch & Fraser, 2006:124; Limpopo Department of Education, 2011:2-6). In order to address the problem of teacher shortages, the Limpopo Department of Education relies on teachers coming from neighbouring countries to offer Mathematics and Physical Sciences subjects at grade 12 (Limpopo Department of Education, 2011:3). A comparison of the Limpopo Province and National Mathematics average percentages is given in Table 1.1.

Table 1.1 Limpopo Province and National Grade 12 Mathematics Average % (2008-2011)

YEAR	Limpopo Province Average %	National Average %
2008	37.4	45.4
2009	39.2	46.0
2010	36.6	47.4
2011	44.5	46.3

© University of Venda

Source: Report on the National Senior Certificate Examination Results (DBE, 2009: 55) and (DBE, 2011f: 61)

1.2 PROBLEM STATEMENT

The majority of learners in South Africa, particularly in the Limpopo Province perform poorly in Mathematics. Given the amount of money spent on education, resources and the infrastructure that the country has compared to most other African countries, it is surprising that South Africa is not doing well in the subject. Learners' poor performance in Mathematics is a serious cause for concern. Studies conducted attribute poor performance in Mathematics to many factors, which range from learners' poor school attendance, lack of resources to enhance effective teaching and learning, educators' lack of pedagogic content knowledge to educators' lack of support (Reddy, 2006:117-119; Howie, 2003:2; Mji & Makgato, 2006:262; Legotlo, Maaga, Sebego, van der Westhuizen, Mosoge, Niewoudt & Steyn, 2002:115-117; Rakumako & Laugksch, 2010:140).

The present state of affairs calls for urgent, radical but meaningful interventions. Failure to address this challenge will force the country to continue sourcing expertise beyond its borders, including Mathematics educators (Buhlungu, Daniel, Southall & Lutchman, 2007:62; Morrow & Keevy, 2006:13).

The main research question in this study is **"What is the role of subject advisors in supporting Mathematics educators in the Further Education and Training band?"**

1.3 PURPOSE OF THE STUDY

The current system is almost completely dependent on subject advisors to act as intermediaries between curriculum policy and implementation in the classroom (DoE, 2009a: 8). In a quest to improve learners' academic performance in Mathematics, this study seeks to:

© University of Venda

- Identify the role of subject advisors in supporting Mathematics educators;
- Examine the impact of subject advisors in supporting Mathematics educators;
- Identify strategies that enhance the effective teaching and learning of Mathematics; and
- Propose intervention strategies regarding the teaching of Mathematics.

1.4 RESEARCH QUESTIONS

The study seeks to investigate the role of subject advisors in supporting Mathematics educators in Further Education and Training band by answering the four questions below:

- How do subject advisors support Mathematics teachers in the Further Education and Training band?
- How do the subject advisors' support impact on teachers' abilities to enhance learner performance in Mathematics in the Further Education and Training band?
- What strategies can be used to enhance effective teaching and learning of Mathematics?
- How can subject advisors improve learner achievement in Mathematics in the Further Education and Training Band?

1.5 LITERATURE REVIEW

A conceptual framework is used in this research to outline possible courses of action or to present a preferred approach to improving performance in Mathematics. A conceptual framework is used to connect all aspects of the inquiry (for example, problem definition, purpose, literature review, methodology, data collection and analysis). Thus, it will act like a map that gives coherence to empirical inquiry. Depending upon the nature of this problem, the literature review will:

- Expose crucial curriculum perspectives and roles of subject advisors that would assist in addressing the research aims and questions;
- Be presented as a set of coherent ideas or concepts organised in a manner that makes them easy to communicate to teachers;

© University of Venda

- Form the basis for thinking (constructivism and social constructivism) about what teachers and learners do and about what it means, as influenced by the ideas and research of others, and
- Expose a set of assumptions, values, and definitions under which teachers and learners work together.

1.5.1 Role of Subject Advisors

The adoption of a new curriculum demands a lot of competencies from the educators compared to the old curriculum. This means that educators have to change the way they teach mathematics in the classroom. According to Le Cornu and Peters (2005:61), if teachers are to make the necessary changes in moving towards constructivist classrooms, they need to be supported in their own learning. Teachers who have taught for a number of years often resort to their old ways of teaching rather than adopting new strategies (Aldridge, Fraser & Sebela, 2004: 252). According to Hattori and Wangeleja (2007: 45), the provision of continuous professional support for teachers helps much in changing their teaching practice, as well as their belief about the way mathematics should be taught. It is the role of Subject Advisors to ensure that educators are supported in the implementation of this education reform and that they stick to the new strategies of teaching.

The researcher concurs with Septimi (2004:34) who says that professional development serves as a bridge between where teachers are now and where they will need to be tomorrow to meet new challenges in guiding students to achieve a higher standard of learning and development. Educators' lack of content knowledge is one of the many factors attributed to poor performance in Mathematics. Therefore pedagogical content knowledge (PCK) is a major component of teacher professional training.

According to Loucks-Horsley, Stiles and Hewson (1996:1-3), the best professional development experiences for Science and Mathematics educators include the following seven principles:

© University of Venda

- They are driven by a clear, well-defined image of effective classroom learning and teaching;
- They provide teachers with opportunities to develop knowledge and skills and broaden their teaching approaches, so they can create better learning opportunities for students;
- They use instructional methods to promote learning for adults which mirror the methods to be used with students;
- They build or strengthen the learning community of science and mathematics teachers;
- They prepare and support teachers to serve in leadership roles if they are inclined to do so;
- They consciously provide links to other parts of the education system; and
- They include continuous assessment.

Subject advisors are subject specialists who should demonstrate both depth of content knowledge and its pedagogy (DBE, 2011b: 41). The position of Subject Advisor exists to ensure that for every Subject there is a specialist to:

- Monitor and support the implementation of the curriculum in the relevant subject;
- Provide and or source relevant teaching and learning material to improve performance in the subject;
- Ensure that teachers have all the requisite curriculum and assessment documents for the subject;
- Support teachers in effectively delivering the curriculum in the classroom;
- Support teachers in strengthening their content knowledge;
- Moderate school based assessment, including Annual National Assessment;
- Support teachers in organizing relevant/ related co-curricular activities.

© University of Venda

1.5.2 Curriculum Perspectives

Attempts to improve student learning through better understanding should be firmly grounded in theory (Biggs, 1993: 73), hence the C2005 in 1998.

1.5.2.1 The advent of C2005

The first adopted curriculum in South Africa after the dawning of democracy was Curriculum 2005 (C2005).The underlying philosophy of C2005 advocates a shift from a system based largely on the tenets of positivist epistemology and behaviourist learning theory to one located within the ambit of constructivist epistemology and learner-centred education (Wilmot, 2003:313). This is an approach to education and learning that involves more than a progressive learner-centred approach to teaching and learning, the use of a resource based approach to learning, a commitment to the development of information, literacy skills as well as the provision of an environment in which lifelong learners flourish (Czemiewicz *et al,* 2000:64).

1.5.2.2 The National Curriculum Statement and the Curriculum and Assessment Policy Statement

The National Curriculum Statement (NCS) and the Curriculum and Assessment Policy Statement (CAPS) above are not different from C2005. The NCS is C2005 made handy. The former had a lot of terminology and its scope was too broad. It was the responsibility of a grade/subject teacher to demarcate the learning material. Thus lack of uniformity was its major limitation. The NCS is C2005 repackaged; content embedded in learning outcomes and assessment standards for each grade and progression was highly maintained (DoE, 2002). The major criticism of NCS is that there was more administrative work than the actual teaching. Teachers could not demonstrate the seven roles for its implementation regardless of several workshops, hence the introduction of Curriculum and Assessment Policy Statement. Curriculum and Assessment Policy Statement is not a new curriculum, but NCS amended to provide educators with clear guidelines as to what content to be taught. Curriculum and Assessment Policy Statement promote uniformity across the province (DoE, 2009a).

© University of Venda

The three curriculum perspectives above recognise the role of social interactions in the teaching and learning environment. This is what underpins constructivism.

1.5.3 Strategies to Enhance Effective Teaching and Learning of Mathematics

The teaching of Mathematics requires that learners construct meaning as individuals and also with others, hence the need for constructivism and social constructivism.

1.5.3.1 Constructivist Traditions in Teaching and Learning Mathematics

There are different forms of constructivism, with different notions about the nature of knowledge and the knowledge construction process (Applefield, Huber, & Moallem, 2000:37), but they all assume that knowledge develops as learners try to make sense of their experiences (Woolflok, 2007:348).

Social constructivism represents a moderate form of constructivism, which emphasises a social nature of knowledge. According to Ernest (1991:42), social constructivism views Mathematics as a social construction, and the grounds for describing mathematical knowledge as a social construction are threefold; namely:

- The basis of mathematical knowledge is linguistic knowledge, conventions and rules, and language is a social construction;
- Interpersonal social processes are required to turn an individual's subjective mathematical knowledge, after publication, into accepted objective mathematical knowledge; and
- Objectivity itself will be understood to be social.

© University of Venda

1.5.3.2 Role of Mathematics teachers and learners in a constructivist classroom

Constructivists view teaching and learning as an interactive process, in which learners construct their own knowledge. The role of the teacher is seen as that of facilitating, guiding, mediating and scaffolding (Wilmot, 2003:313; Draper, 2002:522; Chen, 2003: 20; Aldridge *et al,* 2004 245; Shashidhar, 2005:5; Sjoberg, 2010:486). It is also my view that the role of language, prior knowledge, culture, and experiences are critical in teaching and learning in order to facilitate interaction between students and teachers, and among themselves as well. Cakir (2008: 202) argues that learning for understanding in the classroom requires well- designed hands-on, as well as mind on activities that challenge students' existing conceptions, thus leading students to reconstruct their personal theories. Table1.2 summarises teachers' roles in traditional and constructivist classrooms

Table 1.2: Traditional Classroom and a Constructivist Classroom

Traditional Classroom	Constructivist Classroom
Curriculum begins with the parts of the whole. Emphasis is on basic skills.	Curriculum emphasises big concepts, beginning with the whole and expanding to include the parts.
Strict adherence to fixed curriculum is highly valued.	Pursuit of student questions and interests is valued.
Materials are primary textbooks and workbooks.	Materials include primary sources of material and manipulative materials.
Learning is based on repetition.	Learning is interactive, building on what the student already knows.
Teachers disseminate information to students; students are recipients of knowledge.	Teachers have a dialogue with students, helping students construct their own knowledge.
Teacher's role is directive, rooted in	Teacher's role is interactive, rooted in

© University of Venda

authority.	negotiations.
Assessment is through testing correct answers.	Assessment includes student works, observations, and points of view, as well as tests, process is as important as product.
Knowledge is seen as inert	Knowledge is seen as dynamic, ever changing with own experiences.
Students work primarily alone.	Students work primarily in groups.

(http:www.thirteen.org/endonline/concept2class/constructivism/index_sub1.html)

Table 1.2 above shows constructivism, as effective for both teachers and learners in their endeavour to improve Mathematics performance. Constructivism is learner-centred and learners are not passive recipients of knowledge.

Windschitl (2002:137) suggests that the following features should characterise teacher and student activity in a constructivist classroom:

- Teachers elicit students' ideas and experiences in relation to key topics, then fashion learning situations that help students elaborate or restructure their current knowledge;
- Students are given frequent opportunities to engage in complex, meaningful, problem-based activities;
- Teachers provide students with a variety of information resources as well as the tools (technological and conceptual) necessary to mediate learning;
- Students work collaboratively and are given support to engage in task-oriented dialogue with one another;
- Teachers make their own thinking process explicit to learners and encourage students to do the same through dialogue, writing, drawings, or other representations;
- Students are routinely asked to apply knowledge in diverse and authentic contexts, to explain ideas, interpret texts, predict phenomena, and construct

© University of Venda

arguments based on evidence, rather than to focus exclusively on the acquisition of predetermined "right answers";

- Teachers encourage students' reflective and autonomous thinking in conjunction with the conditions above; and
- Teachers employ a variety of assessment strategies to understand how students' ideas are evolving and to give feedback on the processes as well as the products of their thinking.

1.5.3.3 Realistic Mathematics Education (RME)

Students are given the opportunity to develop their own strategies for solving problems and to share their experiences with others (Uzel & Uyangor, 2006:1952; Wubbels, Korthagen & Broekman, 1997: 2; Zulkardi, 2002:11). In addition, students make use of realistic situations to develop Mathematics skills. Well researched activities encourage them to move from informal to formal representations. Less emphasis is on algorithms and the use of 'guided reinvention' is crucial and progression towards formal ideas is seen as a long-term process.

1.5.3.4 Acquisition of Pedagogical Content Knowledge (PCK)

PCK involves teachers' interpretations and transformations of subject knowledge in the context of facilitating student learning (Van Driel, Verloop & De Vos, 1998: 673). Pedagogical content knowledge is an important domain of teachers' knowledge together with content knowledge, general pedagogical knowledge, curricular knowledge, and knowledge of learners, knowledge of educational contexts, and knowledge of the philosophical and historical aims of education (Akkoc, Yesildere & Ozmantar, 2007: 7). The components of mathematics teachers' knowledge are:

- Knowledge of mathematics;
- Knowledge of mathematical representations;
- Knowledge of students; and
- Knowledge of teaching and decision making (Turnukhu & Yesildere, 2007:1)

© University of Venda

Knowledge of Mathematics and knowledge of mathematical representations are related to content knowledge, while knowledge of students and knowledge of teaching are related to pedagogical content knowledge (ibid: p 2).

A study conducted by Turnukhu and Yesidere (2007:1) revealed that the teacher's knowledge and deep understanding of the content to be taught are prerequisite of effective teaching, but that they are not sufficient to teach Mathematics. These findings support Shulman's assertion that mathematical content knowledge and pedagogical content knowledge are integrated parts of effective mathematics instruction (ibid).

In order to align PCK with a constructivist view of teaching, Cochran, De Ruiter and King (1993:266) rename it pedagogical content knowing (PCKg) and define it as a teachers' integrated understanding of pedagogy, subject matter content, student characteristics and the environmental context. De Miranda (2008:17) asserts that PCK involves knowing how to take advantage of different teaching approaches that make learning experience most suitable for learners. It includes flexible instruction to account for various learning styles, abilities and interests.

It is important that teachers offering Mathematics in grades 10,11 and 12 are fully aware of their PCK, hence the investigation of the role of Subject Advisors in supporting Mathematics educators in the FET band with regards to pedagogical content knowledge.

1.6 DEFINITION OF CONCEPTS

1.6.1 Constructivism

Constructivism is a theory based on observation and scientific study about how people learn. It argues that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. When we encounter something new, we have to reconcile it with our previous ideas and

© University of Venda

experiences, possibly changing what we believe, or maybe discarding the new information as irrelevant (Woolflok, 2007:348).

In a Mathematics classroom as it is in this study, the constructivist view of learning can point towards a number of different teaching practices. In the most general sense, it usually means encouraging students to use active techniques (experiments, real-world problem solving) to create more knowledge and then to reflect on and talk about what they are doing and how their understanding is changing. The teacher makes sure he/she understands the students' pre-existing conceptions, and guides the activity to address them and then build on them.

1.6.2 Pedagogical Content Knowledge (PCK)

Pedagogic content knowledge represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organised, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction (Van Dijk & Kattman, 2007:886). According to (Adedoyin, 2011: 277), pedagogical content knowledge concerns how teachers relate knowledge of their subject matter to their pedagogical knowledge and how subject matter knowledge is related to the process of pedagogical reasoning.

1.6.3 Realistic Mathematics Education (RME)

Realistic Mathematics Education is the Dutch answer to the world-wide felt need to reform the teaching and learning of Mathematics. The roots of the Dutch reform movement go back to the early seventies when the first ideas about RME were conceptualised. It was a reaction to both the American "New Math" movement that was likely to flood most countries in those days, and to the then prevailing Dutch approach to mathematics education, which often was labelled as "mechanistic mathematics education" (NORMA-lecture, Norway on 5-9 June 1998).

© University of Venda

In summary, RME can be described by means of the following five characteristics (Treffers, 1987):

- The use of contexts;
- The use of models;
- The use of students' own productions and constructions;
- The interactive character of the teaching process; and
- The intertwinement of various learning strands.

1.6.4 Subject Advisor

According to the Department of Education (DBE, 2011b:41), a Subject Advisor is an individual who is a subject specialist, demonstrating both depth of content as well as its pedagogy.

To investigate the impact of Subject Advisors in supporting FET Mathematics educators with regard to pedagogical content knowledge, I refer to a Subject Advisor as a person who has specialised in mathematics and whose responsibility is to improve the quality and ensure high standards of teaching and learning in the classroom, by monitoring, supporting, guiding and motivating educators.

1.7 RESEARCH DESIGN AND METHODOLOGY

The researcher employed a research design to specify the plan for generating empirical evidence used to answer the research questions. Therefore, the chosen methods are aligned with the selected design.

1.7.1 Research Design

To investigate the role of Subject Advisors in supporting FET Mathematics educators with regard to pedagogical content knowledge, I employed a mixed approach design. A mixed approach design consists of collecting both quantitative and qualitative data. According to Creswell (2005:515), the rationale for mixed approach is that the quantitative data results provide a general picture of the research. Quantitative

© University of Venda

research explains phenomena by collecting numerical data that are analysed using mathematically based methods (Muijs, 2008:1). Qualitative research is a type of educational research in which the researcher relies on the views of participants, asks broad, general questions, collects data consisting largely of words (or text) from participants, describes and analyses these words for themes, and conducts the inquiry in a subjective, biased manner (Creswell, 2005:39).

In this study, information was collected in two phases. The researcher obtained quantitative data in the first phase of data collection, followed by an in-depth qualitative exploration in the second phase.

1.7.2 Research Methodology

Since the design is a mixed approach design, both the survey and the interview schedules were employed as methods for data collection.

1.8 POPULATION, SAMPLING PROCEDURE AND SAMPLE

The study has a target population; hence a sampling procedure was employed to establish the sample for the study.

1.8.1 Population

A population is a collection of elements about which we wish to make an inference (Scheaffer, 1999: 1). The population in this study comprised Mathematics educators teaching grades 10, 11 and 12 in Tshilamba circuit and Vhembe District Further Education and Training band Mathematics subject advisors. Tshilamba circuit is under the jurisdiction of Vhembe District, Limpopo Province. The circuit has thirteen secondary schools all offering Mathematics. The target population was made up of thirty five educators and six Mathematics subject advisors.

© University of Venda

1.8.2 Sampling Procedure

Different sampling procedures can be used depending on the type of research. Since the researcher conducted the investigation in two phases, using quantitative and qualitative approaches, the sampling procedures were different for each phase.

Phase 1: Quantitative approach

I considered the whole population of thirty five educators who teach Mathematics in grades 10, 11 and 12 as participants because the size is manageable for a quantitative study.

Phase 2: Qualitative approach

In this phase I used purposive sampling. I chose seven educators on the basis that they also participated in the first phase. Vhembe District has six subject advisors for Mathematics and all were chosen to participate in the study.

1.8.3 Sample

According to Sapsford and Jupp (2006:26), a sample is a set of elements selected in some way from the population. In this study, the first phase, which is quantitative in nature, had thirty five participants and the second phase which is qualitative in nature constituted seven educators and six subject advisors as participants. The seven participants were among the thirty five that took part in the first phase.

1.9 DATA COLLECTION, DATA COLLECTION PROCEDURE AND DATA COLLECTION INSTRUMENTS

Data collection entailed collection procedure and data collection instruments.

1.9.1 Data Collection

In order to address the research questions on the role of subject advisors in supporting Mathematics educators in grades 10, 11 and 12, the researcher gathered both quantitative and qualitative information.

© University of Venda

1.9.2 Data Collection Procedure

Phase 1: Quantitative data

During the first phase, questionnaires were administered to educators teaching Mathematics in grades 10, 11 and 12. Questionnaires were hand-delivered to schools and collected after three days.

Phase 2: Qualitative data

Educators were interviewed in two separate focus groups, four educators in the first session and three in the second session. The seven educators were selected from the thirty five educators who participated in the first phase. The interview session took about 60 minutes and the information was gathered through note taking and the use of a tape recorder. Subject advisors were individually interviewed.

1.9.3 Data Collection Instruments

Phase 1: Quantitative data

During the first phase of data collection, the researcher used a questionnaire as an instrument for data collection. The questionnaire comprised both closed and open-ended questions. Great care was taken to ensure that questions were unambiguous, simple and to the point. The questionnaire was brief and took respondents about twenty minutes to complete.

Phase 2: Qualitative data

During the second phase of data collection, the researcher used focus group interviews for educators and individual interviews for subject advisors. Since seven educators were involved, four in the first session and three in the second session, everyone was given an opportunity to express his or her opinion, and that way, a diversity of opinions was obtained. The third session involved individual interviews of subject advisors.

© University of Venda

1.10 DATA ANALYSIS AND INTERPRETATION

Data analysis and interpretation made use of SPSS and content analysis respectively.

1.10.1 Quantitative Data

I used Statistical Package for the Social Sciences (SPSS) because it reads almost all kind of data, analyses that data, and create reports from that data. SPSS performs many different types of data analysis, from simple descriptive statistics to logistic regression and reliability measures. After data analysis, I thoroughly and critically reviewed the stated findings in order to detect errors of measurement, bias and mistakes which could distort the findings of the study.

1.10.2 Qualitative Data

Data analysis in qualitative research was not left until all data were collected. The researcher began data analysis from initial interaction with participants, and continued that analysis throughout the entire study. Gray and Airasian (2003:228) mention five steps in analysing data as organizing, reading or memoing, describing context and participants, classifying and interpreting.

In analysing and interpreting data, I examined data by listening to the tape recordings and reading the transcripts in order to identify useful, relevant and meaningful information that could best inform the study. Then themes, patterns and relationships were identified in order to classify and arrange data in a manageable form. Lastly, the organised data was interpreted into general conclusions.

1.11 DELIMITATION OF THE STUDY

According to Vithal and Jansen (2010:35), acknowledging limitations empowers the reader to appreciate what constraints were imposed on the study, and to understand the context in which the research aims are set.

© University of Venda

The study confined itself to Tshilamba Circuit which is under the jurisdiction of Vhembe District, Limpopo Province. The Tshilamba Circuit is one of the twenty-seven circuits in the district and it forms part of the Mutale cluster. The study focuses on the impact of subject advisors in supporting Mathematics educators in the FET band, therefore participation is also delimited to educators teaching Mathematics in grades 10, 11 and 12 and Vhembe District subject advisors.

1.12 ETHICAL CONSIDERATIONS

Ethics are a set of moral principles which are suggested by an individual or group. They are subsequently widely accepted and offer rules and behavioural expectations about the most correct conduct towards experimental subjects and respondents, employers, sponsors, other researchers, assistants and students (Strydom in White, 2009:149). In this study, the researcher will ensure that respondents are:

- Informed of all the aspects of the investigation. They will be allowed to exercise their rights to voluntarily be part of the research, and no one will be coerced to participate;
- Thoroughly informed about the nature and potential impact of the research, so as to give them an opportunity to withdraw if they wish to do so;
- Fully informed about the procedures and risks involved in the research. Their informed consent to participate will be secured;
- Protected from any risk of harm, whether physical or psychological as a result of their participation; and
- Subjected to confidentiality by using pseudonyms during data collection and in the final research report.

I sought approval to conduct the study from the district Department of Education before any data was collected. The research report will be made available to the

© University of Venda

University of Venda library. This will provide educators who participated in the study the opportunity to access the results of the study.

1.13 SIGNIFICANCE OF THE STUDY

According to McMillan and Schumacher (2006: 67), the significance of the problem is the rationale for a study. A research problem is significant when it aids in developing theory, knowledge or practice.

This study is significant because:

- It will enable Mathematics subject advisors to have a better understanding of their role to support educators, thus improve teacher development and training processes;
- It will provide insights that will assist the Department of Education to improve policies regarding the roles and operations of Mathematics subject advisors;
- It will add value to research and literature as a useful resource for the University of Venda Library; and
- It will also broaden the knowledge base on the topic being investigated.

1.14 CHAPTER DIVISIONS

The study is divided into five chapters as shown below.

Chapter 1: Introduction and Background to the Study

Chapter 1 focuses on the background to the study, problem statement, purpose of the study, research questions, definition of concepts, the study design, population, sampling procedure, sample, data collection and analysis, interpretation of data, ethical considerations as well as significance of the study.

Chapter 2: Literature Review

Chapter 2 focuses on the review of literature on roles of subject advisors regarding the teaching and learning of mathematics.

© University of Venda

Chapter 3: Research Design and Methodology

Chapter 3 discusses in detail the research design and methodology used in the study.

Chapter 4: Analysis and Interpretation of Data

Chapter 4 presents analysis and interpretation of data

Chapter 5: Findings and Conclusions of the Study

Chapter 5 provides the researcher's findings, recommendations, suggestions for further study and conclusions.

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER 2

LITERATURE REWIEW

2.1. INTRODUCTION

This chapter provides a review of the literature on the role of subject advisors in supporting mathematics educators in the Further Education and Training Band. The knowledge gained from the literature aids in stating the significance of the problem, developing the research design, and relating the results of the study to prior knowledge (Mc Millan & Schumacher, 2006:75). The literature reviewed unpacks constructivism, pedagogical content knowledge and roles and responsibilities of subject advisors.

The 2009 National Curriculum Statement (NCS) Implementation Review Report commissioned by Basic Education Minister, Angie Motsekga acknowledged the role of subject advisors as the main intermediary between the curriculum policy and classroom practice. Subject Advisors are also referred to as subject specialists, subject supervisors, subject coaches, subject facilitators and subject coordinators etc., depending on the country and place.

Education districts are the link between schools and the provincial education departments (Education for All (EFA), 2008: 43; Department of Basic Education (DBE), 2011b: 5). They play a pivotal role in ensuring that education needs are understood and addressed and that national learning objectives are achieved. In order to support instruction, school districts must provide a wide array of assistance to schools (Supovitz, 2008: 479; Kersaint, 2001: 73). Districts play the roles of *authority* in holding schools accountable for their activities and performance, and *support* in assisting school faculties to build their capacity to better instruct students (Supovitz, 2008: 479).

According to Louis, Leithwood, Wahlstrom and Anderson (2010: 197), district policies and practices around instruction are sufficiently powerful that they can be felt,

© University of Venda

indirectly, by teachers as stronger and more directed leadership behaviours by principals. Higher performing districts tend to be led by district staff who:

- Communicate a strong belief in the capacity of teachers and principals to improve the quality of teaching and learning, and in the district's capacity to develop the organizational conditions needed for that to happen (high collective efficacy).
- Build consensus around core expectations for professional practice (curriculum, teaching, leadership).
- Differentiate support to principals in relation to evidence of compliance and skill in implementing the expectations, with flexibility for school-based innovation.
- Set clear expectations for school leadership practices, and establish leadership development systems to select, train, and assist principals and teacher leaders consistent with district expectations.
- Provide organized opportunities for teachers and principals to engage in school-to-school communication, focusing on the challenges of improving student learning and program implementation.
- Develop and model strategies and norms for local inquiry into challenges related to student learning and program implementation.
- Coordinate district support for school improvement across organizational units (e.g., supervision, curriculum and instruction, staff development, human resources) in relation to district priorities, expectations for professional practice, and a shared understanding of the goals and needs of specific schools.

The results emerging from the research conducted by Southern Regional Education Board (SREB) in August 2010 provides seven strategies that supportive districts can use to support schools succeed in improving student achievement and the learning environment:

- Establish a clear focus and a strategic framework of core beliefs, effective practices and goals for improving student achievement.

© University of Venda

- Organize and engage the school board and district office in support of each school.
- Provide instructional coherence and support.
- Invest heavily in instruction-related professional learning for principals, teacher-leaders and district staff.
- Provide high-quality data that link student achievement to school and classroom practices, and assist schools to use data effectively.
- Optimize the use of resources to improve student learning.
- Use open, credible processes to involve key school and community leaders in shaping a vision for improving schools.(Southern Regional Education Board 2010: 1-2)

Strengthening the accountability of district offices and enhancing the technical assistance and support provided to principals via district offices, are crucial objectives that will improve, not only the performance of schools, but the education system as a whole (EFA, 2008: 43).

According to the department of education (DBE, 2011b:7-8), research findings identified the main limiting factors on districts effectiveness as follows:

- Many education districts are responsible for too many education institutions and as result cannot provide effective services to them.
- The respective delegated powers, roles, relationships and lines of accountability of provincial head offices, district offices and education institutions are not clearly formulated, understood and exercised.
- Many district offices do not have the devolved authority to plan and develop their programmes, manage their own budgets and recruit or deploy staff members in their own offices or in education institutions. District directors need adequate delegated decision-making authority to effect necessary changes that are designed to improve learning performance. The absence of clearly delegated powers causes intolerable bureaucratic delays in service delivery since many decisions cannot be taken promptly but must be referred to higher authority.

© University of Venda

- Districts need more financial resources and the delegated authority to use such resources effectively. Lack of such powers creates uncertainty, impedes delivery and hampers quality management.
- Post-provisioning is uneven and does not reflect the responsibilities entrusted to district offices. Even when posts have been established many are unfilled. Few staff members have job related training or have been required to meet skills criteria suited to the work they do. Service delivery by many district offices therefore falls short of what the institutions and the public expect.

This chapter explores constructivism, pedagogical content knowledge and the roles and responsibilities of subject advisors in supporting schools to enhance the quality of teaching and learning.

2.2. CONSTRUCTIVISM

Constructivism is the philosophy, or belief, that learners create their own knowledge based on interactions with their environment including interactions with other pupils (Young, 2004:375 Draper, 2002: 522; Applefield *et al*, 2000: 37). There are different forms of constructivism with different notions about the nature of knowledge and the knowledge construction process (Applefield *et al*, 2000: 37), but they all assume that knowledge develops as learners try to make sense of their experiences (Woolflok, 2007: 348).

According to Lerman (1992: 20), constructivism is the dominant view of learning within the mathematics education community because it offers a theoretical rationale for the desire of most teachers to shift the locus of authority and control from the teacher to the pupils; it offers a justification for mixed ability classes and individualised learning. The powerful metaphor of children constructing their own knowledge seems to describe the processes which are currently emphasised as thinking mathematically, particularly in problem-solving.

© University of Venda

2.2.1. Social constructivism

Social constructivism represents a moderate form of constructivism, emphasizing a social nature of knowledge. According to Ernest (1991: 42), social constructivism views mathematics as a social construction. The grounds for describing mathematical knowledge as a social construction are threefold:

- The basis of mathematical knowledge is linguistic knowledge, conventions and rules, and language is a social construction.
- Interpersonal social processes are required to turn an individual's subjective mathematical knowledge, after publication, into accepted objective mathematical knowledge.
- Objectivity itself will be understood to be social.

2.2.2. Radical constructivism

Von Glasersfeld (1995: 51) defines radical constructivism in the form of two propositions:

- Knowledge is not passively received, but is actively built up by the cognizing subject.
- The function of cognition is adaptive, and serves the subject's organization of the experiential world, not the discovery of an objective ontological reality.

Ellerton and Clements (1992: 271) view the strength of radical constructivism in mathematics education as the way it seeks to make the notion of ownership powerfully relevant to learners of Mathematics, and its weakness as that mathematical concepts and principles cannot be communicated by language.

2.2.3. Role of Mathematics teachers and learners in a constructivist classroom

Teachers who begin to base their practice on principles of constructivism should not expect to develop a finished repertoire of behaviours that, once achieved, will become routine. There is no point of arrival, but rather a path that leads on to further growth and change (Schifter, 1996: 1).

© University of Venda

Constructivists view teaching and learning as an interactive process, in which learners construct their own knowledge and the role of the teacher is to facilitate, guide, mediate and scaffold (Wilmot, 2003: 313; Draper, 2002: 522; Chen, 2003: 20; Aldridge et al 2004: 245; Belbase 2005: 5; Sjoberg, 2010: 486). It is also the view of the researcher that the role of language, prior knowledge, culture, and experiences are critical in teaching and learning in order to facilitate interaction between students and teachers, and among themselves as well. Cakir (2008: 202) alludes to the fact that learning for understanding in classroom requires well-designed hands-on, as well as mind-on, activities that challenge students' existing conceptions leading them to reconstruct their personal theories.

Windschitl (2002: 137) suggests that the following features characterize teacher and student activity in a constructivist classroom;

- Teachers elicit students' ideas and experiences in relation to key topics, and then fashion learning situations that help students elaborate or restructure their current knowledge.
- Students are given frequent opportunities to engage in complex, meaningful, problem-based activities.
- Teachers provide students with a variety of information resources as well as the tools (technological and conceptual) necessary to mediate learning.
- Students work collaboratively and are given support to engage in task-oriented dialogue with one another.
- Teachers make their own thinking process explicit to learners and encourage students to do the same through dialogue, writing, drawings, or other representations.
- Students are routinely asked to apply knowledge in diverse and authentic contexts, to explain ideas, interpret texts, predict phenomena, and construct arguments based on evidence, rather than focusing exclusively on the acquisition of predetermined "right answers".

© University of Venda

- Teachers encourage students' reflective and autonomous thinking in conjunction with the conditions above.
- Teachers employ a variety of assessment strategies to understand how students' ideas are evolving and giving feedback on the processes as well as the products of their thinking.

In order to develop these traits, teachers need to be supported in this regard. This is highlighted by a study conducted by Pitsoe (2007: 212) which revealed that most teachers were trained in the traditional approach to classroom management and the emerging paradigm poses significant challenges for teachers to equip themselves with the new knowledge and skills for classroom management.

2.3. PEDAGOGICAL CONTENT KNOWLEDGE (PCK)

The concept of pedagogical content knowledge was introduced by Shulman (1986) and refers to teachers' interpretations and transformations of subject knowledge in the context of facilitating student learning (van Driel, Verloop & de Vos, 1998: 673). Shulman (1987: 8) proposes the following as major categories of teacher knowledge:

- Content knowledge
- General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organisation that appear to transcend subject matter
- Curriculum knowledge, with particular grasp of the materials and programs that serve as "tools and trade" for teachers
- Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their special form of professional understanding
- Knowledge of learners and their characteristics

© University of Venda

- Knowledge of educational contexts, ranging from the workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures
- Knowledge of educational ends, purposes, and values, and their philosophical and historical grounds.

Fennema and Franke (1992) as cited in Turnukhu and Yesildere (2007: 1) indicate the components of mathematics teachers' knowledge as:

- Knowledge of mathematics
- Knowledge of mathematical representations
- Knowledge of students
- Knowledge of teaching and decision making.

Knowledge of mathematics and knowledge of mathematical representations are related to content knowledge, while knowledge of students and knowledge of teaching are related to pedagogical content knowledge. Ball, Lubienski and Mewborn (2001:453) refer to pedagogical knowledge as a special form of knowledge that bundles mathematical knowledge with knowledge of learners, learning and pedagogy. The bundles offer a crucial resource for teaching Mathematics because they can help the teacher to anticipate students' problems and have ready alternative models or explanations to mediate those difficulties.

A study conducted by Turnukhu and Yesidere (2007: 1) reveals that a teacher's knowledge and deep understanding of the content to be taught is a prerequisite of effective teaching, but it is not sufficient in teaching mathematics. In order to align pedagogical content knowledge with a constructivist view of teaching, Cochran, De Ruiter and King (1993: 266) rename it pedagogical content knowing and define it as teachers' integrated understanding of pedagogy, subject matter content, student characteristics and the environmental context. De Miranda (2008: 17) asserts that pedagogical content knowledge involves knowing how to take advantage of different teaching approaches that make learning experience most suitable for learners, including

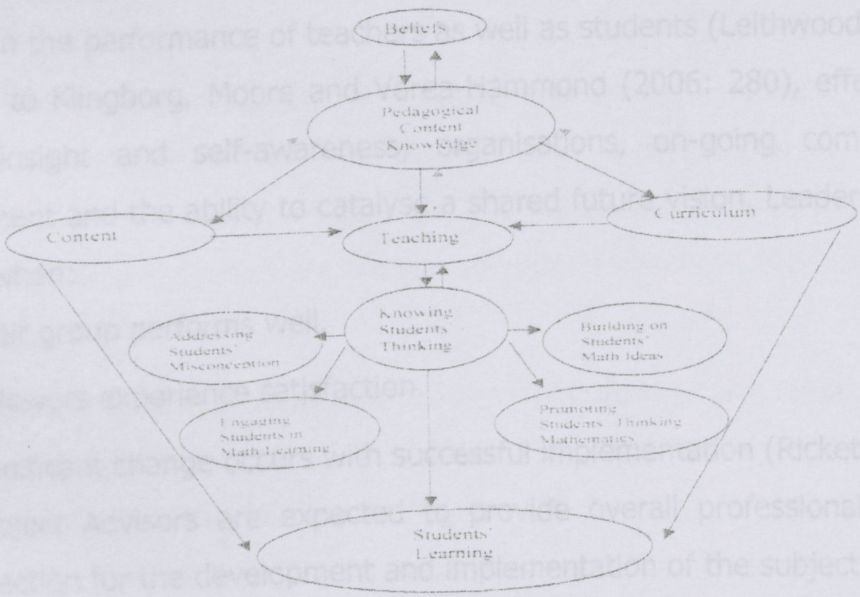
© University of Venda

flexible and adjusting instruction to account for various learning styles, abilities and interests.

Cheang, Yeo, Chan and Lim-teo (2007: 27) maintain that Mathematics pedagogical content knowledge of teachers cannot be easily defined but is a complex concept integrating generic pedagogical knowledge, Mathematics teaching methodology as well as knowledge of the discipline of Mathematics. Adedoyin (2011: 289) maintains that the knowledge and pedagogical competence of teachers are intertwined, and improving both is important to upgrading pupils' mathematical achievement.

According to An, Kulm and Wu (2004: 147), although all three parts of pedagogical content knowledge are important to effective teaching, the core component of pedagogical content knowledge is knowledge of teaching. Figure 2.1 suggests the interactive relationship among the three components and shows that knowledge of teaching can be enhanced by content and curriculum knowledge.

Figure 2.1: The network of pedagogical content knowledge



An, Kulm and Wu (2004: 147)

© University of Venda

Ruhama and Tirosh (1995: 1-2) argue that even though it is usually assumed that teachers' subject-matter knowledge and pedagogical content knowledge are interrelated there is little evidence to support and illustrate the relationships. According to Ball and Bass (2000: 88), although pedagogical content knowledge provides a certain anticipatory resource for teachers, it sometimes falls short in the dynamic interplay of content with pedagogy in teachers' real-time problem solving. No repertoire of pedagogical content knowledge, no matter how extensive, can adequately anticipate what it is that students may think, how some topics may evolve in a class, the need for a new representation or explanation for a familiar topic.

It is important that teachers offering mathematics in the FET band be fully aware of their pedagogical content knowledge, hence the investigation of the role of subject advisors in supporting mathematics educators.

2.4. ROLES AND RESPOSIBILITIES OF SUBJECT ADVISORS

2.4.1. Provision of overall leadership

Successful educational leaders develop schools as effective organizations that support and sustain the performance of teachers as well as students (Leithwood *et al*, 2004:62). According to Klingborg, Moore and Varea-Hammond (2006: 280), effective leadership requires insight and self-awareness, organisations, on-going communication and reinforcement and the ability to catalyse a shared future vision. Leaders are considered effective when:

- Their group performs well.
- Followers experience satisfaction.
- Significant change occurs with successful implementation (Ricketts, 2009: 2)
- Subject Advisors are expected to provide overall professional leadership and direction for the development and implementation of the subject in schools (DBE, 2011b: 45). Hull, Balka and Miles (2009: 4-5) argues that mathematics coaches

© University of Venda

are well versed in mathematics content and pedagogy and should understand the developmental nature of mathematics and be familiar with current research on how students learn. The traits of leadership as envisioned by the department of basic education (DBE, 2011b: 45) are that Subject advisors;

- Become experts in their subject field.
- Have a thorough knowledge and understanding of all official policy/curriculum documents with respect to their subjects.
- Provide an environment that creates and fosters commitment, confidence and collegiality among colleagues and teachers.
- Network with organizations and acquaint themselves with recent research articles in order to provide teachers with additional support to promote teaching and learning in the classroom.
- Engage with teachers and Head of Departments on their academic improvement plans for the subject including plans for teacher development (DBE, 2011b: 43).
- Keep a database of all the schools and teachers that they are responsible for with respect to record of academic performance, special support needs, outstanding teachers, and teachers needing support and community involvement (DBE, 2011b: 42).

In order to win confidence of school principals and teachers, subject advisors need not be aware of issues related to their subjects only, they need to be acquainted with issues pertaining to education in general. This will enable them to provide information or advice in other areas which are not subject related when the need arises.

2.4.2. Supporting teachers in delivering curriculum in the classroom

According to Education for All (EFA) (2005: 25), the teaching and learning process brings the curriculum to life. It determines what happens in the classroom and the quality of learning outcomes. A core function of curriculum personnel is to visit schools

© University of Venda

and support teachers on a regular basis. The purpose of conducting school support visits is to:

- Provide support to teachers for continuous growth and development.
- Identify successes and challenges in the implementation of the National Curriculum Statement (NCS)
- Ensure quality school-based curriculum development that will culminate in quality teaching and learning.
- Contribute to the process of evaluating a teacher's performance and to promote accountability (Eastern Cape DoE, 2006:3)

2.4.2.1 Intervention strategies for school support

The purpose of school visits can be achieved by using a variety of intervention strategies. Intervention strategies should be implemented to address the needs of teachers to enhance learners' academic achievements. The needs may include, development of pedagogy, subject knowledge or strengthening assessment practice, addressing the specific needs of a group of pupils.

Table 2.1 Intervention strategies for school support

Strategy	Description	Recommended for
Demonstration Lesson	A curriculum official or a teacher who has mastered a particular skill delivers a lesson for other teachers in the school to observe. A lesson-debriefing instrument is developed to guide observations. At the end of the lesson, or at the end of the school day, the curriculum official engages with teachers in a mini-workshop or directed discussion about the lesson.	A group of teachers who are all trying to master the same new skill or method.
Co-operative Planning	A particular lesson or activity is co-planned with the curriculum official. In this way, opportunities are created for planning processes to be modelled and reinforced. It builds confidence in teachers as the risk of implementing a new innovation is shared with the curriculum official. Co-planning is particularly effective if it is followed by a team teaching demonstration lesson.	A group of teachers who are trying to implement a new way of planning the best way of supporting the lesson.

© University of Venda

Team teaching	This approach works best when a process of cooperative planning has preceded the teaching of the lesson. During the planning stage, specific roles are allocated. Team teaching works best when the same lesson is taught to more than one class. In this way, it is possible to teach – reflect – revise and then teach again.	A group of new or inexperienced teachers trying out new teaching methods and techniques or teachers focusing on specialized areas and aspects of a particular subject/learning area.
Mediating reflection (post lesson focus group discussions)	An approach used for a group of teachers in a school who have a particular issue or challenge with regard to classroom practice, for example, managing a large class. The curriculum official encourages experimentation and enquiry. Reflections are recorded and shared in a focus group discussion. Effective strategies to deal with the issue are identified and implemented.	A group of teachers who share a common issue or challenge about classroom practice.
Whole-school Workshop	In some cases school support visits may take the form of a workshop with the whole staff of the school. For example, the development of an assessment policy for the school.	A school that wishes to develop its own teaching and learning policies and strategies.
Lesson observation	The curriculum official observes a few lessons in the school. The instrument for observation is agreed in advance and teachers are clear about what will be discussed afterwards.	Curriculum officials, subject heads and others who must monitor the implementation of new skills or teaching methods, as well as observing the NCS being implemented.

Source: Eastern Cape Department of Education (2006: 4)

2.4.2.2 Effective mathematical instruction

Effective mathematics instruction must include a variety and a balanced pedagogical approaches, knowing and understanding mathematics, students as learners, a challenging and supportive classroom learning environment; and continually seeking improvement (Mc Graner, Van Der Heyden & Holdheide, 2011: 4). A pedagogical approach that is able to move students' thinking forward involves significantly more

© University of Venda

than developing a respectful, trusting, and non-threatening climate for discussions and problem solving (Walshaw & Anthony, 2008: 527; Ontario Education, 2004: 8; NCTM, 2000: 17-19). According to Larson (2002: 4), effective mathematics instruction depends on well-defined mathematics objectives, worthwhile and engaging mathematical tasks, appropriate use of hands-on activities to build conceptual understanding, quality discussion of the mathematical tasks, and meaningful practice to ensure mastery of those concepts and skills. Anthony & Walshaw (2007: 16) sum it up by saying that quality teaching is about enabling students to develop habits of mind whereby students can engage with mathematics productively and use the tools to support their learning. *Mathematics Teaching Today* (2007) lists six major shifts in the environment of the mathematics classroom that are necessary to allow students to develop mathematical understanding:

- Communities that offer an equal opportunity to learn to all students
- A balanced focus on conceptual understanding as well as on procedural fluency
- Active student engagement in problem solving, reasoning, communicating, making connections, and using multiple representations
- Well-equipped learning centres in which technology is used to enhance understanding
- Incorporation of multiple assessments that are aligned with instructional goals and practices
- Mathematics authority that lies within the power of sound reasoning and mathematical integrity (NCTM, 2007: 7).

School visits by subject advisors should include supporting teachers in teaching and learning processes as well as sharing mechanisms to improve teaching strategies (Eastern Cape DoE, 2006: 3). Improving teacher quality can be achieved if teachers are getting the necessary support. A study conducted by Hightower, Delgado, Lloyd, Wittenstein, Sellers and Swanson (2011: 35) concluded that pedagogical training in how to teach mathematics contributes to positive influence on student achievement.

© University of Venda

University of Venda
Creating Future Leaders

2.4.2.3 Classroom observations

Onsite support should include classroom visits during teaching time to assess quality of classroom interaction (DBE, 2011b: 44) so that teachers can be supported in a practical and realistic manner (Eastern Cape DoE, 2007: 4). According to Little, Goe and Bell (2009: 6), classroom observations are the most common form of teacher evaluation and vary widely in how they are conducted and what they evaluate. Classroom observations can provide important, useful information about a teacher's practice if used thoughtfully (Goe, Bell & Little, 2008: 21). The components to be observed during the lesson include:

- Methodology
- Classroom management
- Classroom atmosphere
- Student learning and Student engagement with the subject (The Inspectorate, 2004: 10).

In an effective mathematics classroom, an observer should find that:

- Teachers demonstrate acceptance of students' divergent ideas.
- Teachers influence learning by posing challenging and interesting questions.
- Teachers project a positive attitude about mathematics and about students' ability to "do" mathematics.
- Students are actively engaged in doing mathematics.
- Students are solving challenging problems.
- Students are sharing their mathematical ideas while working in pairs and groups.
- Students are provided with a variety of opportunities to communicate mathematically.
- Interdisciplinary connections and examples are used to teach mathematics (Protheroe, 2007: 53-54).
- Teachers use a variety of instructional strategies.
- Curriculum is implemented as designed (Hull *et al*, 2009: 19).

© University of Venda

- Using a variety of activities or learning methods.
- Applying teaching methods appropriate to the national curriculum objectives.
- Using a variety of questioning techniques to probe pupils' knowledge and understanding (McBer, 2000: 10).

According to Wise, Darling-Hammond, McLaughlin and Bernstein (1985: 68), for improvement objectives, evaluation processes must yield rich, descriptive information that illuminates sources of difficulty as well as viable courses for change. Feedback based on the overall teaching and learning in the subject should be provided to the teachers being evaluated. According to Nevo (1994: 113), evaluation feedback is intended to help teachers improve their teaching performance according to the needs of their students, and thus improves students' learning. An evaluation process must have meaningful implications both positive and negative, in order to earn sustained support from teachers and school leaders and to contribute to the systematic improvements of the teacher workforce (The New Teacher Project, 2010: 8).

2.4.2.4 Mathematics teaching and learning approaches

The aims and skills of mathematics require that appropriate mathematics teaching and learning approaches be used to ensure that the acquisition of content knowledge and skills by learners takes place effectively (Limpopo DoE, 2012: 20). According to the Ontario Ministry of Education (2005: 24), it is important that students have opportunities to learn in a variety of ways, individually, cooperatively, independently, with teacher direction, through hands on experience, through examples followed by practice. The report of the Task Team (DoE, 2009a: 23) suggests that subject advisors can fulfill the function of providing support for appropriate methodologies in line with particular subjects. Mathematics teaching and learning approaches include:

(a) Cooperative learning

Johnson, Johnson and Stanne (2000:1) define cooperative learning as a "relationship in a group of students that requires positive interdependence (a sense of sink or swim

© University of Venda

together), individual accountability (each of us has to contribute and learn), interpersonal skills (communication, trust, leadership, decision making and conflict resolution), face-to-face promote interaction, and processing (reflecting how well the team is functioning and how to function better)." Members of the group promote each other's success, doing real work together, helping and supporting each other's efforts to learn (Smith, Sheppard, Johnson & Johnson 2005: 94). Effandi, Chin and Yussof (2010: 274) assert that cooperative learning gives more space and opportunities for students to discuss, solve problems, create solutions, provide ideas and help each other.

(b) Problem-solving approach

Polya in Doorman, Drijvers, van den Heuvel-Panhuizen, de Lange and Wijers (2007: 405) describes problem solving as a means of finding a way out of a difficulty, a way around an obstacle, attaining an aim which was not immediately attainable. Solving problems is the specific achievement of intelligence, and intelligence is the specific gift of mankind. Problem solving is an integral part of all mathematics learning (NCTM, 2000: 52). Lajoie in Mc Intosh and Jarret (2000: 15) defines mathematical problem solving as "modelling the problem and formulating and verifying hypotheses by collecting and interpreting data, using pattern analysis, graphing, or computers and calculators." Ho and Hedberg (2005: 238) maintain that problem solving involves a wide range of problem types from routine mathematical problems to problems in unfamiliar contexts and open-ended investigations that make use of the relevant mathematics thinking process. Mathematical problem solving includes using and applying mathematics in practical tasks, in real life problems and within mathematics itself (MOE, 2005: 5).

(c) Project-based learning

According to Bell (2010: 39), project based learning (PBL) is an approach to learning that teaches a multitude of strategies critical for success. Students drive their own learning through inquiry, as well as work collaboratively to research and create projects that reflect their knowledge. Project-based learning is the instructional strategy of

© University of Venda

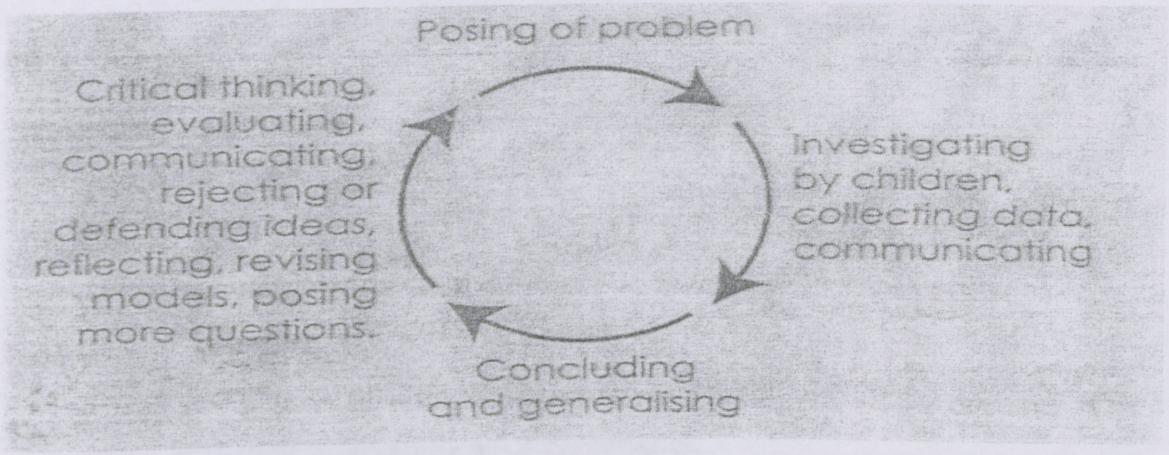
empowering learners to pursue content knowledge on their own and demonstrate their new understandings through a variety of presentation modes, and it provides students with multiple ways to acquire content, to process or make sense of ideas, and to develop products that demonstrate effective learning (NYC Department of Education, 2000: 8-9).

(d) Investigative approach

"Investigation (or enquiry) in mathematics is understood to refer to a task given to pupils that uses mathematics and which to varying degrees gives the pupils the opportunity to pose their own questions, to determine their own approaches, to make their own discoveries, and to articulate and communicate their findings to others" (Haylock & Thangata, 2007: 96). Grouws and Cebulla (2000: 17) assert that when students discover mathematical ideas and invent mathematical procedures, they have a stronger conceptual understanding of connections between mathematical ideas. According to

Kwang (2002: 42), investigative approach to mathematics teaching and learning allows teachers to maximize their potential as mathematics teachers, and helps pupils of all abilities to learn mathematics meaningfully.

Figure 2.2 Diagram of the investigative approach



Source: Quinell (2010: 36)

© University of Venda

The teaching and learning approaches dealt with are in line with student-centred approach. They provide learners the opportunity to reason and communicate mathematics. It is crucial that teachers be taken on board regarding the use of these approaches in an integrated manner. Tsanwani (2009: 212) suggests that teachers whose students perform poorly in mathematics need further training in order to conduct better teaching practices in mathematics.

2.4.2.5 Learners experiencing barriers to learning

Barriers to learning are any factor, either internal or external to the learner which causes a hindrance or barrier to that person's ability to benefit from schooling (Engelbrecht, Kriegler and Booysen, 1996: 53). All barriers to learning and development should be addressed in our classrooms and schools (DoE, 2005a: 10) and the Ministry believes that the key to reducing barriers to learning within all education and training lies in a strengthened education support service (Education White Paper, 2001: 28).

According to the Education White Paper 6 (2001: 17-18), different learning needs may arise because of:

- Physical, mental, sensory, neurological and developmental impairments.
- Psycho-social disturbances.
- Differences in intellectual ability.
- Particular life experiences or socio-economic deprivation.
- Negative attitudes to and stereotyping of differences.
- An inflexible curriculum.
- Inappropriate languages or language of learning and teaching.
- Inappropriate communication.
- Inaccessible and unsafe built environments.

© University of Venda

- Inappropriate and inadequate support services.
- Inadequate policies and legislation.
- The non-recognition and non-involvement of parents.
- Inadequately and inappropriately trained education managers and educators.

Teachers are encouraged to use the principle of 'designing down', 'breaking down' or 'scaffolding' in planning or adapting learning programmes, work schedules and lesson plans (DoE, 2005a: 40). In order to meet the needs of individual learners the following process is essential:

- First determine the learners' operational level in the Learning Area.
- Design Baseline Assessments using the assessment standards of the previous grade.
- Administer the Baseline Assessments.
- Analyse the responses of the Baseline Assessments.
- Use the results of the Baseline Assessments to plan or adapt the learning programmes, work schedules and lesson plans.
- Ensure that the necessary adapted learning and teaching support material and assistive devices are available.
- Support learners through clear accessible, attainable tasks or activities, allowing enough time and multiple opportunities for learners to master the task or activity and to experience success thus building their confidence.

2.4.2.6 Learning styles

Learning styles reflect the students' preferences on how they perceive the environment, interact with this environment, react and experience learning in those process (Kazu, 2009: 85). Kazu further indicates that when the lessons are taught by taking into

© University of Venda

consideration the individual learning styles, their interests and successes increase considerably.

According to Kolb model, there are four types of learning styles (Simpson & Du, 2004: 126))

- Diverging (concrete, reflective) - experience is gathered through tangible, felt qualities of immediate experience and is turned to thought by internal reflection on the external world. People with this style perform better in situations that call for generation of ideas, and they prefer to learn in groups.
- Assimilating (abstract, reflective) - can understand information best when it is presented symbolically and conceptually and time is given for internal reflection. The assimilating style is important for library and information careers. People with this style generally find it more important that a theory have logical soundness than practical value. They prefer reading and having time to think things through.
- Converging (abstract/active) - understand and perceive information best through concepts and symbols but need the opportunity to work actively (external manipulation) in order to internalize the information. People with this style prefer lab assignments, practical applications, and to experiment with new ideas.
- Accommodating (concrete/active) - gather information best by tangible, felt qualities of immediate experience and need to process information through active action. This type applies new course material to new situations to solve real problems. They prefer to work with others to get assignments done and to test different approaches to complete projects.

According to Kazu (2009: 91-92), in order to accommodate different learning styles, the teacher:

© University of Venda

- Has to plan the lesson according to different styles and concentrate on having different learning styles equally.
- Use methods and materials that take learning styles of students into consideration.
- Guide the parents in providing learning conditions suitable for the students learning styles.

2.4.3 Supporting novice educators

Beginning to teach and transitioning from student to teacher is a demanding transition for any novice (Cwikla, 2004: 182). Supporting less experienced teachers requires consideration and collaborative opportunities as they present a different cognitive profile than their more experienced peers (Cwikla, 2004: 181). It is the responsibility of subject advisors to meet and assess capacity of all new teachers with special attention to newly qualified teachers (DBE, 2011b: 43). According to Cooper and Alvarado (2006: 17), teachers are primarily attracted to teaching by intrinsic motivation, but extrinsic factors play a major role in retaining them.

The role of induction support, well designed mentoring programmes, and professional development can improve retention rates as the new teachers are apprentice who need time, support, and additional training to learn the complex craft (Cooper & Alvarado 2006: 20; Reinhard 2003: 64; Ingersoll, Merrill & May, 2012:30; Graham & Fennel 2001: 323). According to Gilbert (2005:38), mentoring is only one piece of induction support, and it can vary greatly in its implementation. School and district administrators can start to improve teacher retention by making the following commitments as part of a comprehensive induction and mentoring program:

- Do not pair new classroom teachers in inclusion teams (especially not with another new teacher). Give them time in their own classrooms before asking them to team teach.

© University of Venda

- Do not require new teachers to advice or coach extracurricular activities until they have at least two or three years of experience in the classroom.
- Do not assign new teachers to a school duty period: instead hold them accountable for using that time toward planning instruction and becoming more proficient in their subject areas.
- Do not place new teachers on school or department committees until they have at least two or three years of classroom experience.
- Avoid assigning new teachers to the most challenging grade levels or students.
- Refrain from assigning new teachers to classrooms with multiple grade levels.
- Refrain from assigning new teachers to more than two course preparations.
- Avoid giving new teachers schedules that require them to change classrooms repeatedly during the day or to work primarily from a cart.
- Decrease the number of professional development activities expected of new teachers. Hold them accountable only for those activities designed to boost classroom effectiveness.
- Make certain that new teachers and their mentors have the same planning period and occasionally provide substitute teachers so that novices can either meet with their mentors for extended periods or observe the mentors' classrooms.
- Keep first year teachers in the same courses or grade levels for two or three years; allow them to become seasoned before their teaching assignment (Renard, 2003: 64).

According to Stransbury and Zimmerman (2004: 4), beginning teacher support should be looked at as a continuum, starting with personal and emotional support, expanding to include specific task or problem-related support. Felman-Nemsen (2003: 5) argues that providing emotional support is not as valuable as helping new teachers to learn to create safe classroom environment, engage all students in worthwhile learning, and work effectively with parents and base instructional decisions on assessment data. Other key areas of support are classroom management, teaching techniques,

© University of Venda

knowledge of relevant curriculum, understanding district standards and assessment of student learning, and how they affect teaching strategies, and understanding procedures and policies related to curriculum adoption (Brewster & Railsback, 2001:10; New Zealand Ministry of Education, 2001:31).

Provision of curriculum materials is necessary as they are the most comprehensive and accessible source of support regarding what and how to teach, but they are more effective as part of a system of supports that includes regular interactions with other professionals (Van Zoest & Stockero, 2006: 563; Kaufmann, 2005: 16; Perez, Swain & Hartsough, 1997: 50). New teachers benefit from a variety of opportunities to work with more experienced teachers (Gilbert, 2005: 38; Cwikla, 2004: 193). The experience of visiting peer's classroom might have a positive impact on both the observer and the teacher being observed as this sparks conversation and collaboration about effective pedagogy between the teachers. Gilbert (2004: 38) indicates that time pressures, paperwork and non-instructional meetings are a major source of stress and frustration for beginning teachers.

2.4.4 Creation of collaboration teams

Collaboration refers to exchanging information, altering activities, sharing resources and enhancing the capacity of another for mutual benefit and to achieve a common purpose (Atkinson, Springate, Johnson and Halsey 2007: 10; Black 2008: 23). Darling-Hammond and Laughlin in Jang (2006: 178) advocate that professional growth must be collaborative, involving the sharing of knowledge among teacher communities of practice rather than concerning individual teachers.

Hargreaves in Johnson (2010: 337) suggests that greater collaboration;

- Provides moral support—'Collaboration strengthens resolve, permits vulnerabilities to be shared and aired, and carries people through those failures and frustrations that accompany change'

© University of Venda

- Increases efficiency—'Collaboration eliminates duplication and removes redundancy'
- Improves effectiveness—'Collaboration improves the quality of student learning by improving the quality of teacher's teaching'
- Reduces overload—'Collaboration permits sharing of the burdens and pressures that come from intensified work demands and accelerated change'
- Establishes boundaries—'Collaboration reduces uncertainty and limits excesses of guilt by setting commonly agreed boundaries around what can be reasonably achieved'
- Promotes confidence—Collaboration strengthens teachers' confidence 'to adopt externally introduced innovations, the wisdom to delay them and the moral fortitude to resist them'
- Promotes teacher reflection—'Collaboration in dialogue and action provides sources of feedback and comparison that prompt teachers to reflect on their own practice'
- Promotes teacher learning—'Collaboration increases teachers' opportunities to learn from each other'
- Leads to continuous improvement—'Collaboration encourages teachers to see change not as a task to be completed, but as an unending process of continuous improvement'

Instructional supervisors facilitate networks between schools as a mechanism for spreading and sharing knowledge (Supovitz, 2008: 461). The researcher supports the idea of clustering schools with similar or common challenges to encourage working cooperation and sharing of best practices amongst teachers. According to Sally and Monk as quoted in Mohammad and Harlech –Jones (2008: 544), in developing countries, trying to improve teaching without addressing wider reform in the school can cause additional pressures on teachers whose professional lives are already very

© University of Venda

difficult. The success of any network is dependent on effective leadership (Black, 2008: 44), and the availability of adequate support for the partnership is important as collaborations require skilful internal facilitation and external support (Atkinson, Springate, Johnson & Halsey 2007: 81).

Black (2008: 44) indicates that lack of teacher readiness to change from traditional practices is a barrier to collaboration. Berry, Daughtrey and Wieder (2009: 6-7) suggest that best practices for collaboration that are linked to teacher effectiveness are:

- Scheduling adequate time for collaboration.
- Aligning collaboration structures for both horizontal and vertical collaboration.
- Structuring collaboration meetings formally.
- Creating an atmosphere for mutual trust.

2.4.5.1 Subject committees

According to the South African Eastern Cape Department of Education (EC DoE, 2005: 4), committees of different subjects are instrumental in driving the implementation of the curriculum by highlighting the state of the subject nationally, provincially and at district level so as to guide implementation and to deal with the challenges that might arise. The Eastern Cape Department of Education (2005: 9) identifies the roles and responsibilities of the subject committees as follows:

- Identify and stimulate research into innovative trends in the subject.
- Provide teachers with guidance on Assessment, including Continuous Assessment (CASS) and other appropriate Learner Assessment strategies.
- Develop systems and templates for recording the progress of learners towards the attainment of Learning Outcomes.
- Develop assessment tools for the Phase and Learning subject.
- Identify and advise on areas for teacher development in the subject.
- Advise on policy gaps and policy review in the subject.

© University of Venda

- Ensure integration of the principles of the National Curriculum Statement (NCS) into activities of the subject (e.g. Social Justice, Healthy Environment, Diversity, HIV/Aids etc.).
- Identify, recommend and co-ordinate curriculum reviews and research.
- Monitoring and evaluation of curriculum implementation.
- Provide a mechanism for consultation and support for schools, districts and the Province.
- Provide a platform for the facilitation and sharing of developmental work done in different schools and districts in the Province.
- Development and maintenance of the Phase and subject item bank.
- Develop LTSM in support of phase and subject implementation excluding textbooks.
- Identify and advise on gaps in relation to LTSM.
- Co-ordinate evaluation processes on commercialised LTSM using approved criteria.
- Initiate, monitor and evaluate projects.
- Strengthen areas of cooperation and articulation between General Education and Training (GET) and Further Education and Training (FET) schools.
- Participate in and contribute to the selection of markers, examiners and moderators.
- Initiate the promotion and development of each phase and subject.

It is the duty and responsibility of a subject advisor to support the formation of school clusters with similar or common challenges to encourage working cooperation and sharing the best practices amongst teachers (DBE, 2011b: 44).

2.4.5.2 Team teaching

According to Wenger and Homyak (1999: 314), team teaching consists of two or more teachers sharing, to some degree, responsibility for a group of students. Jang

© University of Venda

(2006:179) argues that a related approach to increased collaboration among teachers exists in team teaching.

Murata (2002:67) asserts that effective team teaching in the high school is a practice with broad appeal and potential for improving teaching. Murata (2002: 76) further indicates that teaming as a best practice also implies that high school structures have to be rearranged not only for implementation purposes, but also for maintenance. Anderson and Speck (1998: 674) argue that team teaching offers students the opportunity for multi-perspective feedback based on teacher collaboration, whether that collaboration focuses on grading papers, observing students' learning or providing feedback to solving problems.

Teamwork can also present challenges, such as time demands or potential conflict among teammates, but at their best, teaching teams are model learning communities that generate synergy through collaboration (Eisen, 2000:12).

2.4.5.3 Lesson Study

According to Sam, White and Mon (2005: 135), the lesson study process is a Japanese model of school based teacher professional development program that focuses on an examination of teachers' pedagogical practice either through direct classroom observation or through research lesson and case studies. Puchner and Taylor (2006: 923) state that lesson studies can be done by teachers within a school, across a district or in large public demonstration lessons. Teachers, usually of the same grade level, meet regularly to collaboratively plan a group of lessons, one of the teachers teach while other teachers observe and take notes.

Lesson study improves instruction by developing teachers' knowledge of pedagogy and student thinking by building teacher professional community, and by improving teaching materials (Lewis, Perry & Hurd, 2009: 302).

© University of Venda

A study conducted by Sam, White and Mon (2005: 138-139) reveals the strength of the Lesson Study process as follows:

- Through group discussions and observing other teachers teach, teachers gain and enhance both their mathematics content knowledge as well as pedagogical knowledge.
- Upon self-reflection and advice from colleagues observing teaching, teachers are able to rectify their own teaching errors. Novice teachers, especially have the opportunity to improve themselves by observing and learning from the experienced colleagues skills and techniques required in teaching various concepts of mathematics.
- Lesson Study promotes a collaborative culture that enhances the professional collegial bonds within mathematics staff.
- Lesson study is a valuable professional development.

Hunter and Back (2011: 113) contend that the process of lesson study is time intensive and requires significant contribution from the teachers involved in the groups. Sam, White and Mon (2005: 139) identify two difficulties in conducting lesson study as time constraint and teachers' commitment. According to Garet, Porter, Desimone, Birman and Yoon (2001: 936), activities that are linked to teachers' other experiences, aligned with other reform efforts, and encouraging of professional communication among teachers appear to support change in teaching practice, even after the effects of enhanced knowledge and skills are taken into account.

2.4.5.4 Mathematics Teacher Professional Associations

According to Morony (1999), teacher professional associations form the third side of the triangle of support for teacher's work, the others being the teacher's formal education, and input from employers. The third side is inherently democratic and empowering for teachers that associations are in control of. Morony further indicates that associations give teachers a voice and contribute to their overall professional standing. A study

© University of Venda

conducted by Tsanwani (2009: 172) on factors that facilitate achievement in Mathematics in traditionally disadvantaged secondary schools reveals that teachers from high performing schools attend Mathematics teacher professional associations meetings more regularly than teachers form low performing schools.

According to Hiebert, Gallimore and Stigler (2002: 7), collaboration becomes essential for the development of professional knowledge, not because collaborations provide teachers with social support groups but because collaborations force their participants to make their knowledge public and understood by colleagues.

2.4.4 Organising professional development for Mathematics teachers

Teacher development is the professional growth a teacher achieves as a result of gaining increased experience and examining his or her teaching systematically (Glatthorn in Villegas-Reimers, 2003: 11). Professional development includes formal experiences such as attending workshops and professional meetings, mentoring, etc., and informal experiences such as reading professional publications, watching television documentaries related to an academic discipline (Ganser in Villegas-Reimers, 2003:11). Sutton & Krueger (2002: 113) assert that teachers who continue learning throughout their careers are more likely to become reflective, competent, and professional teachers. Professional development that is sustained, aligned to the curriculum, focuses on teacher's knowledge and instructional practices, enhances school level achievement in mathematics (Wei, Darling-Hammond, Andree, Richardson & Orphanos, 2009: 1; Goe & Stickler, 2008: 13-14; Zambo & Zambo, 2008: 167; Owston, 2007:1; Huffman et al, 2003: 383). Some professional development may be deemed compulsory because the skills and knowledge the development activities aim to enhance are important for teacher quality (OCED, 2009: 64).

The kinds of professional development programmes and activities designed for teachers must respond to: their professional needs, their personal and professional interests, the stage of professional development attained at that particular time, and the stage of the

© University of Venda

education system in force in their place of work (Villegas-Reimers, 2003: 142). According to Sutton and Krueger (2002: 46), effective professional development strategies help teachers work collaboratively to reflect on practice within a collegial culture. They identify five major purposes of professional development for teachers as: developing awareness, building knowledge, translating knowledge into practice, and reflection. Different strategies address one or more of these different purposes:

- Immersion in mathematics: engaging in solving mathematics problems as learners.
- Study groups: engaging in regular collaborative interactions around topics identified by the group to examine new information, reflect on classroom practice, and analyse data.
- Case discussions: discussing problems and issues illustrated in written narratives or videotapes of classroom events.
- Examining student work: looking at student products to understand their thinking so that appropriate instructional strategies and materials can be identified.
- Action research: looking at one's own teaching and student products learning through a classroom research project.
- Curriculum implementation: learning, using, and refining specific curriculum materials to build understanding.
- Curriculum development and adaptation: creating new instructional materials and strategies or adapting existing ones to better meet the needs of students.
- Coaching and mentoring: working regularly with another teacher at the same or greater level of expertise to improve teaching and learning.
- Lesson study: designing, implementing, testing, and improving one or several lessons over long periods, ranging from several months to a year.

A study conducted by Tsanwani (2009: 217) in tracing factors that facilitate mathematics achievement in traditionally disadvantaged secondary schools revealed that teachers from high performing schools continue with professional development and it is therefore important for teachers to continue with development as long as they are still in the profession. According to Garet, Porter, Desimone, Birman and Yoon (2001:

© University of Venda

935), professional development that focuses on academic subject matter (content), gives teachers opportunities for "hands-on" work (active learning), and is integrated into the daily life of the school (coherence), is more likely to produce enhanced knowledge and skills.

Kibuka-Sebitosi in Fisher, Koul, and Wanpen (2008: 284) indicates that professional development in South Africa is facilitated by subject advisors and workshops are held to improve knowledge and pedagogical content knowledge (PCK) for each subject.

2.4.6 Monitoring and supporting implementation of curriculum in Mathematics.

The quality of the implementation of a teaching practice greatly influences its impact on student learning (Protheroe, 2007: 52). Monitoring implementation is imperative as this informs the kind of support needed. According to Reeves (2010: 28), monitoring refers to the observation and recording of specific teaching and leadership practices. Effective monitoring includes three characteristics:

- It is frequent.
- It addresses adult action.
- It is constructive (Reeves, 2010: 28).

Conducting school visits is an essential component for ensuring effective curriculum implementation at classroom level (Eastern Cape DoE, 2006: 3). The Eastern Cape Department of Education (2007: 4) further indicates that school visits that are limited to and focus mainly on auditing of curriculum structures, curriculum documents, LTSM and workshop attendance do not yield sufficient information about the levels of implementation of the NCS. Curriculum visits for monitoring purposes include to:

- Establish pace depth and sequencing of curriculum coverage.
- Compare written work to teacher planning and availability of resources.
- Check frequency and management of home and class work as well as usefulness of feedback to improve learner understanding (DBE, 2011b: 44).

© University of Venda

- Ensure that schools have received and are using NCS policy and other related documents.
- Conduct a needs analysis in the subject to determine the needs of teachers in respect of gaps in content knowledge, teaching methodologies and assessment practices.
- Monitor and support the implementation of the NCS curriculum and its related policies in terms of planning systems, classroom management and organisation, resource development and management, the implementation of lesson plans and assessments.
- Support and monitor the implementation of specific assessment and examination issues such as compliance with CASS policy and promotion and progression procedures and examinations.
- Support and monitor LTSM selection, utilization and management.
- Address specific needs as identified by individual schools (Eastern Cape DoE, 2006: 9).
- After the purpose of the visit has been achieved, immediate feedback should be provided to the teacher concerned and such interaction should not be one-sided as teachers need to be given sufficient opportunity to share and reflect on their own practice (Eastern Cape DoE, 2006: 9).

According to the Department of Basic Education (DBE, 2011e: 16), all teachers are expected to keep a file containing evidence of their teaching and assessment, viz. Annual teaching plan, Assessment plan, Formal assessment tasks and memoranda, Indication of Textbooks(s) and any resources used, Record sheet containing learners' marks for each formal assessment task and informal notes or any intervention that is planned by the teacher to assist learners who require additional support (where they exist). Teachers' files should be available on request at all times for moderation and accountability purposes.

© University of Venda

2.4.7 Provision of resources and assessment documents

Resources mean not only what is available in the financial budget, but also the entire range of physical, human and social capital that is needed to achieve desired outcomes (Government of Western Australia Department of Education, 2004: 69). When visiting schools, subject advisors are expected to establish that teachers have all necessary support materials that include policy documents, content framework, text books, examination guidelines, exemplar papers and memoranda, training materials on content, etc (DBE, 2011b: 43). They are also expected to advise schools on procuring resources like equipment (p44). According to Anthony and Walshaw (2009: 24), there is an increasing array of technological tools available for use in mathematics classroom which provide new opportunities for teachers and students to explore and represent mathematical concepts. These include calculator and computer applications and Internet.

2.4.7.1 Provision of assessment documents

Kanjee (2009: 81) maintains that education policy that requires teachers to conduct classroom assessments for enhancing learning must be accompanied by the provision of sufficient resources and support for teachers. This entails that teachers need to be provided with templates of marking rubrics and record sheets. The effective use of technology to enhance assessment for learning as well as the assessment of learning can improve the effectiveness of teaching approaches and enhance the student learning experience (The Higher Education Academy, 2009: 11).

2.4.7.2 Providing information on the selection of mathematics textbooks

Text books play an important role in teaching and learning (Ewing, 2006: 8; Lemmer, Edwards & Rapule, 2008: 175; Reys, Reys & Chavez, 2004: 65; Rezat, 2009: 1260; Sutton & Krueger, 2002: 67; DBE, 2011a: 18; Ontario Education, 2004: 28; EFA, 2005: 26). According to Leite as cited in Lemmer *et al* (2008: 184), textbooks can promote or impair effective teaching and learning of a topic, more so in classrooms where teachers depend to great extent on text books. Vincent and Stacey (2008: 103) indicate that

© University of Venda

different teachers have different expectations of a textbook, depending on how they choose to supplement the textbook with their own resources and pedagogical experience. A good choice of textbooks can help proactive learners to tackle certain topics on their own and understand the procedures thereof without the teacher's assistance.

In South Africa textbooks are screened by the National Department and a national catalogue is provided to schools by the Department of Basic Education (DBE), listing all approved material, which is the basis for selection. Since schools are expected to make a choice of material for their classrooms, it is crucial that they employ and follow criteria that will enable them to select wisely within materials provided by the national department. Sutton and Krueger (2002: 67) assert that the process used to select mathematics materials is critical to providing students and teachers with a solid foundation for improving achievement. Sutton & Krueger further indicate the four key steps in the process of selecting instructional materials for mathematics as:

- Establishing a review/selection committee
- Determining selection criteria
- Selecting an evaluation instrument
- Evaluating and selecting materials.

The Department of Basic Education (DBE, 2011a: 19) points out that school-based choice can be achieved through collaborative effort of relevant subject teachers, Heads of Department, Subject Advisors and expertise from surrounding schools forming School LTSM Committees. The Subject Advisor should provide leadership role as he/she is supposed to have full knowledge of the curriculum and be well conversant with specific aims and skills in mathematics. According to Reys et al (2004: 65), the following questions should be addressed in order to effectively assess textbooks:

- What key mathematical ideas in each content strand should each grade level address?
- How does the content of the textbook align with the mathematical ideas?

© University of Venda

- What types of activities does the textbook provide? Are students challenged to think and develop understanding, or are they simply shown how to work some exercises and then asked to practice procedures? Will these activities engage students in mathematical thinking activity?
- Is there a focus on mathematical thinking and problem solving? Are students expected to explain why? Does the textbook encourage students to expose "what if" questions and to offer and test conjectures.

According to the Gauteng Department of Education (2009: 43), resources impact on the quality of mathematics, Science and Technology teaching and learning. Therefore, more effort is needed to ensure that teachers can identify, access and use the available materials effectively.

2.4.8. Support on Assessment

2.4.8.1 Assessment practice

Curriculum and Assessment Policy Statement (CAPS) Mathematics FET Gr 10-12 (DBE, 2011d: 51) defines assessment as a continuous planned process of identifying, gathering and interpreting information about the performance of learners, using various forms of evaluation. It involves four steps: generating and collecting evidence of achievement; evaluating this evidence; recording the findings and using this information to understand and assist in the learner's development to improve the process of learning and teaching. Assessment information assists teachers, parents and other stakeholders in making decisions about the progress of the learner (DBE, 2011e: 3).

The National Protocol for Assessment Grades R-12 (DBE, 2011e: 3) states that classroom assessment should be both informal and formal and in both cases it is important that learners know what knowledge and skills are being assessed and feedback should be provided to learners after assessment to enhance the learning experience. Informal or daily assessment is the monitoring and enhancing of learners' progress, and formal assessment provides teachers with a systematic way of evaluating

© University of Venda

how well learners are progressing in a particular subject and in a grade. Teachers must ensure that assessment criteria are very clear to the learners before the assessment process (DBE, 2011e: 3).

Effective assessment practices are essential to support mathematics instruction that improves student performance (Charleston, 2006: 13; Boud, 2006: 102; Lianghuo, 2004: 11; Shepard, 2000: 8; Ontario Education, 2004: 41). According to the Report of the Task Team for the Review of the Implementation of the NCS (DBE, 2009a: 29), School based assessment allows teachers to measure learner progress and to diagnose areas of lack of progress to enable remediation and focused teaching, and it provides crucial feedback to learners and parents about academic progress. According to Maxwell (2006: 2), a key component of successful school-based assessment is teacher expertise. The two kinds of expertise are involved, obtaining good information on student learning (using good procedures) and making good judgment. Angelo (1999: 9) asserts that assessment practices should help students develop the skills, dispositions, and knowledge to:

- Engage actively, intellectually and emotionally in their academic work.
- Set and maintain realistically high, personally meaningful expectations and goals.
- Provide, receive, and make use of regular, timely, specific feedback.
- Become explicitly aware of their values, beliefs, preconceptions, and prior learning and be willing to unlearn when necessary.
- Work in ways that recognize their present learning styles and levels of developments.
- Seek to find connections to and real world applications of what they are learning.
- Understand and value the criteria, standards, and methods by which they are assessed and evaluated.
- Work regularly and productively with staff and other students.
- Invest much engaged time and high quality effort in academic work.

© University of Venda

Anthony and Walshaw (2009: 17) assert that effective teachers make use of a wide range of formal and informal assessments to monitor learning progress, diagnose learning issues, and determine what they need to do next to further learning. Hill et al as quoted in Wagner, Speer and Rossa (2007: 261) identify the knowledge required to assess student understanding as a form of mathematical knowledge for teaching. When teachers assess, they need to know how and what to assess. The table below compares assessment goals in a traditional classroom and inquiry-oriented classroom.

Table 2.2 Assessment goals.

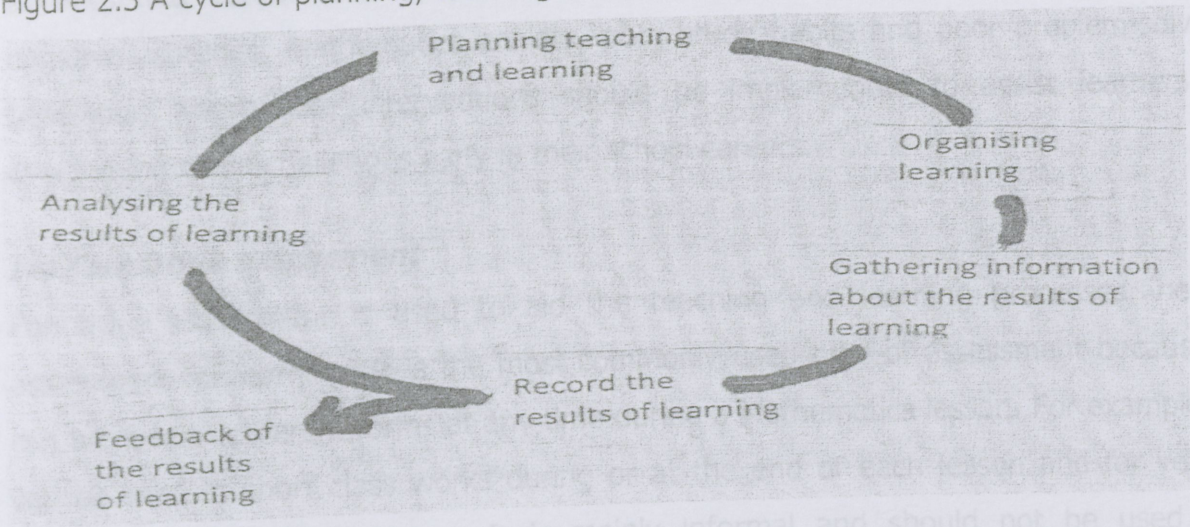
Assessment Goals What is taken as evidence of learning? What determines pace?	
Traditional Classroom	**Inquiry-Oriented Classroom**
• Traditionally established: assessment occurs "after" learning through homework and exams • Learning measured by success in solving problems and through exhibited knowledge of definitions, theorems, etc. • Pace determined largely by $pace = \frac{remaining\ content}{remaining\ time}$	• How/When does one assess in real time? • What are signs that understanding is "sufficient" to move on? What questions, activities or problems can reveal such understanding? • How rigorous should students' explanations and justifications be?

Source: Wagner, Speer and Rossa (2007: 261)

According to Linchevski, Liebenberg, Sasman and Olivierl (1998: 3), assessments aimed at evaluating students' performance on core material or on topics/concepts that are crucial for understanding the subsequent topics in the curriculum, should be an integral part of the teaching plan. Decisions regarding the design of activities and class organisation should, to great extent, be dependent on the analysis of such assessments. The figure below shows how assessment fits into teaching and planning by means of a diagram.

© University of Venda

Figure 2.3 A cycle of planning, teaching and assessing



Source: Sieborger (2004: 10),

2.4.8.2 Types of assessment

The following types of assessment are very useful in Mathematics; as a result teachers are encouraged to use them to serve the purpose associated with each assessment (DBE, 2011c: 293).

(a) Baseline assessment

Mathematics teachers who might want to establish whether their learners meet the basic skills and knowledge levels required to learn a specific Mathematics topic will use baseline assessment. Knowing learners' level of proficiency in a particular Mathematics topic enables the teacher to plan her/his Mathematics lesson appropriately and to pitch it at the appropriate level. Baseline assessment, as the name suggests, should therefore be administered prior to teaching a particular Mathematics topic. The results of the baseline assessment should not be used for promotion purposes.

(b) Diagnostic assessment

It is not intended for promotion purposes but to inform the teacher about the learner's Mathematics problem areas that have the potential to hinder performance. Two broad areas form the basis of diagnostic assessment: content-related challenges where

© University of Venda

learners find certain difficulties to comprehend, and psychosocial factors such as negative attitudes, Mathematics anxiety, poor study habits and poor problem-solving behaviour. Appropriate interventions should be implemented to assist learners in overcoming these challenges early in their school careers.

(c) Formative assessment

Formative assessment is used to aid the teaching and learning processes, hence assessment for learning. It is the most commonly used type of assessment because it can be used in different forms at any time during a Mathematics lesson. For example, it can be used in short class works during or at the end of each lesson and for verbal questioning during the lesson. It is mainly informal and should not be used for promotion purposes. The fundamental distinguishing characteristic of formative assessment is constant feedback to learners, particularly with regard to learners' learning processes. The information provided by formative assessment can also be used by teachers to inform their methods of teaching.

(d) Summative assessment

Contrary to the character of formative assessment, summative assessment is carried out after the completion of a Mathematics topic or a cluster of related topics. It is therefore referred to as assessment of learning since it is mainly focusing on the product of learning. The results of summative assessment are recorded and used for promotion purposes.

2.4.8.3 School Based Assessment (SBA)

The SBA component in the FET band includes tests, examination, projects, assignments and investigations. Assessment need to accommodate a range of cognitive levels and abilities of learners (DBE, 2011d: 52). The Department of Basic Education (DBE, 2011c: 294-295) provides explanation to different forms of assessment as follows:

© University of Venda

(a) Test and examinations

These are individualised assessment tasks and should be carefully designed to ensure that learners demonstrate their full potential in Mathematics content. The questions should be carefully spread to cater for different cognitive levels of learners. Tests and examinations are predominantly assessed using a memorandum.

(b) Assignment

As the case with tests and examinations, an assignment is mainly an individualised task. It can be a collection of past questions, but should focus on the more demanding work as any resource material can be used. This is not the case in a task that is done in class under supervision.

(c) Projects

Projects are used to assess a range of skills and competences. Through projects, learners are able to demonstrate their understanding of different Mathematics concepts and apply them in real life situations. Caution should however be exercised not to give projects that are above learners' cognitive levels. The assessment criteria should be clearly indicated on the project specification and should focus on the Mathematics involved and not on duplicated pictures and facts copied from reference material. Good projects contain the collection and display of real data, followed by deductions that can be substantiated.

(d) Investigation

Investigation promotes critical and creative thinking. It can be used to discover rules or concepts and may involve inductive reasoning, identifying or testing patterns or relationships, drawing conclusions, and establishing general trends. To avoid having to assess work which is copied without understanding, it is recommended that whilst initial investigation could be done at home, the final write-up should be done in class, under supervision, without access to any notes. Investigations are assessed with rubrics, which can be specific to the task, or generic, listing the marks awarded for each skill. The skills include, organising and recording ideas and discoveries, communicating ideas

© University of Venda

with appropriate explanations, calculations showing clear understanding of mathematical concepts and procedures, and generalising and drawing conclusions.

Reyneke, Meyer and Nel (2010: 290) argue that only when the benefits of school based assessment (SBA) for learning are realized and teachers implement it as a process by which learners get to know exactly what is expected of them in order to perform and what to do to fill the gap between not performing and performing, will FET learner find themselves prepared for the high stakes end-of-year examinations.

2.4.8.4. Moderation of school based assessment

Moderation refers to the process that ensures that the assessment tasks are fair, valid and reliable (DBE, 2011c: 297). Moderation should be carried out internally at school and/or externally at district, provincial and national levels. The moderation process should be intensified to ensure that learners are not disadvantaged by invalid and unreliable assessment tasks, and quality assessment is given and high but achievable standards are maintained. According to Daly, Billingtong, Chamberlain, Meyer, Stringer, Taylor and Tremain (2011: 2), moderation can be considered a form of quality management, something which provides accountability and a means of improving assessment. Quality procedures are used to improve the inherently imperfect process of assessment (Daly *et al,* 2011: 1). Although these quality procedures can differ slightly in the way that they occur within moderation activities, all are focused upon the setting, taking and marking of assessment tasks.

In South Africa, the position of subject advisor exists to ensure that for every subject there is specialist capacity to moderate school based assessment (DBE, 2011b: 41). Moderators must fulfill the roles and functions allocated to them in terms of the relevant policies and procedures of South African Qualifications Authority (SAQA). Such roles and functions may include:

- Carrying out and evaluating internal assessment and quality assurance systems.

© University of Venda

- Supporting providers and assessment agencies in identifying the assessment and moderation capacity required to implement the NQF and the skills development strategy effectively.
- Conducting moderation of assessment instruments, plans and guides on any occasion in which these are first used, or are revised, including documenting proof of individual learners' competence status.
- Verifying that assessments are fair, valid, reliable and practical.
- Identifying areas of improvements within the assessment system.
- Provide support and guidance to the assessors.
- Identifying the need to redesign assessments, assessment tools /instruments if required.
- Identifying the need to redesign moderation, moderation systems, tools if required.
- Conducting moderation of assessment results and records using a 10% minimum sample as prescribed by organizational and sectorial policies (Janish, 2009: 16).
- According to Maxwell (2006: 5), external moderators offer strong external control but the disadvantage can be that authoritative interpretations are not always right or appropriate and that external authority can be stultifying rather than liberating, encouraging conformity rather than innovation.

CONCLUSION

This chapter reviewed literature on the role of subject advisors in supporting educators in the further education and training band with regards to pedagogic content knowledge. The literature reviewed provides the context within which to place this investigation. The South African curriculum is embedded in constructivism. Therefore, constructivism was briefly reviewed as a point of departure. Literature on pedagogic content knowledge and roles and responsibilities of subject advisors were also reviewed. The next chapter focuses on the research design and methodology employed in this study.

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1. INTRODUCTION

Research is an orderly investigation of a subject matter for the purpose of adding knowledge to the already existing body of knowledge (Postlethwaite, 2005: 1). It is with this understanding that my research intends to contribute to the understanding of the roles of subject advisors in supporting Mathematics educators and to communicate this understanding to others. This chapter describes the overall approach used in this study and justify the use of the approach to address the research questions. The aspects outlined include: research design, data collection and analysis.

3.2. RESEARCH DESIGN

According to De Vause (2001: 9), a social research needs a design or a structure before data collection or analysis can commence. In designing a study, a researcher must develop a sound plan for selecting a sample, collecting data, and analysing data (Gall, Borg & Gall, 1996: 165).

McMillan and Schumacher (2006: 22) describe a research design as an indication of the general plan, how the research is set up, what happens to the subjects, and what methods of data collection are used. Harwell (2011: 148) argues that identifying a study's research design is important because it communicates information about key features of the study, which can differ for quantitative, qualitative and mixed methods.

In order to investigate the role of subject advisors in supporting mathematics educators in the FET band with regards to pedagogical content knowledge, the researcher employed a mixed method design. Creswell (2005: 510) describes a mixed method research design as a procedure for collecting, analysing, and mixing both quantitative

© University of Venda

and qualitative data in a single study to understand a research problem. Mixed methods are used to enrich understanding of an experience or issue through confirmation of conclusions, extension of knowledge or by initiating new ways of thinking about the subject of the research (Bazeley, 2002: 9).

Migiro and Mangangi (2011: 3763) list the strength and weaknesses of a mixed method research as follows:

Strengths

- Mixed method research can answer a broader and more complete range of research questions because the researcher is not confined to a single method or approach.
- A researcher can use strengths of an additional method to overcome the weaknesses in another method by using both in a research study.
- Mixed method research can provide stronger evidence for a conclusion through convergence and corroboration of findings.
- Mixed method research can add insight and understanding that might be missed when only a single method is used.
- Mixed method research can be used to increase the general ability of the results.
- Qualitative and quantitative research used together produce more complete knowledge necessary to inform theory and practice.
- Researchers can generate and test a grounded theory.
- Words, pictures, and narrative can be used to add meaning to numbers.
- Numbers can be used to add precision to words, pictures and narrative.

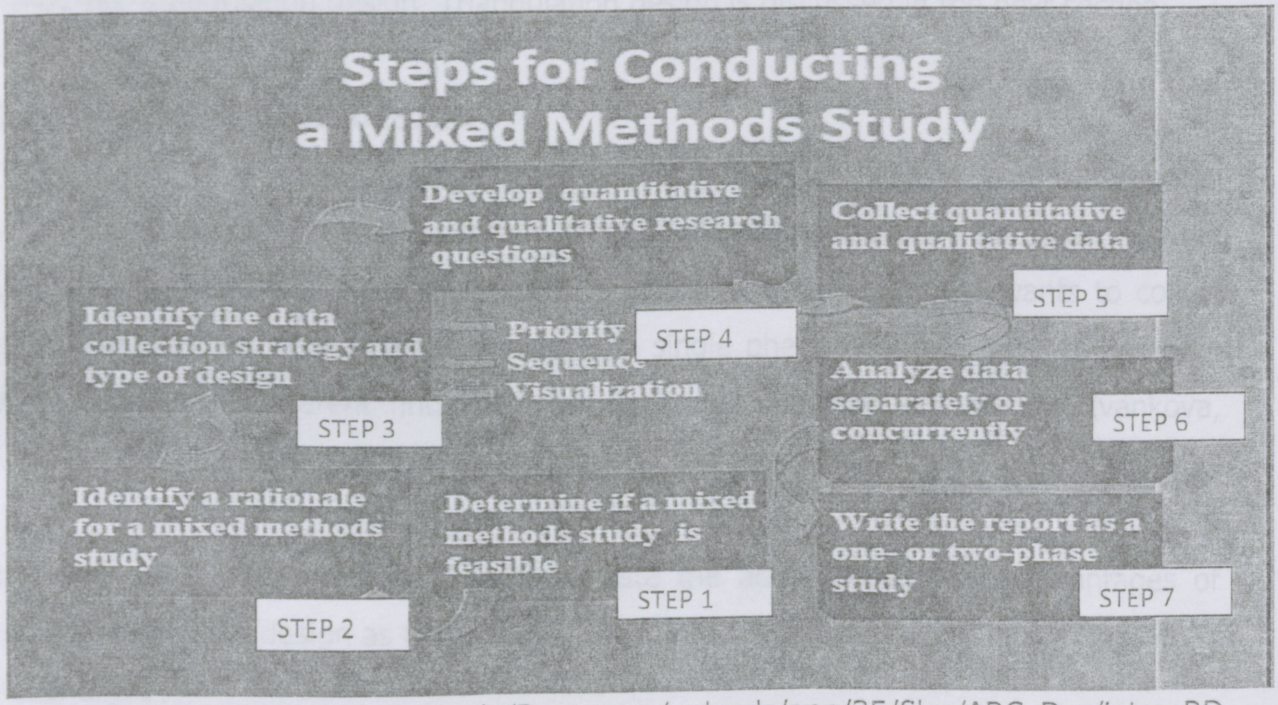
Weaknesses

- A researcher has to learn about multiple methods and approaches and understand how to mix them appropriately.
- Methodological purists contend that one should always work within either a qualitative or a quantitative paradigm.

© University of Venda

- The application of mixed methods in a single study is a difficult issue since the rationales for methodological decisions are often justified by the questions addressed and the way data have to be analysed.
- Some of the details of mixed research remain to be worked out fully by research methodologists (for example, problems of paradigm mixing, how to qualitatively analyse qualitative data, how to interpret conflicting results and report them).
- Mixed method research can be difficult for a single researcher to carry out, especially if the two approaches are expected to be used concurrently.
- Mixed method research is more expensive and more time consuming.

Figure 3.1 Steps for conducting a mixed methods study.



http://www.fischlerschool.nova.edu/Resources/uploads/app/35/files/ARC_Doc/intro_RD.pdf

In this study, the researcher:

- Determined the feasibility of employing a mixed methods study as this provides stronger evidence for conclusions through corroboration of findings.
- Decided to use both quantitative and qualitative data collection methods.

© University of Venda

- Developed questionnaire and questions for focus group and individual interviews.
- Distributed questionnaire to Mathematics educators, conducted focus group and individual interviews with educators and subject advisors respectively.
- Analysed quantitative and quantitative data separately.

There are three types of mixed method designs; explanatory design, exploratory design and triangulation designs. According to McMillan and Schumacher (2006: 28), in explanatory design quantitative data are collected first, depending on results, qualitative data are gathered second to explain the quantitative findings. In exploratory design, qualitative data are gathered first, and a quantitative phase follows. In triangulation design, both qualitative and quantitative data are collected at the same time. This study employed triangulation design. Triangulation design is discussed in the next section.

3.3. TRIANGULATION DESIGN

Triangulation is a plan of action that will eliminate sociologists and other social researchers' personal biases that stem from single methodologies (Babbie & Mouton, 2001: 275). Triangulation design is most suitable when a researcher wants to collect both types of data at the same time about a single phenomenon in order to compare and contrast the different findings to produce well validated conclusions (Ivankova, Creswell & Plano-Clark in Maree, 2010: 268).

Ivankova *et al* in Maree (2010: 269) indicate the advantages and disadvantages of using triangulation design as follows;

Advantages

- It takes time to complete than a sequential design.
- It is reasonable to combine two types of data to study a research problem.

Disadvantages

- It takes a lot of effort to collect and analyse two complete but separate sets of data at the same time.

© University of Venda

- A researcher needs to consider how the different data sets will be compared with each other and this can be very difficult if the two sets of results do not agree.
- Stake in Adams, Khan, Raeside and White (2007: 114) state the following as protocols for triangulation:

3.3.1. Data source Triangulation

The analyst asks whether or not what they are reporting is likely to be constant at other times or circumstances.

3.3.2. Investigator Triangulation

Other researchers take a look at the same scene. Or findings can be presented to other researchers to discuss alternative interpretations.

3.3.3. Theory Triangulation

Multiple investigators agree as to the meaning of the phenomenon.

3.3.4. Methodological Triangulation

This involves using a variety of data collection methods to build confidence in the interpretations made.

3.3.5. Member Triangulation

The respondent is asked to review the material for accuracy and to add further comments that might aid description and explanations.

This study employed methodological triangulation. Questionnaires, focus group and individual interviews were used to collect data. During data analysis participants were contacted to confirm information that they provided. According to Babbie and Mouton (2001: 275), triangulation is generally considered to be one of the best ways to enhance validity and reliability.

© University of Venda

3.4. POPULATION

A population is a group of elements or cases, whether individuals, objects or events, that conform to specific criteria and to which we intend to generalize the results of the research (McMillan & Schumacher, 2006: 119). In this study the population comprise all educators teaching Mathematics in the FET band in 13 secondary schools within Tshilamba circuit and Mathematics subject advisors in Vhembe District. The population was made up of thirty five educators and six Mathematics subject advisors. The District has six Mathematics subject advisors.

3.5. SAMPLING

Total population sampling which is a type of purposive sampling technique was used in this study. The power of purposeful sampling is that a few cases studied in depth yield insights about the topic (McMillan & Schumacher, 2006: 319). The researcher chose to study the entire population because the size of the population is relatively small and manageable for a research.

3.6. SAMPLE

A sample is a set of elements selected in some way from the population (Sapsford & Jupp, 2006: 26). According to White (2003: 80), if the population is relatively small, the sample should comprise a reasonably large percentage of the population. In this study, thirty five educators teaching Mathematics in the FET band in Tshilamba circuit completed the questionnaire (Phase1). A total of seven educators participated in focus group discussions and six subject advisors in individual interviews (Phase 2).

3.7. ORGANISATION OF THE STUDY

The study was conducted in two phases. The first phase involved quantitative research methodology. Questionnaires were administered to grade 10, 11 and 12 Mathematics educators. The second phase involved qualitative research methodology. Focus group and individual interview sessions were held with the selected grade 10, 11 and 12 Mathematics educators and subject advisors, respectively.

© University of Venda

3.7.1. Phase 1: Quantitative approach

3.7.1.1. Quantitative research

Quantitative research is a process that is systematic and objective in its ways of using numerical data from only a selected subgroup of a universe (or population) to generalize the findings to the universe that is being studied (Maree & Pietersen in Maree, 2010: 145). Maree and Pietersen (2010:14) further point out that the ideal quantitative researcher is detached from the study in order to avoid bias.

According to White (2003: 15), the following are paradigms of a quantitative research:

- Uses a deductive form of reasoning.
- The meaning is determined by the researcher.
- Aims to objectively measure the social world, to test hypothesis, and to predict and control human behaviour.
- Sees reality as objective.
- Tests hypotheses that the researcher starts off with.
- Concepts are in the form of distinct variables.
- Seeks to control phenomena.
- Observations are systematically undertaken in a standardized manner.
- The research design is standadised according to fixed procedures and can be replicated.
- Data analysis is undertaken by means of standadised statistical procedures.
- The unit of analysis is variables which are anatomistic (elements that form part of the whole).

3.7.1.2. Questionnaires

According to Adams and Cox (2008: 18), a questionnaire is a tool and as such it must be usable so that the reader can easily understand, interpret and complete it. This will increase the accuracy of responses.

© University of Venda

De Vos, Strydom, Fouche and Delport (2002:174) mention the following advantages and limitations of using questionnaires:

Advantages

- Much time is saved.
- Response rates are raised because of the personal contact and the fact that the fieldworkers merely distribute the questionnaires and do not bother the respondents at an inconvenient time.
- If respondents experience some difficulties with the questionnaires, they can clarify the matter with the fieldworker on his return.

Limitations

- Only a small geographical area can be covered per occasion because fieldworkers have to return to collect the completed questionnaires.
- On occasion, the fieldworker may find that the respondents have simply lost the questionnaires or did not complete it.

Crowther and Lancaster (2009: 152) list key aspects with regard to designing and implementing the questionnaire. The researcher must consider the following:

- The range and scope of questions to be included
- Question types, for example, open or close ended
- Content of individual questions
- Question structure
- Question wording
- Question order

With regard to implementing and administering the questionnaire, the researcher must further consider the following:

- Method of administering the questionnaire
- Methods of distributing/returning questionnaires
- Methods of recording responses

© University of Venda

3.7.1.3. Data collection technique

In this study, I personally distributed questionnaires to participants and collected them after three days. Thirty five questionnaires were completed and given back to the researcher. The questionnaire consisted of twenty five questions, twenty four close-ended and one open-ended. Participants were expected to spend about 20 minutes in completing the questionnaire.

3.7.1.4. Data analysis

According to Kruger, De Vos, Fouche and Venter (2005: 217), quantitative data analysis has become relatively easy, with clear step by step processes and the aid of computerised data analysis software. The researcher used Statistical Package for the Social Sciences (SPSS) to analyse data. This was done with the assistance of supervisors. The researcher reviewed and verified the stated findings in case there were errors. The verification process was possible because the number of questionnaires analysed was 25.

The data obtained was represented in terms of tables. The tables provide variables, frequencies and percentages.

3.7.2. Phase 2: Qualitative approach

3.7.2.1. Qualitative research

Qualitative research as a research methodology is concerned with understanding the process and cultural contexts which underlie various behavioural patterns and is mostly concerned with exploring the "why" questions of research (Nieuwenhuis in Maree 2010:51). McMillan and Schumacher (2006: 315) state that qualitative research describes and analyses people's individual and collective social actions, beliefs, thoughts, and perceptions.

© University of Venda

Babbie and Mouton (2001: 270) list key features of qualitative research as follows:

- Research is conducted in the natural setting of social actors.
- A focus is on process rather than outcome.
- The actor's perspective is emphasised.
- The primary aim is in-depth descriptions and understanding of actions and events.
- The main concern is to understand social action in terms of its specific context rather than attempting to generalize to some theoretical population.
- The research process is often inductive in its approach, resulting in the generation of new hypotheses and theories.
- The qualitative researcher is seen as the "main instrument" in the research process.
- The following are the characteristics of the qualitative researcher:
- The researcher looks at people and settings holistically.
- Quantitative researchers are sensitive to the effect they have on the people they study.
- Qualitative researchers try to understand people from their own frame of reference.
- The qualitative researcher sets aside his own beliefs, perspectives and predispositions.
- For the qualitative researcher all perspective are valuable.
- Qualitative researchers emphasise validity in their research.
- The researcher is the primary instrument for data collection and analysis (White, 2003: 17-18).

3.7.2.2. Focus group interviews

In a focus group interviews, purposefully sampled group of people is interviewed, rather than each person individually (McMillan & Schumacher, 2006: 360). Welman, Kruger and Mitchel (2005: 203-204) list the advantages of focus group interviews as follows:

© University of Venda

- Focus groups provide sources of information that can be obtained rapidly and at low cost.
- The researcher can easily clarify some aspects of the questions put to the respondents.
- Focus groups enable the participants in the group to discuss their opinions and experiences in such a way that a consensus of opinion regarding research problems can be reached.
- De Vos, Strydom, Fouche and Delport (2002: 319) give the following disadvantages of focus group interview:
- If the facilitator is unskilled, expressions of only the active participants may be voiced, and this creates the risk that passive participants may be unduly influenced or inhibited by active participants.
- Social posturing, the desire for people to be polite and fit within the norm or forced compliance.

According to Adams *et al* (2008: 24), focus group should not exceed six or seven participants (eight at maximum) and it should also be no smaller than three people. Adams *et al* further indicate that the role of the investigator during the focus group is to facilitate the discussion of a number of topics and to ensure that the data is recorded.

3.7.2.3. Individual interviews

Individual interviews are valuable to provide detailed information about the meaning of an event, situation or social context to each participant in a setting (Fox, 2006: 8).

3.7.2.4. Data collection technique

In this study, two focus group sessions and six individual interviews were conducted. A total of seven educators from seven schools (one independent and six public schools) participated in the focus group discussions. The first group consisted of four participants and the second group of three participants.

© University of Venda

The researcher was the facilitator of the focus group discussions as well as the individual interviews. In each session, the researcher went about collecting data as follows:

- The researcher arrived early at the location to ensure that the venue was comfortable and conducive to discussion. Sitting arrangements were made in such a way that all participants and the facilitator were around one table. Participants were able to see and hear each other clearly. Participants were given tags with codes in case they would like to refer to one another while discussing.
- The researcher introduced himself to the participants to establish rapport and participants were in turn given the opportunity to introduce themselves.
- The researcher explained to the participants the overview of the topic, purpose of the study and why they were selected to participate in the discussions.
- Participants were encouraged to freely share their point of view even if it differed from that of others. It was indicated to the participants that the interview session is scheduled for one hour to one and half hours.
- The researcher asked permission from the participants to use a voice recorder to collect information.
- The researcher used semi-structured questions read from the interview guide. This helped the researcher to stay on track and on time and ensured that each group was given adequate opportunity to discuss questions in a similar fashion.
- During the interview, a voice recorder was used to record information and at the same time the researcher maintained eye contact with the participants. The researcher used a notebook to indicate gestures, facial expression and postures that participants made when expressing their opinions.
- At the end of the interview session, participants were asked if there were questions regarding the proceedings. The researcher then summarised proceedings and closed the session.

© University of Venda

3.7.2.4. Pilot study

The pilot study is one way in which the prospective researcher can orientate himself to the project he has in mind (De Vos, 2002: 210). According to McMillan and Schumacher (2006: 202), it is best for researchers to locate a sample of subjects with characteristics similar to those that will be used in the study.

In this study, a pilot study with three participants who teach Mathematics in the FET band was conducted. All participants were from the same school and the interviews were done at their workplace. The reasons for conducting the pilot study were to:

- Establish if there is a need for change in question design or wording.
- Establish if the questions asked are likely to provide the output data required.
- Ensure that the interviews can be completed within specified time.
- Rehearse in order to prevent making mistakes during actual interviews.
- Boost my confidence as a facilitator.
- Ensure correct operating of the tape recorder and that the tape recorder works properly.

3.7.2.5. Data analysis

Qualitative data analysis is primarily an inductive process of organising data into categories and identifying patterns (i.e. relationships) among the categories (McMillan & Schumacher, 2006: 364). According to Nieuwenhuis in Maree (2010: 99), data analysis tries to establish how participants make meaning of a specific phenomenon by analysing their perceptions, attitudes, understanding, knowledge, values, feelings and experiences in an attempt to approximate their construction of the phenomenon. Nieuwenhuis in Maree (2010: 100) further indicates that in qualitative data analysis, the aim of the researcher is never to measure, but to interpret and make sense of what is in the data. This requires creativity, discipline and a systematic approach.

Taylor-Powell and Renner (2003: 2-5) provide the following five steps of the analysis process:

© University of Venda

- Step 1: Get to know your data.
- Step 2: Focus the analysis.
- Step 3: Categorise information.
- Step 4: Identify patterns and connections within and between categories.
- Step 5: Interpretation.

The five above-mentioned steps were used to analyse data in this study.

a) Get to know your data

The researcher listened to tape recordings for several times, read and re-read the transcript in order to get familiar and understand data.

b) Focus the analysis

I analysed how participants responded to each question. This was facilitated by making a table with four columns. The first column was for the question, the second column for session 1 responses, the third column for session 2 responses and the fourth column for the notes (i.e. list of recurring words, ideas, concepts and themes).

c) Categorise information

Data was closely reviewed and coded. Subcategories were also created in the process. The reason for coding was to gain understanding of the nature and types of relationships involved. This helped to organise data into categories.

d) Patterns and connections

The researcher identified themes, patterns and relationships that were emerging across the data. This included identification of similarities and differences as well.

e) Interpretation of data

Themes, relationships and connections were interpreted at the same time comparing the findings to the existing literature.

© University of Venda

3.8. RELIABILITY, VALIDITY AND GENERALISABILITY

According to Adams, Khan, Raeside and White (2007: 235), three criteria are generally used for testing and evaluating measurements of variables and ensuring the quality of data, research design methods and the overall accuracy of study results. These criteria are reliability, validity and generalizability.

3.8.1. Reliability

Reliability refers to the consistency of the measurement, the extent to which the results are similar over different forms of the same instrument or occasion of data collection (MacMillan & Schumacher, 2006: 183).

3.8.2. Validity

Raises the question of whether a measuring device is actually connected adequately to the theoretical mechanism, process or construct it was intended to capture (Aldridge and Levine, 2001: 40).

3.8.3. Generalisability

The crux of generalisability- the ability to explain the same (or similar) phenomena at all times and in all places without necessarily having to study it directly at all times and in all places (Adams, Khan, Raeside & White, 2007: 238).

Babbie and Mouton (2001: 275) indicate that when enhancing validity and reliability in the quantitative paradigm, one has to be more concerned with triangulation, writing extensive field notes, member checks, peer review, reasoned consensus, audit trial and letting respondents speak freely without distorting what they say while being interviewed. McMillan and Schumacher (2006: 117) assert that credibility is enhanced when the research design takes into account potential sources of error that may undermine the quality of the research and may distort the findings and conclusions.

© University of Venda

In order to enhance validity and reliability in this study, the following steps were taken before data collection, during data collection and during data analysis.

Before data collection the researcher:

- Reviewed literature in order to build knowledge and identify design and methodology to be employed in the study.
- Developed questionnaire, focus group and individual interview guides. All instruments were given to colleagues who hold Master's degrees for inputs and then submitted to the supervisors for corrections and other suggestions. The supervisors ensured that all questions were in line with the study under investigation and the main research question was addressed.
- Prepared a representative sample to take part in the investigation. Participants were educators teaching Mathematics in the FET band and FET subject advisors.
- Piloted the focus group instrument in order to orientate himself and to get the feel of how things would go during the actual interview session. The pilot study was done with three participants having similar characteristics as those of the main investigation.

During data collection the researcher:

- Questionnaires, focus group and individual interviews were used to obtain information regarding the role of subject advisors in supporting educators in the FET band.
- Distributed questionnaires to participants and collected them after three days. The questionnaire distributed was of reasonable length. Participants were expected to spend twenty minutes to complete the questionnaire.
- Ensured that the venue was conducive for focus group interviews. The time spent with first and second groups were 62 and 53 minutes respectively.
- Created rapport with participants by showing respect towards them and spelling out the purpose of the study. The situation was non-threatening and participants were free to give information.

© University of Venda

- Used a tape recorder and a note book to collect information. Non-verbal communication was also observed during the interviews.

During data analysis the researcher:

- Consulted literature on how to carry out quantitative and qualitative data analysis. Steps taken in analysing data involved organising, coding and categorizing information.
- Used SPSS software to analyse quantitative data. This was done with the assistance of supervisors. Statistical findings were verified.
- Compared questionnaire, focus group and individual interviews findings with literature.
- Took transcripts and analysed texts back to the respondents to check if the information was actually what they provided.
- Gave transcript and provisional interpretations to a colleague who is a Master's degree graduate for inputs.
- Submitted transcriptions and interpretations to the supervisors for the purposes of detecting flaws and other problems in the study.

3.9. ETHICAL CONSIDERATIONS

According to Strydom as cited in White (2003: 149), ethics is a set of moral principles which is suggested by an individual or group, is subsequently widely accepted, and offers rules and behavioural expectations about the most correct conduct towards experimental subjects and respondents, employers, sponsors, other researchers, assistants and students. According to Welman, Kruger and Mitchel (2005: 181), ethical considerations come into play at three stages of a research project, namely

- When participants are recruited.
- During the intervention and/or measurement procedure to which they are subjected.
- In the release of the results obtained.

I considered the following ethical issues:

© University of Venda

3.9.1 Permission

I obtained permission to conduct the research from the district office, circuit office as well as the principals of schools.

3.9.2. Voluntary participation

The nature and purpose of the study were fully explained to the principals of schools and the participants. Participants were allowed to exercise their right to be part of the study or not.

3.9.3. Harm to experimental subjects

In this study, no physical harm or danger was considered as a possibility; however, the researcher ensured that participants were not subjected to emotional or psychological harm by treating them with respect.

3.9.4. Confidentiality

To ensure confidentiality, participants' names were not reflected on the questionnaire, only the code assigned to the school for the purposes of follow-up visits. In the case of group discussions, pseudonyms were used to protect participants' identities. The researcher promised to destroy all the information provided after the completion of the study.

3.10. CONCLUSION

This chapter discussed the research methodology employed in the study. This included the research design adopted, organisation of the study, ethical considerations and issues pertaining to validity and reliability. Organisation of the study dealt with research approaches used in the study, data collection methods, and data collection techniques and data analysis. Chapter 4 will focus on analysis and interpretations of data.

© University of Venda

CHAPTER 4

ANALYSIS AND INTERPRETATION OF RESEARCH RESULTS

4.1. INTRODUCTION

This chapter presents the obtained quantitative and qualitative data. The quantitative data was obtained through questionnaires and the qualitative data through interviews.

Data is analysed and where possible, results are compared to literature. This is done to address the aim of the study, research questions and the main research question outlined in Chapter 1.

4.2. QUANTITATIVE DATA

The total of thirty five educators from thirteen schools completed the questionnaire. The questionnaire was divided into two sections, personal and professional development information. The quantitative data is presented in tables indicating variables, frequency and percentages as well as bar graphs indicating variables and percentages.

SECTION A: PERSONAL INFORMATION

1. Respondents were requested to indicate their gender

TABLE A1

	Frequency	Percentage
Female	11	31.4
Male	24	68.6
Total	35	100.0

The study reveals that 31.4% of educators are female, and 68.6% educators are male. The indication is that Mathematics teaching in the FET band is dominated by males.

© University of Venda

This concurs with the survey done in 2004 which highlights that while the number of female teachers has been rising overall, it has not been increasing to any comparable or significant degree in secondary specialist areas such as Science and Mathematics (DoE, 2005b: 43).

2. Respondents were requested to indicate their age

TABLE A2

	Frequency	Percentage
Less than 25 years	1	2.9
25 – 35	9	25.7
Above 35 years	25	71.4
Total	35	100.0

Only 1 educator from the total of 35 is below 25 years, which makes it 2.9% of the sample, 25.7 % of educators are within the range of 25 years to 35 years and 71.4% of educators are above 35 years. The study highlights that the majority of respondents are old. According to the Department of Education (DoE, 2005b: 45), while older teachers may be highly experienced and confident in their teaching role, there is also a need for updated curriculum knowledge and pedagogical procedures. When new curriculum is introduced, educators undergo training. The researcher deduces that though experienced, educators need support to change their views, attitudes and old practices.

3. Respondents were requested to indicate years of experience in teaching Mathematics in the FET band

TABLE A3

	Frequency	Percentage
Less than 5 years	6	17.1
5 – 10 years	13	37.1

© University of Venda

11 – 20 years	8	22.9
Above 20 years	8	22.9
Total	35	100.0

From the analysis, it is clear that 17.1% of the respondents have less than five years teaching experience, 37.1% have five to ten years, 22.9% have eleven to twenty years and another 22.9% have above twenty years teaching experience. Statistics indicate that only a small percentage of respondents are inexperienced. Though inexperienced educators demonstrate content knowledge, they lack understanding and dynamics of Mathematics teaching as well as classroom management. Support in these areas is imperative.

4. Respondents were requested to indicate when they started working as educators

TABLE A4

	Frequency	Percentage
Before 1988	17	48.6
After 1988	18	51.4
Total	35	100.0

Less than half of the respondents, 48.6%, became educators before 1998 and 51.4% after 1998. Educators who started working before 1998 had their own way of teaching Mathematics until the introduction of the new curriculum in 1998. According to Aldridge *et al* (2004: 252), teachers who have taught for a number of years often resort to their own ways of teaching rather than continue with new strategies. Since the majority of educators started teaching before the introduction of the new curriculum, Curriculum 2005, they may resort to old ways of teaching mathematics as a matter of habit.

© University of Venda

5. Respondents were requested to indicate their highest qualification in Mathematics

TABLE A5

	Frequency	Percentage
JSTC	1	2.9
STD 10	7	20.0
Bachelor's degree	14	40.0
Honours degree	4	11.4
Master's degree	0	0.0
Doctorate	0	0.0
Other	9	25.7
Total	35	100,0

2.9% of respondents indicated Junior Secondary Teachers' Certificate as highest qualification, 20.0% indicated Standard 10 as highest qualification, 40% indicated Bachelor's degree as highest qualification, 11.4% indicated Honours degree as their highest qualifications and 25.7% indicated others. Slightly more than half of the respondents have a Bachelor's degree or an Honour's degree. According to the researcher, the figures imply that many educators possess good content knowledge in Mathematics.

6. Respondents were requested to indicate FET grade that they are currently teaching

TABLE A6

	Frequency	Percentage
Grade 10 only	7	20/0
Grade 11 only	3	8.6
Grade 12 only	3	8.6

© University of Venda

Grade 10 and 11 only	0	0.0
Grade 10 and 12 only	6	17.1
Grade 11 and 12 only	6	17.1
Grade 10,11 and 12	10	28.6
Total	35	100.0

The statistics indicate that 20.0% of the respondents teach Mathematics in grade 10 only, 8.6% in grade 11 only, 8.6% in grade 12 only, 0% in grades 10 and 11 Only, 17.1% in grades 10 and 12 only, another 17.1% in grades 11 and 12 only, and 28.6% in grades 10, 11 and 12. According to the figures, slightly more than half of respondents teach Mathematics in more than one grade. The researcher realizes that this gives educators the opportunity to know their learners better, as they proceed from grade 10 through grade 11 to grade 12. Knowledge of leaners is one of the components of PCK.

SECTION B: PROFESSIONAL DEVELOPMENT

7. Have you ever observed a subject advisor demonstrating a Mathematics lesson?

TABLE A7

	Frequency	Percentage
Yes	19	54.3
No	16	45.7
Total	35	100.0

The figures indicate that 54.3% of the respondents have observed a subject advisor demonstrating a lesson and 45.7% have never observed a subject advisor delivering a lesson. In their role to support educators, subject advisors demonstrate how best to conduct Mathematics lessons.

© University of Venda

8. Have you ever been observed or evaluated by a subject advisor offering Mathematics lesson to your students?

TABLE A8

	Frequency	Percentage
Yes	11	31.4
No	24	68.6
Total	35	100.0

The results revealed that only 31.4% of the respondents have been observed or evaluated by the subject advisor offering a Mathematics lesson. The majority of respondents (68.6%) have never been evaluated by the subject advisor giving a Mathematics lessons. Nevo (1994: 113) advocates that evaluation is intended to help teachers improve their teaching performance according to the need of their students, and thus improve students' learning. This indicates to the researcher that many educators may not be aware of their weak points with regard to teaching Mathematics.

9. How often do subject advisors engage you and your Head of Department on academic improvement of Mathematics?

TABLE A9

	Frequency	Percentage
Always	4	11.4
Sometimes	23	65.7
Never	8	22.9
Total	35	100.0

The figures indicate that 11.4% of respondents are always engaged with their Head of Departments on academic improvement of Mathematics, 65.7% of respondents are sometimes engaged with their Head of Departments, and 22.9% of respondents are

© University of Venda

never engaged with their Head of Departments. This suggests that Head of Departments are not sufficiently empowered to support educators and to coordinate the teaching of Mathematics in schools.

10. When Mathematics advisors visit your school for monitoring purposes, do they

10.1. Establish pace, depth and sequencing of content?

TABLE A10.1

	Frequency	Percentage
Yes	20	57.1
No	15	42.9
Total	35	100.0

From the analysis, 57.7% of the respondents indicate that Mathematics advisors establish pace, depth and sequencing of content when visiting their schools, and 42.9% indicate that they do not do that at all. This indicates that the majority of educators are able to cover all the content because they get support on the pacing of work. Studies conducted by Mji and Makgato (2006: 259) point to non-completion of syllabus as one of the factors contributing to Mathematics high failure rate.

10.2. Check the availability of content framework?

TABLE A10.2

	Frequency	Percentage
Yes	25	71.4
No	10	28.6
Total	35	100.0

© University of Venda

University of Venda
Creating Future Leaders

The statistical figures reveal that 71.4% of the respondents agree that Mathematics subject advisors check the availability of subject content framework when visiting their schools, and 28.6% of respondents indicate that subject advisors do not check the availability of subject framework when visiting their schools. The researcher deduces that the majority of teachers have subject content framework which implies that they know which content to teach in their respective grades.

10.3. Check the availability of textbooks?

TABLE 10.3

	Frequency	Percentage
Yes	17	48.6
No	18	51.4
Total	35	100.0

In this table, 48.6% of respondents indicate that Mathematics subject advisors check the availability of textbooks when visiting their schools, and 51.4% which is slightly more than half of the respondents indicate that Mathematics subject advisors do not check the availability the availability of textbooks. This suggests that requisition and delivery of textbooks is not the subject advisors' core responsibility.

10.4. Check the availability of examination guidelines?

TABLE A10.4

	Frequency	Percentage
Yes	23	65.7
No	12	34.3
Total	35	100.0

© University of Venda

The table reveals that 65.7% of respondents indicate that subject advisors check the availability of examination guidelines when visiting their schools, and 34.3% of the respondents indicate that subject advisors do not check the availability of examination guidelines when visiting their schools. The researcher deduces that many educators have examination guidelines and know sections to be included in the examination.

10.5. Check lesson preparations?

TABLE A10.5

	Frequency	Percentage
Yes	20	57.1
No	15	42.9
Total	35	100.0

From the analysis, it is clear that 57.1% of the respondents have their lesson preparations checked when Mathematics subject advisors visit their schools and 42.9% of the respondents indicate that Mathematics advisors do not check their lesson preparations. The researcher deduces that the majority of educators plan their lessons before the actual teaching takes place.

11. Do subject advisors provide you with guidelines on how to select Mathematics textbooks?

TABLE A11

	Frequency	Percentage
Yes	11	31.4
No	24	68.6
Total	35	100.0

© University of Venda

The statistical figures reveal that less than one third of the respondents (31.4%) indicate that subject advisors provide them with guidelines on how to select Mathematics textbooks and 68.6% of the respondents indicate that they are not provided with guidelines on how to select Mathematics textbooks. The Department of Basic Education (DBE, 2011a: 19) advocates that school-based choice of textbooks can be achieved through collaborative effort of relevant subject teachers, Heads of Department, Subject Advisors and expertise from surrounding schools forming School LTSM Committees. Data results indicate that the majority of educators do not know how to go about choosing textbooks.

12. How often do subject advisors provide you with assessment strategies?

TABLE A12

	Frequency	Percentage
Always	10	28.6
Sometimes	20	57.1
Never	5	14.3
Total	35	100.0

This table shows that 28.6% of the respondents are always provided with assessment strategies, 57.1% of the respondents indicate that they are sometimes provided with assessment strategies, whereas 14.3 % of the respondents indicate that they are never provided with assessment strategies. These statistics show that fewer educators know how to apply assessment strategies.

© University of Venda

13. Do you receive training on how to develop Mathematics assessment tasks and the corresponding assessment tools?

TABLE A13

	Frequency	Percentage
Yes	22	62.9
No	13	37.1
Total	35	100.0

From the analysis, it is clear that the majority of the respondents (62.9%) indicate that they receive training on how to develop Mathematics assessment tasks and assessment tools, and 37.1% of the respondents indicate that they do not receive training on how to develop Mathematics assessment tasks. The above figures show that the majority of educators are able to develop different assessment tasks.

14. Does your school receive assessment documents like templates of marking rubrics and record sheets?

TABLE A14

	Frequency	Percentage
Yes	35	100.0
No	0	0
Total	35	100.0

From the survey results it is apparent that all respondents (100%) indicate that they receive templates of marking rubrics and record sheets. The schools are using relevant assessment tools to assess learners' work and relevant record sheets.

© University of Venda

15. How often do subject advisors monitor the management of Mathematics classwork and homework?

TABLE A15

	Frequency	Percentage
Always	5	14.3
Sometimes	21	60.0
Never	9	25.7
Total	35	100.0

The survey results reveal that only 14.3% of the respondents indicate that their management of Mathematics classwork and homework is always monitored, 60% of respondents which is more than half, indicate that their management of classwork and homework is sometimes monitored and 25.7% of the respondents indicate that their management of classwork and homework is never monitored. These figures suggest that there is no consistency in monitoring the management of homework and classwork.

16. Respondents were requested to indicate to which extent they agree or disagree with the following:

16.1. Regular visits by Mathematics subject advisors increase my confidence in teaching Mathematics.

TABLE 16.1

	Frequency	Percentage
Strongly agree	16	45.7
Agree	15	42.9
Disagree	4	11.4
Strongly disagree	0	0
Total	35	100.0

© University of Venda

It is apparent from Table A16.1. that 45.7% of the respondents strongly agree with the statement that regular visits by Mathematics subject advisors increase their confidence in teaching Mathematics, 42.9% of the respondents agree with the statement. Altogether, 88.6% of the respondents indicate that regular visits by Mathematics subject advisors increase their confidence in teaching Mathematics. Only 11.4% of the respondents disagree with the statement. This shows that on-site visits by Mathematics subject advisors increase educators' confidence in teaching the subject.

16.2. It is difficult to get access to Mathematics subject advisors when the need arises.

TABLE A16.2

	Frequency	Percentage
Strongly agree	3	8.6
Agree	15	42.8
Disagree	14	40.0
Strongly disagree	3	8.6
Total	35	100.0

The analysis reveals that 8.6% of the respondents strongly agree with the statement that it is difficult to get access to Mathematics advisors when the need arises, 42.8% of the respondents agree with the statement, 40.0% of the respondents disagree with the statement and 8.6% of the respondents strongly disagree with the statement. More than half of the respondents indicate that it is difficult to get access to Mathematics advisors when the need arises. The above information shows that Mathematics subject advisors are not easily accessible. One of the reasons for this scenario is the small number of subject advisors compared to the large number of educators to be supported.

© University of Venda

16.3. Subject advisors support should also emphasise pedagogical Knowledge.

TABLE A16.3

	Frequency	Percentage
Strongly agree	15	42.9
Agree	20	57.1
Disagree	0	0
Strongly disagree	0	0
Total	35	100.0

From the analysis, it is apparent that all respondents concur with the statement that subject advisors' support should also emphasise pedagogical knowledge. 45.7% of the respondents strongly agree and 54.3% of the respondents agree with the statement. None (0%) of the respondents disagree with the statement. This is in line with the report of the task team for the review of the implementation of the National Curriculum Statement (DoE, 2009a: 48) that there was a strong call from teachers that more explicit direction regarding how to teach a particular subject be given. The figures indicate that Mathematics educators need guidance on how to teach different topics in the subject.

© University of Venda

University of Venda
Creating Future Leaders

17. Have you attended in-service training in Mathematics in the past five years?

TABLE A17

	Frequency	Percentage
Yes	22	62.9
No	13	37.1
Total	35	100.0

From the analysis, 62.9% of the respondents agree that they have attended in-service training in Mathematics in the past five years, and 37.1% of the respondents indicate that they did not attend in-service training in Mathematics in the past five years. The above figures show that the majority of Mathematics educators have gone through in-service training in the past.

18. Have you ever received training on using different teaching approaches?

TABLE 18

	Frequency	Percentage
Yes	25	71.4
No	10	28.6
Total	35	100.0

From the analysis, 71.4% of the respondents agree that they have received training on using different teaching approaches, and 28.6 % of the respondents indicate that they have never received training on using different teaching strategies. The above information indicates that many educators are aware of different teaching approaches.

© University of Venda

19. How often do you use the following Mathematics teaching and learning approaches?

19.1. Cooperative

TABLE 19.1

	Frequency	Percentage
Regularly	22	62.9
Occasionally	12	34.3
Never	1	2.8
Total	35	100.0

The analysis indicates that 62.9% of the respondents use cooperative teaching and learning approach regularly, 34.3% of the respondents use it occasionally, while 2.8% of the respondents never use cooperative teaching and learning approach at all. This means that the majority of teachers are employing cooperative teaching and learning approach in their Mathematics classroom.

19.2. Project-based

TABLE 19.2

	Frequency	Percentage
Regularly	6	17.1
Occasionally	26	74.3
Never	3	8.6
Total	35	100.0

The analysis indicates that 17.1% of the respondents use project-based teaching and learning approach regularly, 74.3% of the respondents use it occasionally, while 8.6% of the respondents never use the project-based teaching and learning approach at all.

© University of Venda

This shows that the majority of teachers rarely employ project-based teaching and learning approach in their Mathematics classroom.

19.3. Problem solving

TABLE 19.3

	Frequency	Percentage
Regularly	29	82.9
Occasionally	6	17.1
Never	0	0
Total	35	100.0

The analysis indicate that 82.9% of the respondents use problem solving teaching and learning approach regularly, and 17.1% of the respondents use it occasionally. All respondents indicate that they employ the problem solving approach. The problem solving is the most popular approach used in Mathematics classrooms.

19.4. Investigative

TABLE 19.4

	Frequency	Percentage
Regularly	16	45.7
Occasionally	18	51.4
Never	1	2.9
Total	35	100.0

From the analysis, less than half (45.7%) of the respondents employ the investigative teaching and learning approach regularly and 51.4% of the respondents use it occasionally and 2.9% of the respondents never use it at all. Although educators

© University of Venda

University of Venda
Creating Future Leaders

indicate an awareness of the investigative teaching and learning approach, it is rarely used in Mathematics classrooms.

20. Do you make use of real life contexts when teaching Mathematics?

TABLE 20

	Frequency	Percentage
Yes	34	97.1
No	1	2.9
Total	35	100.0

From the analysis, it is clear that 97.1% of the respondents indicate that they use real life contexts when teaching Mathematics and 2.9% of the respondents indicate that they do not use real life situation when teaching Mathematics. These figures indicate that educators use real life contexts to enhance learners' conceptual understanding when teaching Mathematics.

21. Do you meet other teachers in your cluster to share knowledge on best practices in Mathematics teaching?

TABLE 21

	Frequency	Percentage
Yes	22	62.9
No	13	37.1
Total	35	100.0

The survey of the study shows that 62.9% of the respondents meet other teachers within the cluster to share knowledge on best practices in Mathematics teaching and the other 37.1% of the respondents indicate that they do not meet other teachers in this regard. The figures reveal that the majority of educators embark on meeting in

© University of Venda

University of Venda
Creating Future Leaders

clusters to share knowledge on Mathematics teaching. This information shows that networking systems are in place to promote collaboration among Mathematics educators.

22. Do you and your colleagues engage in Mathematics team teaching at your school?

TABLE A22

	Frequency	Percentage
Yes	27	77.1
No	8	22.9
Total	35	100.0

From the analysis, it is clear that 77.1% of the respondents engage in Mathematics team teaching at their respective schools and 22.9% of the respondents indicate that they do not engage in team teaching. According to Syh-Jong (2007: 179), an increased collaboration among teachers exists in team teaching, but has less frequently been implemented at the secondary school level. The percentages above indicate that collaboration is taking place in schools through team teaching.

23. Do you receive sufficient feedback from subject advisors after moderation of Mathematics continuous assessment?

TABLE A23

	Frequency	Percentage
Yes	24	68.6
No	11	31.4
Total	35	100.0

© University of Venda

University of Venda
Creating Future Leaders

The study reveals that 68.6% of the respondents receive sufficient feedback from subject advisors after moderation of Mathematics continuous assessment and the other 31.4% of the respondents do not receive sufficient feedback from subject advisors. The above shows that teachers receive feedback after moderation of Mathematics continuous assessment.

24. Do subject advisors provide support on how to deal with learner experiencing barriers to learning and development with regard to Mathematics learning?

TABLE A.24

	Frequency	Percentage
Yes	5	14.3
No	30	85.7
Total	35	100.0

From the analysis, it is clear that 14.3% of the respondents indicate that subject advisors provide support on how to deal with learners experiencing barriers to learning and development with regard to Mathematics learning. The other 85.7% of respondents indicate that they do not receive support on how to deal with learners experiencing barriers to learning and development. These figures indicate that educators struggle to support learners with barriers to learning of Mathematics.

25. What do you suggest is the most needed support that can enhance learners' performance in Mathematics

Table A25

SUPPORT NEEDED
Support on teaching methods
Support based on difficult topics
Support on learners with barriers to learning and development in Mathematics

© University of Venda

Support on investigation and problem solving
Support based on lesson evaluation and demonstration
Support on provision of materials
Support based on lesson study
Support on team teaching
Support on motivating learners
Support on written work
Support on selection of textbooks
Support by assisting GET Mathematics educators

Table A25 summarises the most needed support as indicated by the respondents. This was an open ended question and respondents were not restricted to give any number of supports they need. Based on responses provided, it is clear that Mathematics educators in the FET band need support in all aspects of pedagogical content knowledge as described in section 2.3

4.3. QUALITATIVE DATA

Qualitative data was collected through focus group interviews and individual interviews.

4.3.1. Focus group interviews

Focus group interviews were conducted to obtain information on the role of subject advisors in supporting educators in the FET band with regards to pedagogic content knowledge. FET Mathematics educators were interviewed in two separate sessions; four educators in the first session and three in the second. Questions and responses are given in tables below.

© University of Venda

Question 1

What support do subject advisors give in your day to day activities regarding teaching and learning of Mathematics?

Educator 1: *They help us by conducting workshops wherein difficult topics in Mathematics are discussed.*

Educator 2: *They help us because they give us work-schedules and assessment plans. I think they are the ones designing them. We are able to work easier as mathematics teachers by following work-schedules and assessment plans. If I am the one designing them, they would be different from those of other teachers. Subject advisors are helping us a lot by providing work-schedules and assessment plans which are common.*

Educator 3: *Subject advisors organise workshops in order to deal with common difficult topics.*

Educator 4: *These days, subject advisors are providing us with common assessment tasks. The standard is good. They also set examination and design memoranda. By so doing they have reduced our workload.*

Educator 5: *They provide work-schedule, pacesetters, common tasks and common tests. But as far as being there, that kind of assistance, as far as I am concerned, is lacking. The last time the subject advisor visited our school was two years ago, just to check what we have covered in the syllabus (I mean work-schedules). Basically it is the provision of those items that I have mentioned.*

Educator 6: *To add on that, subject advisors also give us CASS templates to complete.*

Educator 7: *What others have mentioned is what we are also getting at our school. What others have mentioned is what we are also getting at our school, but to add on*

© University of Venda

that, subject advisors sometimes call us to a neutral venue where different Mathematics topics are treated.

Educators 1, 3 and 7 express that subject advisors support them through workshops based on difficult Mathematics topics. Educators 2, 4 and 5 indicate that subject advisors support them by providing work-schedules; assessment plans common assessment tasks (with memoranda) and pacesetters. Educator 6 indicates that subject advisors provide templates for recording continuous assessment (CASS) marks.

Below is a summary of aspects of the support subject advisors give in day to day activities regarding teaching and learning of Mathematics.

Subject advisors:

- Conduct workshops based on Mathematics content
- Provide work-schedules
- Provide assessment plans
- Provide common assessment tasks (with memoranda)
- Provide pacesetters
- Provide CASS templates

Educator 3 indicates that provision of work-schedules and assessment plans help educators to work easier as they guide them on what to do and when. Educator 4 indicates that the provision of assessment tasks and examinations reduces their workload. The Report of the Task Team for the Review of the implementation of National Curriculum Statement (DoE 2009a: 31) indicates that officials' bureaucratic approach to assessment, with emphasis on assessment standards rather than content covered is burdensome to many teachers. Educator 5 emphasises that the kind of support that educators receive from subject advisors is largely on the provision of items and not on direct interaction between educators and subject advisors. This kind of support is lacking.

© University of Venda

The interviews highlight that subject advisors support educators in their day to day activities of teaching and learning Mathematics. This kind of support rendered by subject advisors is in line with the literature reviewed in section 2.4.7. The information above suggests that apart from workshops based on content, there is not much on the development of individual educators, but the provision of documents.

Question 2

How do subject advisors influence your commitment to teaching and learning of Mathematics?

Educator 1: *What I can say is that; say there are chapters that are difficult, subject advisors call us for a meeting to discuss those difficult chapters. By so doing, at least you will be confident in what you do. When going back to learners we are motivated. Support adds motivation to teach.*

Educator 2: *When we attend courses, you find that it is difficult for one to tackle certain chapters, but after the course, you find it easy to teach learners. Support from subject advisors influences our commitment positively.*

Educator 3: *When called to workshops by subject advisors we are able to share information, for example using different approaches, which motivate us a great deal.*

Educator 4: *When subject advisors come to school, normally they want paperwork. Instead they should take us to classrooms. They should coach me on how can I deliver information to learners. They come for paperwork and if things are not alright, they start commenting here and there. At times you will be discouraged by some of the comments.*

Educator 5: *I wouldn't say it is actually support as such. But the commitment comes because if you are given the pacesetter, they are now saying by this time you should*

© University of Venda

have covered this, by this time you are getting tests. My commitment is now controlled by pacesetters; it is controlled by what is coming in. But my feeling is that it puts a strain, Sometimes you haven't covered the work the way you want it and you are not satisfied that learners understand certain concepts. But because of the coming tests, I am forced to cover all the work.

Educator 6: *According to me, I can say there is an influence. After subject advisors have given us work-schedules you have to work hard because you know that there is a common test coming. You have to make sure that you are following the pacesetter and learners have to know the work that is going to be covered in the test.*

Educator 7: *The other thing I can say is on the issue of classwork and homework. When subject advisors come to school they check as to how many classwork and homework you have given to learners, which means one has to ensure that he is giving more classwork and homework. You cannot give learners classwork and homework without first teaching them.*

Educators 1, 2 indicate that workshops based on Mathematics content positively influence their commitment to teaching and learning of Mathematics. Such workshops boost their confidence and as result, they are motivated to teach and find it easy to teach. Educator 3 mentions workshops that involve sharing of information amongst educators themselves. The motivation gained influences the commitment to teach Mathematics. Educator 4 is indirectly indicating what he/she would like to see happening that would influence his/her commitment to teaching and learning of Mathematics, being coached on how to deliver information to learners. The teacher also dwells on the issue of communication during interaction between the educator and the subject advisor, that if things are not right, some of the comments made by the subject advisors discourage them.

© University of Venda

Although Educator 5 agrees that provision of pacesetters influences his/her commitment to teaching and learning of Mathematics, it is so because pacesetters dictate timelines for the completion of certain sections for the purposes of the coming assessment task. The educator is implying that this kind of commitment impacts negatively because it serves the pacesetters and the coming tasks more than the learners themselves. This is so because even if the educator is not satisfied that learners understand certain topics, for the sake of the coming tests, he/she is compelled to cover all the work.

According to Educator 6, provision of work-schedules and pacesetters influences the commitment to teaching and learning Mathematics because one has to cater for the coming common test. Educator 7 says that when subject advisors visit schools, they audit the number of classwork and homework given to learners. For the teacher to give more classwork and homework he/she has to teach learners first, hence commitment is influenced.

Summary of aspects on how subject advisors influence educators' commitment to teaching and learning of Mathematics.

- Support in strengthening educators' content knowledge
- Provision of work-schedules, assessment plans and pacesetters
- Auditing of classwork and homework given to learners
- Provision of environment that creates and fosters sharing of information among educators.

Literature reviewed in sections 1.5.1, 2.4.1 and 2.4.7 covers the aspects given. The responses indicated above show that monitoring quantity and quality of work done in schools, support on educator development and provision of materials enhances commitment to teaching and learning of Mathematics.

© University of Venda

Question 3

How do subject advisors support you in your effort to support learners experiencing barriers to learning and development in Mathematics?

Educator 1: *Subject advisors encourage us to give more written work to learners, so that they are able to practice. They encourage us to give more informal assessment as well as assignments.*

Educator 2: *They encourage us to direct most of the simple questions to "slow" learners in order to build their confidence. We also give them extra work so that they can improve on their learning.*

Educator 3: *I have never attended a meeting where such a topic was under discussion.*

Educator 4: *No comment* (shaking head).

Educator 5: *What I can say is subject advisors encourage us as teachers, especially concerning those learners, to have extra lessons with them and to give them more work just in order for them to be with others.*

Educator 6: *Subject advisors feel that more time with learners will uplift everyone, improve everyone. But I want a situation whereby a subject advisor would come to school to assist. I believe that being the subject advisors; they have got some other ways of approaching certain concepts. That is what I would like them to do. But as for now they encourage us to have more time with learners and to give more work.*

There are those who have barriers, you can give work and more work, but still not getting results. I would rather have a situation where subject advisors would come to my school. I want them to come and show learners or to say this topic can be

© University of Venda

approached like this and maybe to listen to learners themselves. That is the kind of assistance I would like.

For now the support they are giving is just to emphasise more time with learners. That is why we have Monday to Saturday, winter school, summer, spring and even Sunday school. (Other respondents laughed)

Educator 7: *They advise us to group learners, combining bright learners with learners experiencing barriers to learning in a group. The expectation is that they may be able to understand their bright peers when discussing Mathematics.*

Educators 1, 2, 5 and 6 indicate that subject advisors encourage them to give more written work to learners experiencing barriers to learning and development in Mathematics. This gives learners the opportunity to practice more and as a result, improvement on their learning is enhanced. Educator 2 also expresses that they are encouraged to build learners' confidence by directing most of the easy questions to them.

Educators 5 and 6 further point out that subject advisors emphasise having extra lessons with these learners in order to bridge the existing gap. Educator 6 argues that more time with learners and giving more work do not guarantee the improvement of every learner experiencing barriers to learning and development in Mathematics. Instead he advocates direct interaction between subject advisors and learners that if they can assess the extent of the barriers they may be able to come up with better approaches to address certain topics.

Educator 7 indicates that subject advisors encourage the grouping of learners. Learners are heterogeneously grouped in terms of ability. This gives learners experiencing barriers to learning and development in Mathematics the opportunity to benefit from the discussions.

© University of Venda

Educator 3 indicates that he/she has never been assisted on how to support learners experiencing barriers to learning and development in Mathematics. Educator 4 does not want to comment but his/her gestures of shaking the head sideways tells it all that he/she has never been exposed to such kind of support.

Below is a summary of aspects on how subject advisors support educators in their effort to support learners experiencing barriers to learning and development in Mathematics. Subject advisors encourage educators to:

- Build learners confidence by including easy questions when teaching
- Give more written work
- Give extra lessons
- Group learners according to ability during discussions.

The above sentiments by the study participants indicate that support on assisting educators to support learners with barriers to learning and development in Mathematics is limited to giving educators encouragement on what to do only.

Question 4

How do subject advisors support you in developing credible assessment tasks?

Educator 1: *At first we used to develop assessment tasks ourselves, but now they provide us with these tasks. They provide common projects, investigations, assignments and tests. What I can say is that subject advisors must train us on how to develop those tasks so that we are able to develop them ourselves.*

Educator 2: I *want to support my colleague that nowadays they are providing us with everything.*

© University of Venda

University of Venda
Creating Future Leaders

Educator 3: *It is true that we used to develop assessment tasks ourselves. But subject advisors are not giving us a strong support on how to develop assessment tasks. Even then, we did not know the difference between projects and investigations. There are projects and investigations in some of the textbooks. We would just use the given rubrics without understanding what is going on. Coming to tests, it is true that they are providing us with tests, but the problem is that the papers are not moderated because they are full of mistakes. Some of them are papers that have been written before. Learners score high because they have seen the paper before.*

Educator 4: *We are not getting support on how to develop different assessment tasks. We receive these tasks from subject advisors through our circuits.*

Educator 5: *We had a workshop where they just introduced this, how to develop projects and investigation. If it is an investigation, what are the requirements? But what happens now is that they give us these tasks. Projects and investigations are provided by them to such an extent that there is no evaluation of our own tasks that we develop. But I remember we once attended a workshop where they were doing those tasks.*

Educator 6: *Even though we don't have to go for negativity, it is of no use going for such kind of workshops because we don't develop our own tasks. All these tasks are set externally. They give us good training but we don't have the opportunity to exercise what we have been taught.*

Educator 7: *Subject advisors provide assessment tasks for CASS purposes. Maybe by doing that they think we will see how it is done.*

All respondents concur that schools receive formal assessment tasks from subject advisors. However, Educators 1, 3 and 4 feel that they do not receive direct support from subject advisors on how to develop credible assessment tasks. Educator 1 mentions question papers which are full of mistakes and question papers that have

© University of Venda

University of Venda
Creating Future Leaders

already been seen by learners. Educator 7 is of the opinion that by providing assessment tasks, subject advisors are indirectly supporting educators on how it is done.

Educators 5 and 6 indicate receipt of support on development of assessment tasks. Nonetheless, the concern is that they do not get the opportunity to assess learners on tasks that they develop themselves. Even if they develop their own tasks, they are not evaluated because they are not formally recorded. Workshops and meetings intended to support educators on the development of credible assessment tasks are considered useless because of this reason.

Below is the summary of aspects on how subject advisors support educators in developing credible assessment tasks as provided by the responses above. Subject advisors provide:

- Tests, projects, assignments and investigations to schools for CASS purposes.

The literature reviewed (section 2.4.7) does not mention the provision of tasks to schools, but the provision of exemplars and memoranda. This study highlights that there is no direct support of educators on how to develop credible assessment.

Question 5

How do subject advisors support you in accommodating different learning styles of learners?

(This question was responded to after a long pause, even after the researcher had tried to clarify it. Respondents were just looking at one another).

Educator 1: *I still remember one time they advised that it is good to identify learners who are gifted and those who are slow. They indicated that we do a lot of examples with the slow learners and give challenging work to the gifted ones. They also advised*

© University of Venda

that we group learners. Say, for argument sake, in a group of four you put one bright learner so that he or she "pick-up" others.

Educator 2: *For me, accommodating different learners demands time. Different learning styles are not accommodated at one time. You have to be flexible from one individual to the other. Subject advisors don't say use this way, what they say is use many ways to teach learners.*

Educator 3: *I have never been supported on this one.*

Educator 4: *No comment*
Educator 5: *No comment*
Educator 6: *No comment*
Educator 7: *No comment*

Educator 1 indicates that the advice received from subject advisors is to give more examples to the slow learners and challenging work to the gifted ones. Educator 2 says that even though the advice from subject advisors is to make use of many ways, there is no support on how to do that. Educators 3, 4, 5, 6 and 7 indicate that they have never been supported on accommodating different learning styles of learners.

Based on the way educators responded and the gestures expressed, it is clear that educators are not supported at a larger scale on how to accommodate different learning styles.

© University of Venda

Question 6

How do subject advisors support you in using different teaching strategies and methodologies to enhance achievement in Mathematics?

(The question was asked and clarified twice. Just like with the previous question respondents were just looking at one another).

Educator 1: *In answering the question I can say subject advisors encourage us not to use one method of teaching. What I am saying is that they encourage us to use different methods when teaching.*

(**Researcher:** Which methods do they encourage you to use?)
They do not actually tell us which methods to use.

Educator 2: *What she is saying is right. We have had workshops, usually based on the introduction of new topics. You attend a workshop from one o'clock until three o'clock and that is done. There is no much time to actually look at it in different ways so that we can put that across to the learners. There is no time to say we can use this method or that method. They actually tell us this is how to go about it, just to develop us. There is no time to say we can use this method or that method.*

Educator 3: *No comment*

Educator 4: *No comment*

Educator 5: *No comment*

Educator 6: *No comment*

Educator 7: *No comment*

Educator 1 indicates that subject advisors encourage teachers to use different teaching methods but there is no support on that. Educator 1 is supported by educator 2 who points out that for the workshops that they attend there is no time to look at different teaching methods.

© University of Venda

The no comment responses by Educators 3, 4, 5, 6 and 7 imply that they have not been supported in utilising different teaching methods and strategies in teaching Mathematics.

The assessment of the responses provided suggests that support on utilising different teaching strategies and methodologies regarding the teaching of Mathematics are done at a lower scale.

Question 7

How do subject advisors support you in choosing textbooks?

Educator 1: *Subject advisors do not tell us which textbooks to order because they are afraid of being accused of promoting certain textbooks. They just say go and look for a textbook which covers all the topics as indicated in the work-schedule. We are not well guided. They only emphasise the topics because if you check well, there are other textbooks which do not include all topics. If I happen to order that book, how am I going to teach learners? They advise us to scan the books well, all topics must be there and must be clearly explained.*

Educator 2: *If the question was how I select textbooks myself, I would be telling you how I do that. Subject advisors don't tell us how to select textbooks. They only tell us to go for books that we feel comfortable with. They tell us just that.*

Educator 3: *There is no clear cut strategy as far as selection of textbooks is concerned. Each and every educator uses his or her own discretion.*

Educator 4: *They do not tell us how to select textbooks. We struggle to do that on our own. Sometimes we get the chance to see different books when representatives from different publishers visit our schools.*

© University of Venda

University of Venda
Creating Future Leaders

Educator 5: *To be honest with you, I have never been supported on how to select textbooks.*

Educator 6: *Regarding selection of textbooks, they just say use different books. But without mentioning how we should choose them.*

Educator 7: *It is basically upon ourselves how to choose textbooks. It depends on the individual teacher to say which textbook to use, which one has got depth and which one has challenging questions.*

Educator 1 agrees that educators are supported on how to select textbooks for their classrooms. It is just that educators are not well guided. The educator indicates that the emphasis is on choosing a textbook which covers all the topics as indicated by the work-schedule, and also that topics must be clearly explained.

Educators 2, 3, 4, 5, 6 and 7 indicate that they do not get support on how to select textbooks. Educator 3 further points out that there are no clear cut strategies on the selection of textbooks as educators use their own discretion. The same sentiments are shared by Educator 2 and 7. Educator 4 expresses that lack of support in this regard makes educators struggle when selecting textbooks.

The Department of Basic Education provides national catalogue to schools to base their selections on. It is the responsibility of the schools themselves to select textbooks for their classrooms. In order for schools to succeed in selecting textbooks they need to follow certain criteria. What the study is revealing is not in line with the literature reviewed in section 2.4.7. The information given above shows that it is not the sole responsibility of subject advisors to provide support on the selection of textbooks.

© University of Venda

Question 8

How do you relate achievement in Mathematics with the support given by subject advisors?

Educator 1: *The support that we are receiving from subject advisors does not affect learner's performance directly. What they normally do is that they just give us some kind of guidelines as to how we can teach our learners. It then depends on my ability, am I able to employ those things to change learner behaviour. I don't know how to put my point clearly. Let me say, for example, they say put learners in groups, that advice on its own won't change learner behaviour, but it depends on how I am going to employ that strategy. I don't know as to whether I am clear.*

Educator 2: *We need to look at the results before support and the results after support by subject advisors. Before they came the percentages were low, the symbols were low. But now that they have come to support us, there is a change, results are improving. Even if the results sometimes fluctuate, I think subject advisors are helping us because there is an improvement.*

Educator 3: *I have mentioned before that subject advisors help us with difficult topics. I identify the difficult topics myself, and the subject advisor comes and assists me with those topics. You find now it is easier to teach learners and at the end of the year learners perform well. I think the support of subject advisors is related to the achievement in Mathematics.*

Educator 4: *Every year subject advisors come to compare the results with those of the previous years. This motivates us to do better. Motivation and support by subject advisors influence and encourage us to work hard in order to get good results. I also think that achievement in Mathematics is related to the support given by subject advisors.*

© University of Venda

University of Venda
Creating Future Leaders

Educator 5: *We cannot say that subject advisors do not contribute towards achievement of Mathematics. But to say to which extent, it will be very difficult. When answering the first question we indicated that subject advisors provide pacesetters and work-schedules. Because we follow timeframes, we are able to cover all the work within specified period. Subject advisors support is related to achievement in Mathematics.*

Educator 6: *I agree with my colleague. The question before was about the support we get from subject advisors. Because I am going to be restricted to the pacesetter, there are timeframes in the pacesetter; therefore I am under pressure to meet the deadlines. Because of this and other kinds of support provided, the achievement of learners can also be attributed to the support rendered by subject advisors.*

Educator 7: *What one can say is that achievement in Mathematics is related to the support given by subject advisors. Subject advisors call us to workshops to deal with difficult topics. I use the knowledge gained from workshops to teach my learners. As a result learners' performance improves. That is why I say achievement is related to the support given.*

Educators 5 and 6 indicate that the provision of work-schedules and pacesetters makes it possible for them to cover all the work that they are supposed to do. Though it puts educators under pressure, timelines and deadlines provided in the work-schedules and pacesetters help them to cover the content. Educator 5 says that it is difficult to determine the extent to which the support contributes toward achievement. However, they both agree that the provision of work-schedules and pacesetters, coupled with other support, lead to achievement in Mathematics.

Educator 1 agrees that, though indirect, the support of subject advisors is related to achievement in Mathematics. He points out that subject advisors provide guidelines on how to teach learners. After that the rest depends upon the individual educator. Educators 3 and 7 indicate that support by subject advisors is related to achievement in

© University of Venda

University of Venda
Creating Future Leaders

Mathematics because after attending workshops that involve the handling of difficult topics, they find it easier teaching and as a result, the performance of learners improves.

Although Educators 2 and 4 are not singling out any kind of support that is related to achievement in Mathematics, they agree that overall support by subject advisors including motivation culminate in Mathematics achievement.

Below is the summary of aspects on how achievement in Mathematics is related to support given by subject advisors. While other respondents indicate that overall support enhances achievement in Mathematics, the kinds of support singled out are the following:

- Provision of guidelines on how to teach learners
- Helping with difficult topics
- Motivation of educators
- Provision of work-schedules and pacesetters

The Educators' comments suggest that they believe that the support they receive from subject advisors is relevant and is related to achievement in Mathematics.

Question 9

How do subject advisors support you to work in collaboration with other Mathematics teachers in your cluster?

Educator 1: *Subject advisors call cluster meetings to discuss difficult topics. We as teachers discuss approaches to solve difficult problems. We also get the chance to discuss our experiences in as far as teaching certain topics in Mathematics is concerned.*

Educator 2: *I think the question also refers to facilitation by subject advisors that teachers come together like we are seated here, to share ideas about Mathematics teaching. Since I started working, I have never met a subject advisor telling us that we*

© University of Venda

University of Venda
Creating Future Leaders

should come to such a place on our own as Mathematics educators to share ideas or to discuss Mathematics topics.

Educator 3: *What they do is..., if I have a problem with a particular chapter, they allow me to call a teacher from another school in the vicinity to come and assist me.*

Educator 4: *Subject advisors encourage us to work as a team, to work with colleagues within the school and from other schools. If I am unable to present a certain topic to my learners, then I can call a colleague from another school to come and teach my learners. They encourage us to do so.*

Educator 5*: The other thing is that besides the common tests which are meant for CASS purposes, neighbouring schools in a cluster are encouraged to exchange own tests that they develop at school level. Learners get exposed to different ways of questioning. That is what they tell us to do and it helps us. While we are still on this one, they also encourage teachers in the cluster not to work in isolation. They encourage us to join organisations like AMESA, and if I happen to attend a conference, on coming back I must share the materials with other teachers.*

Educator 6*: What I can say is that subject advisors do encourage us to come together, maybe as a cluster to share ideas. Let's say there is a topic that I don't understand well, I can request a colleague to teach my learners while I am there as well, or just to take my learners to another school for Mathematics lessons. That is what they encourage us to do. But because of the time factor, this is not always happening.*

Educator 7: *Subject advisors say we should meet as clusters. They say schools which are closer to each other come together to share ideas. But it is not happening. I have seen it happening in one subject. But for Mathematics, it is not happening. I have come to your school to teach during weekends* [Educator 7 looking at Educator 6]. *I*

© University of Venda

University of Venda
Creating Future Leaders

remember another guy from a certain school that was also coming to this particular school to help with some topics. That is the sharing that has been there. But coming together as educators to discuss how to approach different topics, that is not happening although the subject advisors encourage us to do that. Maybe they can come up with a time table, to say, these schools are supposed to meet on such and such date and discuss something. Maybe that kind of support can do.

Educators 1 and 6 indicate that subject advisors call cluster meetings where teachers themselves get involved in discussions based on solving difficult problems. Educators also use the meetings to share their experiences regarding the teaching of Mathematics.

Educators 3, 4 and 6 point out that if teachers have a problem or do not understand certain topics in Mathematics, subject advisors encourage them to embark on team work. This can be done at school or cluster level. Educators are advised to either invite colleagues from other schools to come and assist with the teaching of the subject, or take learners to another school for assistance. The indication is that this is not always feasible due to time constraints.

Educator 5 explains that subject advisors encourage educators to exchange their own developed tests within the cluster. By so doing, learners are exposed to different ways of questioning. The educator further indicates that subject advisors encourage teachers to affiliate to Mathematics organisations like AMESA and to attend conferences. What transpires in conferences should be shared with other educators in the cluster.

Educator 7 indicates that subject advisors tell educators to meet as schools within the cluster to discuss Mathematics issues. The educator expresses that meeting as schools for such discussions is not happening, but he acknowledges that team teaching is taking place and she is also involved. The educator suggests that for such meetings to

© University of Venda

University of Venda
Creating Future Leaders

materialise, subject advisors should facilitate by developing programmes for such meetings.

Educator 2 indicates that he/she has never been advised to meet other educators within the cluster to deal with Mathematics teaching issues.

Below is a summary of aspects on how subject advisors support educators to work in collaboration with other Mathematics teachers in the cluster. Subject advisors encourage:

- Educators to hold meetings to discuss teaching experiences
- Educators to embark on team teaching
- Educators to exchange Mathematics tasks
- Educators to affiliate to Mathematics organisations and to attend conferences.

The educators' above sentiments suggest that even though subject advisors encourage educators to work collaboratively, efforts on facilitating collaboration need to be intensified.

Question 10

What kind of support do you think is needed in order to enhance improvement in Mathematics?

Educator 1: *Subject advisors should come to school to motivate learners, sometimes to present lessons on the topics which I find difficult. Learners will be motivated to see that what we are doing as teachers, subject advisors do it the same way. Learners will pay more attention to the subject advisor because he/she is unfamiliar to them.*

Educator 2: *What I have observed is that when subject advisors invite us to attend workshops to discuss difficult topics in Mathematics, it ends there. There are no follow-up visits to establish how teachers are doing what was taught in the workshop, even to*

© University of Venda

University of Venda
Creating Future Leaders

check how learners are performing in those topics. There are no follow-ups. My opinion is that after workshops, subject advisors must do follow ups to check as to whether teachers are doing what they have been trained to do.

Subject advisors concentrate on schools that produce good results, neglecting schools producing low results. You hear colleagues from good performing schools indicating frequent visits by subject advisors and in your case it is the sixth year without seeing one at your school. Subject advisors must visit low performing schools to establish what is going wrong. Subject advisors are concentrating much on the FET band, they must also go down to the lower grades, so that learners reach the FET band with the basic knowledge necessary.

Educator 3: Subject advisors should come to our schools. Instead of looking at the paperwork only, they should take me to class and observe how I teach learners. Then they should comment on my teaching, assisting, whether I am doing it the right way or is there something that I need to improve on. They may demonstrate a lesson for one period or ten to fifteen minutes. I think this will help me a lot. Sometimes I may go to the class and think that I am doing the right thing, especially in my case. I am the only Mathematics teacher at our school, so it means there is no one who can assist. If the subject advisor comes, he may make corrections here and there.

Educator 4: There are subject advisors who come to school to frighten us. Instead of assisting they attack us. Subject advisors must come to schools to assist. I think Subject advisors should identify schools that are performing well in Mathematics and tell us, so that we are able to contact those school teachers to find out how they make it.

Educator 5: If possible, subject advisors can facilitate workshops wherein teachers support themselves by sharing ideas. Given a topic, one teacher can present, we discuss indicating strength and weaknesses and how the lesson can be improved. The intention should not be to embarrass anyone, but to make sure that everybody benefits

© University of Venda

University of Venda
Creating Future Leaders

from the discussions. If we could have time, where we are directly involved in discussions, let's say in a cluster of three schools, I think this can work.
I once attended a workshop at provincial level. We discussed topics among ourselves in the presence of subject advisors. I benefited a lot. If we can do that, but not at faraway places, say locally or within the school itself, it can work.

Educator 6: At the beginning of the year, subject advisors should call all Mathematics teachers and indicate the manner in which we are going to operate. Subject advisors should put systems in place for teachers to meet as clusters in order to discuss how to approach certain topics in Mathematics. They also need to visit schools, say if the subject advisor comes to my school, he or she should accompany me to the class, observing and listening to how I present my lesson. I am saying this because we may take it for granted that teachers are doing the right thing whereas it is not the case. The other thing I want to mention is that subject advisors and Mathematics teachers need to meet regularly, say once or twice per quarter, so that teachers get the opportunity to indicate whatever problems they are experiencing regarding the teaching of Mathematics. All these would enhance achievement in the subject.

Educator 7: What my colleague is saying is true. We do not have this conduct with our subject advisors. I have got a friend who is teaching Mathematics in another province. He tells me if he phones a subject advisor, to say come and assist with this particular topic, he would come. We need a situation where, suppose I phone a subject advisor to visit my school, I need to tell teachers of neighbouring schools that on such a date and time, the subject advisor is coming.

When the subject advisor comes to the school, he must spend time, helping learners approaching tricks in different ways. Teachers are there, but he is actually teaching your learners that this is how we approach this and learners are given the opportunity to ask questions. This I think will actually help us, because as we are, I cannot be a master of all topics. In some schools, they might be well staffed in such a way that they

© University of Venda

University of Venda
Creating Future Leaders

do not need outside help in that regard. There are schools where we need subject advisor to come and assist with different topics.

Educator 1 and 7 advocate that subject advisors need to come to schools to motivate learners and to assist in presenting difficult topics in their presence together with educators from neighbouring schools. Learners should be taught how to approach problems in different ways and should be allowed to pose questions. It is also indicated that because learners are unfamiliar with subject advisors they will pay more attention during lessons. Educator 7 expresses that it is difficult to get hold of subject advisors.

Educator 2 expresses that after workshops, subject advisors should do follow up visits to schools to establish whether educators are able to implement what they have been taught. He/she further indicates that not only good performing schools should be supported, but low performing schools as well in order to find out the cause of poor performance. The educator highlights that teachers in the lower grades must also be supported so that learners acquire the necessary basic knowledge needed for the FET band.

Educator 4 indicates he/she wants to see subject advisors facilitating networks with good performing schools. He/she would like to know from good performing schools how they manage to make it. Educator 6 advocates facilitation of meetings for educators to meet as clusters to discuss approaches about certain topics in Mathematics. He/she also supports regular meetings between subject advisors and educators to discuss whatever Mathematics problems that educators may have.

Educator 5 believes in teachers helping one another to improve their teaching. What he/she sees as the most needed support is the facilitation by subject advisors of educators' lesson study sessions. An educator presents a lesson in the presence of others and this is followed up by discussions based on how the lesson was presented.

© University of Venda

University of Venda
Creating Future Leaders

Below is a summary of aspects on the kind of support needed in order to enhance improvement in Mathematics. Subject advisors should:

- Visit schools to motivate learners
- Visit schools to teach difficult topics
- Visit schools as a follow up to workshops held
- Support both good performing schools and low performing schools
- Support educators in the lower grades so that learners acquire basic skills and knowledge required for FET grades
- Visit schools to evaluate teachers
- Visit schools to demonstrate lessons
- Facilitate networks between schools
- Facilitate educators' lesson study sessions
- Facilitate collaboration teams
- Facilitate regular meetings

What the study reveals is in line with the literature reviewed (sections 2.4.4; 2.4.5 and 2.4.6). What educators say above suggests that while educators need support on the provision of materials, their most needed support has to do with their personal development.

Question 11

How do you relate general performance of learners in all subjects to the support rendered by subject advisors?

Educator 1: *One can say that subjects whose advisors do not come to schools for paperwork only are well performed. When you look at the subjects whose advisors come to check files only, there is no improvement in the results, the results are always down. This tells us that the more subject advisors give support to different subjects, the performance improves. There are subject advisors who do their work and you find that learners perform well in those subjects. When those subject advisors visit schools, you*

© University of Venda

University of Venda
Creating Future Leaders

hear teachers responsible for those subjects commenting that their problems regarding this and that have been solved.

Educator 2: *Subject advisors are not coming to schools. There are subjects that are doing well, learners perform well. But if subject advisors can come to schools, even those subjects can do exceptionally well.*

Educator 3: *For those subjects whose subject advisors visit schools, there is improvement in the performance. They come to school to unlock something that teachers on their own, cannot do. Where there is support, there is improvement in performance.*

Educator 4: *Generally speaking, when you look at this, performance in all subjects is not that satisfying. In a way this means that, subject advisors support is needed all the times.*

Educator 5: *Since we are not just talking about Mathematics only, even the support that other subjects are getting. There is this subject where there are a lot of follow-ups by the subject advisor. The subject advisor is in regular contact with the educators around and he sometimes writes messages to learners themselves, just to encourage them to do well. But as far as ours is concerned, the follow-up is lacking. The constant services to the teachers is bearing fruits because you find that in some cases, both average and below average learners are pushed up some more.*

Educator 6: *Since I do not know what is happening in the other subjects regarding support, I cannot comment on this one.*

Educator 7: *No Comment*

© University of Venda

University of Venda
Creating Future Leaders

Educators 1, 2, 3, 4 and 5 agree that general performance of learners in subjects is related to the support rendered by the subject advisors. Educator 1 indicates that general performance of learners improves in those subjects whose subjects advisors come to school for support and not to do paperwork only. Educator 5 also indicates that subject advisors who do follow ups with educators, who are in regular contact with educators and encourage and motivate learners to do well, contribute towards learner performance improvement.

Educator 2 says subject advisors are not visiting schools while Educator 4 mentions that performance in all subjects is not satisfying. Both Educators 2 and 4 concur that if support in schools is intensified, performance in all subjects can be improved, even in those subjects where learners are doing well.

Educators 6 and 7 indicate that they cannot comment on this one because they do not know how the other subjects are supported.

Below is a summary of aspects on how educators relate general performance of learners in all subjects to the support rendered by subject advisors:

- Subject advisors who do not visit schools for paperwork only.
- Subject advisors who come to school to assist educators on what they cannot do on their own.
- Subject advisors who are in regular contact with educators.
- Subject advisors who motivate and encourage learners to do well.
- Strengthening of support in schools.

The educators' views above suggest that for those subjects whose subject advisors visit schools for intensified support, the general performance of learners improves.

© University of Venda

4.3.2. Individual interviews

In order to obtain more information on the roles of subject advisors in supporting Mathematics educators in the FET band individual interviews were conducted with six subject advisors in the district. Questions and responses are given in tables below.

Question 1

What support do you provide to educators with regard to their day to day activities regarding teaching and learning of Mathematics?

Subject advisor 1: *At the beginning of the year we provide educators with work schedules and assessment plans. Then we visit schools monitoring how they teach. We advise educators to give learners classwork and homework on daily basis. As we visit schools we monitor the quantity of informal written work given to learners and give comments accordingly.*

When we visit schools we also establish topics and sections which are challenging to educators. Then we sit down together and discuss how they should approach such challenging topics and sections. Sometimes we call for workshops like we did when training them for CAPS.

The other support that we provide is to develop common tests for schools. We develop them and send them to schools.

Subject advisor 2: *We provide pacesetters at the beginning of the year. Pacesetters are sent to schools through circuits. We also provide annual assessment plans to schools that show the scope of each task.*

When visiting schools the first thing that I request for is written work. In that case I will be looking for classwork and homework, checking the amount of work done and checking as to whether topics have been covered as indicated in the pacesetter. The classwork will tell me how far the teacher has taught a particular topic or topics. By so

© University of Venda

University of Venda
Creating Future Leaders

doing, I will also be checking the educator's performance in terms of curriculum coverage.

To prepare the educator for classroom situation I will visit him or her in the classroom to observe how he or she presents the lesson. We normally prepare the lesson together, but the educator presents the lesson. As learners will be writing exercises, we move around monitoring what learners are doing and at the same time supporting those who are struggling. After the lesson we go back to the staffroom and discuss what we have observed during the lesson.

I don't encourage educators to give learners many exercises at a go. At the beginning it should be one problem until the educator is satisfied that learners are able to deal with this particular type of problem. As learners are solving that problem, the educator must be monitoring and supporting them where necessary.

Subject advisor 3: We do school visits and what we usually do, we concentrate much on underperforming schools in the circuits allocated to us. When we visit them we check their informal tasks, which are classwork and homework. We check as to how many written work they have given as per pacesetter provided.

We provide pacesetters from the district. So we check as to whether the content coverage is sufficient for that time that we visited the particular school. That is what we do to support our educators.

Subject advisor 4: What we do when we support teachers, the first thing that we do we try to know these teachers, we look at their qualifications, we look at learners performance, we find out their challenges or problems that they experience when teaching. When we have collected this information we look for common areas that are in need of improvement and if need be for the common challenges and problems we organise meetings like workshops where we concentrate on common challenges.

Thereafter we visit teachers individually at their schools and see how they are doing. When we visit them, we check also the learners' work, we check learners' written work

© University of Venda

against the work schedule to make sure that they are on schedule. If not we encourage them to catch up.

Another thing that we do, we give them common work-schedule so that they could write common tests, we provide also common mid-year examinations so that they do the same kind of work at all schools. In short, this is basically what we do.

Subject advisor 5: *When we support educators we carry along monitoring and support instrument. The instrument indicates many things that are to be checked when visiting schools, like the number of informal tasks. We compare if the number of written informal tasks is in line with the expected number of tasks, if not we give advice as to how they should catch up or how they should provide the necessary tasks in such a way that they are in line with expected number of written work.*

We also advice educators on how to address learners' content knowledge gaps, to ensure that they do revision of earlier grades work and how to approach topics that are problematic to learners.

***Subject advisor 6**: As for daily support in our district, a lot of that happens in terms of common support because the work schedules and annual assessment plans that they need for planning purposes are received from the district. We provide work schedules and assessment plans.*

Regarding assessment, though they set their own assignments, tests, investigations and projects are provided by the district. For educators to plan and to get themselves organised, we are doing a lot for them. That is what we are providing as support.

Subject advisors 1, 2, 3, 4 and 6 indicate that they provide work schedules or pacesetters, though subject advisors 1, 2 and 6 also mentioned the provision of annual assessment plans. Subject advisors 1, 2, 3, 4 and 5 indicate providing support with regard to administering informal written work that includes classwork and homework in terms of quantity and frequency. When visiting schools, subject advisors 2, 3 and 4 monitor written work against provided work schedules or pacesetters in order to give

© University of Venda

support on content coverage and pacing of work. Subject advisors 1, 4 and 5 indicate that they support educators with challenging topics. Subject advisor 1 expresses supporting educators with challenging topics when visiting schools and during workshops, while subject advisor 4 supports educators through meetings and workshops. Subject advisor 2 prepares the lesson together with the educator and observes the same educator teaching in the classroom, thus providing support on lesson preparation and how to conduct a Mathematics lesson and how to assess at the end of the lesson. Subject advisors 1, 4 and 6 allude to the fact they provide assessment tasks such as tests, investigations, projects and half yearly examinations.

Below is a summary of support provided to educators by subject advisors regarding teaching and learning of Mathematics:

- Provision of work schedules
- Provision of annual assessment plans
- Administration of informal written work
- Pacing of work and content coverage
- Support on challenging topics
- Support on lesson preparation
- Support on how to conduct a Mathematics lesson
- Provision of assessment tasks

The interviews conducted with subject advisors highlight that the support that they provide is mainly twofold; it involves provision of materials and interaction with educators. Subject advisors provide work schedules, annual assessment plans and assessment tasks to schools. They interact with educators during school visits, meetings and workshops. When subject advisors visit schools, they monitor and support administration of informal written work and pacing of content. They also provide support on challenging topics, lesson preparation and how to conduct a Mathematics lesson.

© University of Venda

Question 2

What do you do to support educators in their effort to support learners who are experiencing barriers to learning and development in Mathematics?

Subject advisor 1: *For those learners who are experiencing barriers to learning and development in Mathematics, what we do, we advise educators to profile learners at the beginning of the year. The educator should know that these learners are bright, these are average and these are learners who experience barriers to learning and development. For the learners experiencing barriers to learning we suggest to educators to pay special attention on them. It is either, after the formation of small groups, the teacher needs to focus more on the groups having such learners.*

The other thing that can assist is that when learners are given classwork, they should be given one problem at a time. While working on the problem, those learners can be assisted. We also advise educators to offer extra lessons to learners experiencing barriers to learning and development of Mathematics. During the afternoon or early in the morning or any other time available. They need to be monitored and supported individually while solving problems. Then the educator will be able to identify misconceptions that they make. If learners are given assignments to do at home, learners experiencing barriers to learning should be given extra work that is not difficult in order to motivate them. Learners experiencing barriers need to be given extra attention.

Subject advisor 2: *The advice that I give to educators is that give learners problems that are within their reach, easy to handle, easy to solve, and thereafter for those who happen to finish solving problems earlier, give additional problems or it might be one difficult problem. But those learners experiencing barriers to learning should be supported on the spot in the classroom. Don't wait for learners to finish the problems, check their steps. Ask learners how they arrive to particular steps. In this way the educator will be able to know the reasoning behind each step.*

© University of Venda

University of Venda
Creating Future Leaders

Learners experiencing barriers to learning should also be separated from learners who are doing well and be supported in the afternoon. This should include individual support. They must be given easier problems to solve before they are given difficult ones. That is what I normally encourage educators to do.

Subject advisor 3: *For those ones experiencing barriers to learning and development, of course we advise educators to give learners extra work and indeed our educators indicate that they are helping such learners during afternoon studies.*

Subject advisor 4: *What we normally do, we encourage educators to profile learners based on the assessment. Profiling learners in the sense those educators should know group of learners who are doing well, those who are average and those who are performing poorly. So we normally advise them to treat these groups separately if need be. Like in providing remedial work, they can take slow learners on their own and concentrate on the common mistakes that the group will be making.*

Usually we encourage educators to do this so that those slow learners can get at least 30% or more, in other words at least for them to pass. The idea is to get everyone passing at the end of the day. If those learners are assisted to at least pass the subject, because obviously the slow learners cannot get distinctions but we encourage educators to work with them and make sure that at least they pass.

Subject advisor 5: *We encourage educators to provide individual support to learners who experience barriers to learning. We expect teachers to give one problem at a time, walk around giving individual attention. That way they are able to see where learners are struggling and then give the necessary support.*

Subject advisor 6: *I always advise teachers that for learners who are struggling, concentrate on the easier paper which is paper one so that learners can get at least a pass. If a learner gets ninety out of hundred and fifty in paper one, that learner passes Mathematics. We also advise teachers to make it a point that the first test is an easy one so that all learners can feel comfortable and feel that they can manage and start*

© University of Venda

University of Venda
Creating Future Leaders

building up. We tell them to start with a test and then do profiling of learners to determine which learners are struggling so that they can give extra work in order to assist them.

Subject advisors 1, 4 and 6 suggest profiling of learners at the beginning of the year in order to identify learners experiencing barriers to learning and development in Mathematics. Profiling of learners should be based on some kind of assessment. Subject advisors 1, 2 and 6 indicate advising educators to give such learners less and easier problems at the beginning and then build up to more challenging problems in order to motivate and increase their confidence. Subject advisors 1, 2 and 5 emphasise that learners experiencing barriers to learning should be given individual support when they are working on Mathematical problems. Subject advisor 1 advocates the use of cooperative learning where learners are arranged in small groups, and the focus should be on such learners. Subject advisors 1, 2, 3, and 4 indicate encouraging educators to separate these learners and offer them extra lessons. Subject advisors 1 and 6 mention advising educators to give extra work that is not difficult in order to motivate them.

Below is a summary of what subject advisors do to support educators in supporting learners who experience barriers to learning and development in Mathematics. Subject educators advise and encourage educators in:

- Profiling learners at the beginning of the year
- Giving such learners less and easy work at the beginning
- Providing individual support
- Making use of cooperative learning
- Offering such learners extra lessons
- Giving such learners extra work that is not difficult

Regarding the support of educators in their effort to support learners who are experiencing barriers to learning and development in Mathematics, the interviews reveal that subject advisors only provide advice and encouragement to educators. The

© University of Venda

University of Venda
Creating Future Leaders

comments of the participants show that the support of subject advisors in this regard is limited to advising and encouraging educators only.

Question 3

How do you support educators in using different teaching strategies and methodologies to enhance achievement in Mathematics?

Subject advisor 1: *We advise our educators to profile learners. Profiling learners is important and useful in the sense that educators know the kind of learners at their disposal. As a result they are able to choose appropriate strategies and methodologies to use.*

We encourage our educators to teach for fewer minutes so that they can have enough time to assess learners. Say a teaching period is thirty five minutes, the educator shouldn't teach for the whole thirty five minutes, it should be fifteen to twenty minutes and the remaining time is for learners to solve problems. When learners are given problems to solve, it shouldn't be many problems at a go, one problem may suffice. After solving the problem, the educator does correction with learners as a way of providing feedback. From there learners can be given other problems to solve.

We also encourage group work where learners are given problems and be allowed to work in pairs. This strategy works. The other strategy is that before educators teach a new topic, learners are given an assignment on that topic. In that way the educator is able to establish what learners already know.

Subject advisor 2: *During workshops I tell educators how to use different strategies. This is how Mathematics should be taught. But what we do during workshops is just theory. The workshops are followed by classroom observation. I prepare the lesson together with the educator. I go into the classroom with the teacher and present the lesson to learners in the presence of the teacher. The presentation must not take more than twenty minutes. Thereafter we give learners one problem to solve at a time.*

© University of Venda

University of Venda
Creating Future Leaders

Together with the educator we should be monitoring and supporting learners as they solve the problem. Those who finish are given another problem to solve and at the same time supporting those who are struggling.

After the lesson I sit down together with the educator and discuss the good things and challenges experienced during the lesson including observation of learners as they solve problems.

We advise educators to use data projectors and overhead projectors. These items can be used together and it is very effective.

Subject advisor 3: *We advise educators to use learner centered approach wherein learners are actively involved in the classroom. Most educators are used to teacher centered approach. We also tell our educators to use cooperative learning where learners work in small groups to solve problems and to assist one another.*

We also advise educators to make use of technology to assist learners. When making use technology educators can achieve more in less time. When using technology like Autograph software in the area of graphs in Mathematics, it is faster than using the traditional method of drawing graphs on the chalkboard. We encourage educators who have computers at schools to integrate the use of technology to their teaching and learning strategies.

Subject advisor 4: *Usually when we meet teachers we use different ways of teaching hoping that when they go back to their schools they will try and use these different approaches. Like if we have a workshop, we put teachers in small groups and use various forms of group work, hoping that when they go back to their schools, they will also put learners in groups apply what we normally do with them.*

Another thing that we do nowadays is the use of technology. We use laptops, overhead projectors and data projectors when we meet teachers hoping that they will do the same at their schools. Some schools are beginning to buy these equipments and they are beginning to use them effectively.

© University of Venda

University of Venda
Creating Future Leaders

Subject advisor 5: *We advise educators that when giving learners problems to solve after teaching them new concepts, they should start by giving simple problems and then go to challenging ones, giving one problem at a time. The advantage of doing it this way is that it builds confidence in learners to solve more problems.*

As for homework, we encourage educators to give learners a reasonable number of exercises daily. The reason being that they shouldn't spend a lot of time the following day correcting previous day problems. They need to spend ten to fifteen minutes on correcting the homework so that they can have sufficient time to teach new concepts.

Subject advisor 6*: We used to have this Heymaths programme. Some of the schools were selected to be part of this programme but we could use the materials with the other schools as well. The other thing is the Autograph programme that all Mathematics subject advisors have. So whenever we get to a school we provide this and also show educators that they don't have to only draw graphs on the chalkboard, they can also make use of the programme. It is matter of connecting a projector to a laptop so that learners can see what is going on.*

Apart from the electronic gadgets, we advise educators to make use of concrete objects in the classroom instead of trying to draw them on the chalkboard. For example, lessons that involve three dimension objects like areas and volumes, educators can bring items like boxes into the classroom.

Subject advisor 1 mentions that educators should profile learners in order to know them so that they are able to choose appropriate strategies and methodologies to teach Mathematics. Educators should also try establishing what learners already know before they teach new topics. Subject advisors 2, 3, 4 and 6 indicate that they encourage educators to integrate the use of technology in teaching and learning of Mathematics. Subject advisors 1, 3 and 4 indicate advising educators to make use of cooperative learning when teaching Mathematics. Subject advisor 2 support educators in using different teaching strategies and methodologies by preparing lessons together with the educators, observing the educators teaching in the classroom and by demonstrating

© University of Venda

how Mathematics should be taught. Subject advisor 6 emphasise bringing concrete objects into the classroom in order to develop conceptual understanding. Subject advisors 1, 2 and 3 advocate that teaching of concepts should be followed by assessment, where learners are actively involved. Subject advisor 5 indicates that learners must be given a reasonable number of classwork and homework and it must be from simple to complex. Subject advisor 2 alludes to the fact that as learners solve problems in the classroom, they must be monitored and supported at the same time. Subject advisor 1 emphasises the importance of providing feedback to learners.

Below is a summary of how subject advisors support educators in using different teaching strategies and methodologies to enhance achievement in Mathematics:

- Encourage educators to profile learners in order to know them well.
- Encourage educators to use learner centered approach.
- Establish what learners already know before embarking on a new topic.
- Integrate the use of technology in teaching and learning of Mathematics.
- Encourage educators to make use of cooperative learning.
- Preparing lessons together with educators.
- Observing educators offer lessons.
- Demonstrating a Mathematics lesson.
- Advise educators to bring concrete material into the classroom.
- Advise educators to assess every day after teaching new concepts.
- Advise educators to give reasonable number of exercises for classwork and homework.
- Advise educators to teach from simple to complex.
- Advise educators to monitor and support learners as they are solving problems.
- Advise educators to always provide feedback.

The interviews show that though subject advisors provide support based on advice and encouragement on many aspects, they also visit schools where they monitor and give support, prepare lessons together with educators, observe educators offering lessons

© University of Venda

and demonstrate lessons themselves. The conclusion that can be drawn from this is that when subject advisors demonstrate lessons they address most of the aspects that they advise and encourage educators to do.

Question 4

What kind of intervention strategies would you propose regarding the teaching of Mathematics?

Subject advisor 1: *What I regard as important is that educators themselves form clusters wherein they discuss and share their own experiences with one another regarding teaching of challenging topics. They can also get outside expertise to come and help them. When going back to their schools they will improve on their teaching of the subject.*

The other strategy is to let schools write common tests, either at cluster, circuit or district levels. One educator or a group of educators can set a test for all the schools within the cluster or circuit to write. This makes both educators and learners to be more committed. Educators will also make sure that they cover all the content required for that particular test. Educators must also be thoroughly prepared when going to teach. Head of departments need to monitor that educators are in line with the provided work schedules.

When learners enter the FET band, educators must try to establish what learners already know, basic things of Mathematics. This can assist in the kind of approach to use.

Subject advisor 2: *If learners write test one, say at the beginning of the year, when they write test two, they must also write topics covered in test one. These topics should be repeated in test two but with fewer marks. The same applies to test three, they must write new topics together with topics written in test one and two, just like that.*

© University of Venda

University of Venda
Creating Future Leaders

The reason of doing that is to ensure that learners don't forget what they have been taught before even in the previous years.

Having extra classes is also very important, especially when dealing with new topics. This helps the educator to cover the content in time and also gives the slow learners enough time to understand new concepts.

Subject advisor 3: *Identify schools which are having a constant increase in Mathematics pass rate and request their Mathematics educators to meet with educators of poor performing schools so that they share with them how they teach Mathematics and also to assist with topics which are challenging to them.*

Learners must always be profiled according to their performance so that struggling learners can be identified and be assisted accordingly. The other way is that of adopting a learner in the school, especially those who are doing poorly. The educator is given the responsibility to adopt a learner so that he or she monitors the learner's performance and also provide motivation.

I will also encourage educators that learners must have advanced scientific calculators. They are useful in the areas of functions and graphs and areas of factorisation. They will find this very much helpful. This is another way of making use of technology.

Subject advisor 4: *Mathematics is sort of a "hands on" subject, so learners need more time to work on Mathematical problems. So if I am to suggest the intervention strategies I would say if learners are to do graphs, they should draw as many as possible and if they are to do calculations, they should do as many as possible. That needs time. I would encourage educators to work during the weekend or in the afternoon during study time in order to give learners enough time to practice on Mathematics.*

The other thing that can assist learners as far as intervention strategies are concerned, give more written work, like assessing on weekly bases or fortnightly, so that learners are used to answering Mathematical questions. The use of previous examination

© University of Venda

University of Venda
Creating Future Leaders

questions is also important because these examinations are more or less the same in the sense that questions may be different but the structure is the same. If learners get used to answering same type of questions, hopefully they can perform better at the end of the year.

Subject advisor 5: The teaching of basic Mathematics concepts is very important because you find that learners who are not taught well in the lower grades struggle to solve simple problems like factorisation of quadratic equation. Mind you that learner is in grade twelve.

Mathematics is a practical subject. The educator is teaching probability, say about throwing a dice. You will find there are learners who do not know what a dice is or who have never seen a dice before. It is important for the teacher to bring support materials into the classroom. Bring such items into the classroom in order to enhance conceptual understanding.

A lot of writing is required in Mathematics. Learners need to do a lot of practice in order to do well in Mathematics.

Subject advisor 6: We need to get all our Mathematics educators to be computer literate. They will be able to use Mathematics programmes that we provide them effectively, let alone preparing their own mark sheets and typing their own tests.

For Mathematics educators, coming together is something very important. If the school has many Mathematics educators they can work as a team. But there are schools with one Mathematics educator teaching from grade 8 to grade 12. That educator is on his or her own. Therefore it is important for circuit Mathematics educators to come together as a group and support one another.

The other thing let learners set their own targets at the beginning of the year. Previous year final mark should be used as a base. After every test, the learner's mark is compared against the set target. This will motivate learners to strive for their targets

© University of Venda

and surpassing them. Lastly for learners to achieve in Mathematics educators must be in class on time and fully prepared.

Subject advisor 3 proposes that profiling learners is important because educators will be able to know and understand their learners better. Subject advisors 1, 3 and 6 suggest that Mathematics educators need to come together as cluster groups in order to share experiences with regard to teaching challenging topics. Subject advisor 1 encourages that educators should prepare thoroughly for lessons and what they do need to be monitored against the work-schedule by the heads of department. Subject advisor 5 says that educators should give emphasis on basic concepts and where necessary educators should make Mathematics more practical by using concrete materials in the classroom. Subject advisor 6 recommends that Mathematics educators should be computer literate. This will help them use Mathematics soft wares and do many other things with computers. Subject advisors 4 and 5 advocate that learners should be given more written work in the form of classwork, homework and tests so that they get enough practice on the subject. Subject advisor 1 submits that schools should write common tests as this will encourage learners and educators to be more committed. The other advantage of writing common tests is that educators will be compelled to cover all the content. Subject advisor 2 recommends that every test given to learners should cover all the topics done so that learners keep on revising what they have done before. Subject advisor 4 emphasises the use of previous question papers so that learners can get used to standardised questions. Subject advisors 2 and 4 propose extra classes in order to give learners enough chance to practise Mathematics. Subject advisor 6 suggests that learners should set their own targets. This will encourage them to work hard as they will always strive to reach their set targets.

Below is a summary of the intervention strategies suggested regarding the teaching of Mathematics:

- Profiling of learners in order to know and understand them.
- Educators should form cluster groups in order to share teaching experiences.

© University of Venda

University of Venda
Creating Future Leaders

- Educators should prepare their lessons thoroughly.
- Head of Departments should intensify monitoring of educators' work
- Basic concepts should be emphasised.
- Educators should use concrete materials in the classroom.
- Mathematics educators should be computer literate.
- Learners should be given more written work.
- Schools should administer common tests.
- All topics taught before should be included in every test.
- Schools should use previous question papers.
- Schools should offer extra lessons.
- Learners should be given the opportunity to set their own targets.

The interviews highlight that intervention strategies involve many areas. The areas include knowledge of learners, collaboration of educators, knowledge of teaching approaches and methodologies, well planned assessment, monitoring and support by school Heads of Department and giving learners the opportunity to be actively involved in their learning. The researcher thinks that for these strategies to be implemented, educators need to be supported holistically in terms of pedagogic content knowledge (Section 1.5.3.4)

CONCLUSION

This chapter provides the analysis and interpretation of both the quantitative and qualitative data. Where possible, the analysis was compared to the literature reviewed. In order to facilitate interpretations in quantitative data, data were presented in tabular form and again represented graphically. In analysing qualitative data, themes and patterns emerging across the data were identified. Chapter 5 focuses on the summary of the findings as well as the recommendations.

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1. INTRODUCTION

This chapter outlines the overview of the study, addresses the research questions, and provides recommendations aimed at improving the teaching of Mathematics in South African schools. The study sought to investigate the role of subject advisors in supporting Mathematics educators; examine the impact of subject advisors in supporting Mathematics educators; identify strategies that enhance the effective teaching and learning of Mathematics; and propose intervention strategies regarding the teaching of Mathematics.

Data was collected employing both quantitative and qualitative approaches, quantitative data through questionnaires and qualitative data through focus group and individual interviews. Educators teaching Mathematics in the further education and training band from thirteen secondary schools in the same circuit and Mathematics subject advisors were used as subjects.

5.2. SUMMARY OF THE STUDY

Chapter 1 of this study briefly provided the background to the study, problem statement, purpose of the study, research questions, definition of concepts, the study design, population, sampling procedure, sample, data collection and analysis, interpretation of data, ethical considerations as well as significance of the study.

Chapter 2 of this study focused on the review of literature. Both local and international literature was reviewed. The knowledge gained from the literature aids in stating the significance of the problem, developing the research design, and relating the results of the study to prior knowledge (Mc Millan & Schumacher, 2006:75). The literature was also useful in developing the research questions. In order to investigate the role of

© University of Venda

University of Venda
Creating Future Leaders

subject advisors in supporting educators in the further education and training band the literature reviewed explores;

- Constructivism
- Pedagogical content knowledge
- Professional development
- Assessment and
- Roles and responsibilities of subject advisors.

Chapter 3 detailed the research design and methodology of the study. The study was conducted using mixed methods wherein both quantitative and qualitative approaches were employed. The first phase (Phase 1) of the research involved quantitative approach and the second phase (Phase 2) qualitative approach. Issues pertaining to population, sample and sampling, quality and verification, and ethical considerations of the study were also discussed.

Chapter 4 provided the results for both quantitative and qualitative phases on the role of subject advisors in supporting Mathematics educators in the further education and training band. Completed questionnaires, focus group and individual interviews were analysed and interpreted. In some cases the research findings in this study were related to the existing literature.

5.3. FINDINGS PERTAINING TO THE RESEARCH QUESTIONS

The following are findings of the study as informed by the research questions:

5.3.1. Research question 1

How do subject advisors support Mathematics teachers in the Further Education and Training band?

Both the survey and interviews revealed that subject advisors are providing support for educators to be able to perform their daily activities in teaching Mathematics. The support received is in terms of provisioning as well as support on professional

© University of Venda

University of Venda
Creating Future Leaders

development. Subject advisors provide work-schedules or pacesetters, assessment plans, assessment tasks and assessment tools. The conducted survey indicates that all schools receive assessment documents. This is in line with the requirements of the education policy that teachers conducting classroom assessments for enhancing learning must be accompanied by the provision of sufficient resources and support (Kanjee, 2009: 81).

Apart from the provisioning of assessment materials and other materials, the study indicates that subject advisors provide professional development to educators. This involves supporting educators on difficult topics in Mathematics. According to Kibuka-Sebitosi in Fisher, Koul, and Wanpen (2008: 284), professional development in South Africa is facilitated by subject advisors and workshops are held to improve educators' content knowledge.

The interviews indicated that subject advisors conduct on-site visits. Their visits include monitoring of learners written work and educators' files. The educators expressed that though subject advisors monitoring of homework and classwork encourages them to work hard, those subject advisors who visit school for monitoring files only, without embarking on any form of support, do not add value to the enhancement of learners' performance. Monitoring of learners' written work enables the subject advisors to determine the content of work covered and the pacing thereof. According to the survey conducted, a small percentage of educators indicate that their administration of classwork and homework is never monitored.

Subject advisors call meetings where educators discuss amongst themselves about the teaching of Mathematics. The study also reveals that subject advisors encourage educators to do team teaching, to come together as schools within the cluster to discuss Mathematics issues and to affiliate to teachers' professional associations. This clearly shows that subject advisors facilitate collaboration among educators. Murata (2002:67) asserts that effective team teaching in the high school is a practice with

© University of Venda

University of Venda

broad appeal and potential for improving teaching. According to the department of education (DBE, 2011b: 44), subject advisors should support the formation of cluster of schools with similar or common challenges to encourage working cooperation, sharing the best practises amongst teachers. Focus group interviews reveal that provision of environment that creates and fosters sharing of information among educators influences commitment to teaching and learning of Mathematics.

The conducted survey shows that the majority of educators receive support on how to use different teaching approaches but the focus group interviews indicate that educators are encouraged to use a variety of strategies without actually getting deep on how they should be used. Individual interviews with subject advisors point out those subject advisors who encourage educators to use learner centered approach, establish what learners already know before teaching the new concepts, integrate the use of technology, bring learning aids into the classroom to enhance understanding of concepts and to make use of cooperative learning. According to the conducted survey, the majority of educators claim that they employ cooperative learning during their Mathematics lesson.

5.3.2. Research question 2

How does the subject advisors' support impact on teacher's abilities to enhance learner performance in Mathematics in the Further Education and Training band?

The provision of assessment materials and other materials, as indicated by the interviews, helps educators to work easier in terms of following the sequencing in the works-schedules and pacesetters. The support rendered by subject advisors has an effect on the workload of educators. The respondents expressed that provision of assessment tasks and assessment tools reduces their workload. A study conducted by the Task Team for the Review of the Implementation of National Curriculum Statement

© University of Venda

University of Venda

(DoE, 2009a: 31), also reveals that issues pertaining to the development of assessment tasks are burdensome to educators.

Work-schedules, pacesetters and assessment provided to schools indicate timelines for topics to be covered. This facilitates for the administering of common tests. Educators are expected to have covered certain sections of work before the common test date. The study shows that educators are compelled to complete a certain scope before test dates. When the final examination comes, they would have completed all the topics. This kind of support impacts on enabling educators to complete the syllabus. A study conducted by Mji and Makgato (2006: 259) identifies syllabus non-completion as one of the factors contributing to poor performance in Mathematics. Educators indicate that following a pacesetter sometimes puts a strain on them because they are forced to move on even when learners have not grasped certain concepts.

The study reveals that when subject advisors visit schools, they also monitor the quantity of homework and classwork administered. As a result, this compels educators to give more homework and classwork to learners. The respondents indicated that for them to give more work they have to teach more. This results in learners getting more practice in Mathematics and educators themselves are able to cover all the content. According to the Department of Basic Education (DBE, 2011b:44), when subject advisors visit schools, they also need to check learners' written work.

Subject advisors provide assessment tasks that include investigations and projects to schools. Educators interviewed indicated that the standard is good, though there are concerns that some of the tests sent to schools are not moderated. Educators use the provided projects and investigations to develop their own, which are not evaluated of course, but those tasks serve as exemplars. Educators are able to develop such tasks to train their learners even if the marks are not recorded formally. The impact of providing such tasks is clear.

© University of Venda

By receiving support on content knowledge, the study reveals that educators' confidence is boosted and they are motivated to teach Mathematics. They indicated that content knowledge gained through workshops positively influence their commitment in teaching the subject. Sutton & Krueger (2002: 113) contend that teachers who continue learning throughout their careers are more likely to become reflective, competent, and professional teachers.

During the interviews, it was indicated that when the educator's work is not properly done, subject advisors comment, and sometimes the nature of the comments discourage educators. It was also mentioned that there are subject advisors who visit schools to simply assert their authority over educators. This means that poor communication leads to conflicts and discouragement. To encourage commitment, there should be good communication between the two parties. Subject advisors need to motivate educators to do more. The Department of Education (DBE, 2011b: 45) mentions that subject advisors as leaders should provide an environment that creates and fosters commitment and confidence.

The study also reveals that subject advisors call meetings, where educators discuss their teaching. This improves the educators' teaching. The facilitation of collaboration by subject advisors impacts on enhancing the educators' ability to teach. Supovitz (2008: 461) asserts that an instructional supervisor facilitates networks between schools as a mechanism for spreading and sharing knowledge.

The respondents mentioned that in those subjects whose subject advisors do follow-up visits after meetings and workshops, and those who are in regular contact with educators, learners' performance improves. This means that follow-up visits and regular contact impact on teachers' ability to enhance learner performance.

© University of Venda

University of Venda
Creating Future Leaders

5.3.2. Research question 3

What strategies can be used to enhance effective teaching and learning of Mathematics?

The educators interviewed indicated that subject advisors provide work-schedules, pacesetters and assessment materials including assessment tasks of which the standard is good. Respondents expressed that as a result, their teaching becomes easy and their workload is reduced. It is clear that the provision of assessment materials and other materials enhance effective teaching and learning in Mathematics.

The interviews indicated that educators used to be called for workshops. The workshops, according to the respondents were about discussions of difficult topics, that is the content knowledge. Content knowledge is one component of pedagogical content knowledge (PCK), others being knowledge of learners and pedagogical knowledge. The study reveals that subject advisors embark on professional development of educators, but emphasis is more on content knowledge than pedagogical knowledge. Turnukhu and Yesidere (2007: 1) argue that teacher's knowledge and deep understanding of the content to be taught are prerequisite of effective teaching, but they are not sufficient to teach Mathematics.

In order to enhance effective teaching and learning in Mathematics, professional development provided to educators should include all the three components of pedagogical content knowledge. It is imperative that educators know how learners think, how they learn, their environment and what they already know. According to Kazu (2009: 85), when the lessons are taught taking into consideration learners' individual learning styles, their interests and successes increase considerably.

The interviewed educators indicated that in order to cater for learners experiencing barriers to learning, they employ cooperation learning and they teach from simple to

© University of Venda

University of Venda

complex. In the survey (table 24) 85.7% of the respondents indicated that subject advisors do not provide support on how to deal with learners experiencing barriers to learning. Both the focus group and the individual interviews reveal that not much is done in this regard besides the giving of insubstantial advice. Interviews with the subject advisors emphasise profiling of learners in order to know them better. The knowledge of learners aids to the choice of teaching methods and strategies to be used in the class. This is in line with the assertion that knowledge of learning styles enables educators to choose the right method and materials (Kazu 2009: 91-92). De Miranda (2008:17) asserts that PCK involves knowing how to take advantage of different teaching approaches that make learning experience most suitable for learners. It includes flexible instruction to account for various learning styles, abilities and interests.

It was also indicated during the interviews that subject advisors encourage educators to do team teaching at either school or cluster levels or form cluster groups wherein they share best practices of teaching Mathematics. The interviewed educators indicated that though time is a problem, they are doing it. A large percentage of respondents in the survey indicated that they meet other teachers in the cluster to share knowledge on the best practices in Mathematics teaching. This shows that educators are heeding subject advisors' call for them to collaborate. Black in Hunter and Back (2011: 112) states that a key indicator of effective sustainable professional development is the development of networks of teachers that focus on learning and facilitate reflection on practice. Collaboration is also a strategy for enhancing effective teaching in Mathematics. Individual interviews indicate that subject advisors also provide support in terms of observing educators offering lessons and they themselves demonstrate how to conduct Mathematics lessons. Educators who were interviewed and many of those who completed the questionnaire expressed that they would like to observe subject advisors demonstrating lessons and would also like to be evaluated presenting lessons in the classroom. According to Nevo (1994: 113), evaluation is intended to help teachers improve their teaching performance according to the need of their students, and thus improves students' learning.

© University of Venda

Interviews with subject advisors suggest that revising basic concepts at the beginning of the year and using concrete material in the classroom is important as it enhances conceptual understanding. The interviewed educators express that they do not get much support on how to use different strategies and methods to teach Mathematics, they are just encouraged to use a variety of methods. In the survey (table 16.3), 100% of respondents agree that subject advisors' support should emphasise pedagogical knowledge as well. A study conducted by Hightower, Delgado, Lloyd, Wittenstein, Sellers and Swanson (2011: 35) concluded that pedagogical training in how to teach mathematics contributes to positive influence on student achievement.

Individual interviews propose that learners need to be given more written work in order to do a lot of practise, write common tests and given the opportunity to use previous question papers. For learners to get enough time to practise, extra classes should be conducted. Both survey and focus group interviews reveal that when subject advisors conduct onsite visits, they monitor learners' homework and classwork, availability of examination guidelines, lesson preparations, and they also establish pace, depth and sequencing of the content. Monitoring of such items can enhance effective teaching and learning of Mathematics (DBE, 2011b: 44). The study also reveals that subject advisors are not easily accessible and do not visit schools regularly. During the interviews, it was expressed that subject advisors need to do follow-up visits to schools after meetings and workshops. Interviews with subject advisors suggest monitoring of work and support by school subject head as important. In the survey, respondents indicate that when subject advisors visit their schools they sometimes engage them and their Heads of Departments (HODs) on academic improvement of Mathematics. There is a need for empowering HODs so that they are able to assist educators within the school.

The conducted survey showed that subject advisors moderate continuous assessment, and after moderation educators receive sufficient feedback. Sufficient and meaningful feedback can enhance effective teaching and learning in Mathematics. Interviews with

© University of Venda

University of Venda

subject advisors also point out that Mathematics educators need to be computer literate. This will enable them to make use of Mathematics software programmes to teach learners. Using technology to teach Mathematics is faster than the traditional way of writing on the chalkboard. Learners should also be actively involved in the teaching and learning of Mathematics. They should be given the opportunity to set their own targets using the previous year's final mark as a base. Every test they write should be compared against the set target and conversation with the educator should not be about passing or failing, but to achieve the set target. This will help the learner to strive for the set target.

5.3.4. Research question 4

How can subject advisors improve learner achievement in Mathematics in the Further Education and Training Band?

The interviews indicated that all formal assessment tasks are provided by the subject advisors. Focus group interviews with educators pointed out that the standard is good. Maintaining the good standards can improve learner achievement in Mathematics.

Educators expressed that when subject advisors visit their schools, they monitor homework and classwork. They also indicated that this makes them want to give more of written work. According to Trautwein, Koller, Schimtz and Baumert (2002: 45), students may profit from regular homework, be it by catching up with newly acquired knowledge and procedures on a daily basis or by preparing for coming lessons and reviewing previous lessons. The Department of Education (DBE, 2011b: 44) states that subject advisors should check frequency and management of home and class work as well as usefulness of feedback to improve learner understanding.

The conducted survey reveals that educators need support on team teaching as that can also enhance achievement in Mathematics. Educators that participated in the interviews indicated that subject advisors encourage them to embark on team teaching.

© University of Venda

University of Venda
Creating Future Leaders

This is another form of collaboration. Anderson and Speck (1998: 674) support that team teaching offers students the opportunity for multi-perspective feedback based on teacher collaboration, whether that collaboration focuses on grading papers, observing students' learning or providing feedback to solve problems.

Both survey and focus group interviews indicate that educators need support on different teaching strategies and methodologies. Though subject advisors embark on observing and demonstrating lessons, it needs to be done more often. The support on strategies should also focus on project based and investigative approaches. The study also reveals that educators need strong support on helping learners with barriers to learning and development in Mathematics. Though interviews with subject advisors indicate that they are supporting educators in this regard, the support needs to be intensified.

Interviews with subject advisors indicate that they provide support on challenging topics at school and cluster meeting levels. The survey conducted also mentions support on challenging topics as one of the most needed support that can enhance learners' performance in Mathematics. Educators who participated in the interviews indicated that they would like to see subject advisors visiting schools to motivate learners. They believe that motivation of learners can enhance achievement in Mathematics.

5.4. RECOMMENDATIONS

The recommendations drawn from the study are as follows:

5.5.1. Recommendation 1

While provision of assessment items and other items is taking place, support on individual development of educators need to be taken care of. Support for Mathematics educators need to be holistic.

© University of Venda

University of Venda
Creating Future Leaders

5.1.2. Recommendation 2

University-District partnership with regard to the teaching of school Mathematics and teacher development should be established.

5.5.3. Recommendation 3

Interactions between subject advisors and Mathematics educators should impact on motivating educators to do more. Proper communication and professionalism should play a significant role in this regard.

5.5.4. Recommendation 4

On-site visit should be done regularly in order to get first-hand information about Mathematics teaching situations. This presents the opportunity to provide specific solutions to specific situations where general solutions cannot work.

5.5.5. Recommendation 5

Assessing learners on provided common assessment tasks should be optional in order to give educators the opportunity to develop their own tasks. However, there must be a mechanism to ensure that developed tasks are moderated before being administered. Provided tasks and assessment tools can serve as exemplars for educators to develop their own.

5.5.6. Recommendation 6

There should be clear guidelines to assist educators on how to select Mathematics textbooks for their classrooms. The department of education selects best textbooks according to their criteria, and the schools have to choose the most suitable textbook for their classrooms.

© University of Venda

University of Venda
Creating Future Leaders

5.5.7. Recommendation 7

There should be a balance in supporting high performing schools and low performing schools in order for high performing schools to maintain the standard and low performing schools to pick up the standard.

5.5.8. Recommendation 8

Support of foundation and Intermediate Phase educators needs to be intensified so that learners are able to acquire basic skills and knowledge needed for FET band Mathematics.

5.5.9. Recommendation 9

Educators must be given a strong support on how to accommodate different learning styles of learners in Mathematics teaching.

5.5.10. Recommendation 10

Subject advisors should facilitate networking of FET Mathematics educators within the cluster to collaborate through lesson studies.

5.5.11. Recommendation 11

When subject advisors support educators on difficult or new topics, sessions must include support on different teaching methods and strategies that can be used, and how they can be used.

5.5.12. Recommendation 12

Subject advisors should empower Mathematics Head of Departments so that they are able to meaningfully support their educators within the school.

© University of Venda

5.6. LIMITATIONS OF THE STUDY

A limitation of a study design is the systematic bias that the researcher did not or could not control and which could inappropriately affect the results (Price and Murnan, 2004: 66). Price and Murnan (2004: 67) further argue that authors who do not include the limitations or include some of the limitations of their study may cause less informed consumers of research to place more credit on a study's findings than warranted.

This study identified the following limitations:

- The study conducted was confined to one circuit in the district. Therefore the findings could not be generalised to the whole Limpopo Province or the country at large.
- The sample size in the qualitative data collection was relatively small and it is therefore difficult to generalise the results to all South African schools.

5.6. SUGGESTIONS FOR FURTHER STUDY

Subject advisors are office based educators also known as education specialists. This is because they have both depth of content knowledge and pedagogy of the particular subjects that they lead (DBE, 2011b: 41). This study reveals that Mathematics subject advisors are not easily accessible when educators need them, and on investigating the role of school science subject advisors, Dilotsothle, Smit and Vreken (2001: 310) assert that the success of the subject advisory services depends critically on logistics factors like schedules, number of teachers per subject advisor, resources and budget.

Head of Departments (HODs) are education specialists at schools, they are experts with regard to the subjects they lead. HODs can assist with some of the responsibilities assigned to the subject advisors. I suggest that a further study could be conducted to explore the role of Mathematics HODs in secondary schools to support teachers on effective teaching of Mathematics. Qualitative and quantitative research approaches may be used, where both Mathematics HODs and teachers are respondents.

© University of Venda

CONCLUSION

The information provided by the participants provided the basis on which the role of subject advisors in supporting educators in the teaching of Mathematics was investigated. In order to obtain other views on the subject, a variety of literature was reviewed. Major findings of the study, including recommendations based on the findings were given. The study highlights that educators need to be supported in all components of pedagogic content knowledge, namely, content knowledge, knowledge of learners and pedagogic knowledge.

The information for this study was obtained from Mathematics educators and subject advisors based in the same district. Therefore, their experiences are not representative of all Mathematics educators and Mathematics subject advisors in the entire South Africa. Nonetheless, this study will enable Mathematics subject advisors to have a better understanding of their role to support educators, thus improving teacher development and training processes. This study will also provide insights that may assist the Department of Education to improve policies regarding the roles and operations of Mathematics subject advisors.

© University of Venda

University of Venda
Creating Future Leaders

REFERENCES

Adams, A. & Cox, A.L. (2008). *Questionnaires, In-depth Interviews and Focus Groups.* In: Cairns, P and Cox, A. Eds. Research Methods for Human Computer Interaction. Cambridge, UK: Cambridge University Press, 17-34.

Adams, J., Khan, H.T.A., Raeside, R. & White, D. (2007). *Research Methods for Graduate Business and Social Sciences Students.* California: SAGE Publications Inc.

Adedoyin, O.O. (2011). The Impact of Teachers' in Depth Pedagogical Mathematical Content Knowledge on Academic Performance: As Perceived by Botswana Junior Secondary School Pupils. *European Journal of Educational Studies*, 3(2): 277-292.

Akkoc, H., Yesildere, S., & Ozmantar, F. (2007). Prospective Mathematics Teachers' Pedagogical Content Knowledge of Definite Integral: The Problem of Limit Process. D. Kuchermann (Ed). *Proceedings of the British Society for Research into Learning Mathematics,* 27: 7-12.

Aldridge, A. & Levine, K. (2001). Bryman, A. (Ed). *Surveying the Social World Principles and Practice in Survey Research.* Buckingham: Open University Press.

Aldridge, J.M., Fraser, B.J. & Sebela, M.P. (2004). Using Teacher Action Research to Promote Constructivist Learning Environment in South Africa. *South African Journal of Education,* 24(4): 245-253.

Aldridge, J.M., Laugksch, R.C., & Fraser, B.J. (2006) . School-Level Environment and Outcomes-Based Education in South Africa. *Learning Environ Res*, 9: 123-147.

An, S., Kulm, G & Wu, Z. (2004) The Pedagogical Content Knowledge of Middle School. Mathematics Teachers in China and US. *Journal of Mathematics Teacher Education 7: 145-172*

© University of Venda

University of Venda
Creating Knowledge

Anderson, R.S. & Speck, B.W. (1998). "In What A Difference A Team Makes": Why Team Teaching Makes A Difference? *Teaching and Teacher Education,* 14(7): 671-686.

Angelo, T.A (1999). *Doing Assessment As If Learning Matters Most.* A Publication of the American Association for Higher Education. May AAHE Bulletin.

Anthony, G. & Walshaw, M. (2009). Effective Pedagogy in Mathematics. Educational Practices Series 19. *International Academy of Education.International Bureau of Education & UNESCO.*

Anthony, G. & Walshaw, M. (2007, April*). Characteristics of Effective Teaching of Mathematics: An Evidential Synthesis.* Paper presented at the American Educational Research Association Annual Meeting: The World of Educational Quality.

Applefield, J.M., Huber, R. & Moallem, M. (2000). Constructivism in Theory and Practice: Toward a Better Understanding. *The High School Journal,* 84(2): 35-53.

Atkinson, M., Springate, I., Johnson, F. & Halsey, K. (2007). *Inter-School Collaboration: A Literature Review.* Slough: NFER

Aun, T.K., Rilley II, J.P., Atputhasamy, L. & Subramaniam, R. (2006). School Science Achievements in Japan and Singapore: A tale of Two Cities. *Educational Research for Policy and Practice,* 5(1): 1-13.

Babbie, E., & Mouton, J. (2001).*The Practice of Social Resea*rch. Cape Town: Oxford University Press.

Ball, D.L. & Bass, H. (2000). *Interweaving Content and Pedagogy in Teaching and Learning to Teach: Knowing and Using Mathematics.* In Boaler, J. (Ed), Multiple

© University of Venda

University of Venda
Creating Future Leaders

Perspectves on Mathematics and Learning. International Perspectives on Mathematics Education. Westport: Ablex Publishing.

Ball, D.L., Lubienski, S.T. & Mewborn, D.S. (2001*). Research on Teaching Mathematics: The Unsolved Problem of Teachers' Mathematical Knowledge*. In Richardson, V (Ed). Handbook of Research on Teaching (4th ed). New York: Macmillan.

Bazeley, P. (2002). *Issues in Mixing Qualitative and Quantitative Approaches to Research. Presented at 1st International Conference*. Qualitative Research in Marketing and Management. University of Economics and Business Administration, Viena.

Beanton, A.E., Mullis, M.O., Martin, M.O., Gonzalez, E.J., Kelly, D.L & Smith, T.A. (1996). *Mathematics Achievement In The Middle School Years: IEA's Third International Mathematics and Science Study (TIMSS)*. Chestnut Hill, MA: Boston College.

Belbase, S. (2011). *Radical versus Social Constructivism: Dilemma, Dialogue, and Defense*. University of Wyoming, Wyoming.

Bell, S. (2010). *Project-Based Learning for the 21st Century: Skills for the Future*. The Clearing House, 83(2): 39-43.

Berry, B., Daughtrey, A. & Wieder, A. (2009). *Collaboration: Closing the Effective Teaching Gap*. Center for Teaching Quality.

Biggs, J.B. (1993). From Theory to Practice: A Cognitive Systems Approach. *Higher Education Research and Development,* 12(1): 73-85.

Black, R. (2008). *Beyond the Classroom: Building New School Networks*. Victoria: ACER Press.

© University of Venda

University of Venda
Creating Future Leaders

Boud, D. (2006). Assessment and the Promotion of Academic Values. *Studies in Higher Education,* 15(1): 101-111.

Brewster, C & Railsback, J. (2001). *Supporting Beginning Teachers: How Administrators, Teachers, and Policy Makers can Help New Teachers Succeed*. Portland, OR: Northwest Regional Laboratories

Buhlungu, S., Daniel, J., Southall, R. & Lutchman, J. (Eds). (2007). *State of the Nation, South Africa 2007*. Human Research Council.

Cakir, M. (2008). Constructivist Approaches to Learning in Science and Their Implications for Science Pedagogy: A Literature Review. *International Journal of Environmental & Science Education,* 3(4):193-206.

Charleston, W.V. (2006). *Closing the Achievement Gap: Best Practices in Teaching Mathematics*. The Education Alliance.

Cheang, K.W., Yeo, J.K.K., Chan, E.C.M., & Lim-Teo, S.K. (2007). Development of Mathematics Pedagogical Content Knowledge in Student Teachers. *The Mathematics Educator,* 10(2): 27-54.

Chen, C. (2003). A Constructivist Approach to Teaching: Implications in Teaching Computer Networking Information Technology*, Learning, and Performance Journal*, 21(2): 17-27.

Cochran, K.F., DeRuiter, J.A., & King, R.A. (1993). Pedagogical Content Knowing: An Integrative Model for Teacher Preparation. *Journal of Teacher Education,* 44(4): 263-272.

© University of Venda

University of Venda
Creating Future Leaders

Collison, V. & Ono, Y. (2001). The Professional Development of Teachers In The United States and Japan. *European Journal of Teacher Education*, 24(2): 223-248.

Cooper, J.M., & Alvarado, A. (2006). *Preparation, Recruitment, and Retention of Teachers*. Education Policy Series. IAE.

Creswell, J.W. (2005). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. New Jersey: Pearson Prentice Hall, Inc.

Crowther, D. & Lancaster, G. (2009). *Research Methods. A Concise Introduction to Research in Management and Business Consultancy (2nd Edition).* Oxford UK: Elsevier Ltd.

Cwikla, J. (2004). Less Experienced Mathematics Teachers Report What is Wrong with Their Professional Support System. *Teachers and Teaching: Theory and Practice*, 10(2): 181-197.

Czerniewicz, L., Murray, S & Probyn, M. (2000). *Learning Support Materials and Curriculum 2005.* A Research Paper on the Role of Learning Support Materials in Curriculum 2005 for the National Institute of Curriculum Research and Development.

Daly, A., Billington, L., Chamberlain, S., Meyer, L., Stringer, N., Taylor, M., & Tremain, K. (2011). *Principles of Moderation of Internal Assessment.* Centre for Education Research and Policy.

De Miranda, M.A. (2008). Pedagogical Content Knowledge and Engineering and Technology Teacher Education: Issues for Thought. *Journal of the Japanese Society of Technology Education,* 50(1):17-26.

© University of Venda

University of Venda

Department of Basic Education. (2011a). *Curriculum News. Improving the Quality of Learning and Teaching Strengthening Curriculum Implementation from 2010 and Beyond.* Pretoria: Department of Education.

Department of Basic Education. (2011b). *Guidelines on the Organization, Roles and Responsibilities of Education Districts*. Pretoria: Department of Education.

Department of Basic Education. (2011c). *National Curriculum Statement (NCS). Curriculum and Assessment Policy Statement. Mathematics Intermediate Phase.* Pretoria: South Africa.

Department of Basic Education. (2011d). *National Curriculum Statement (NCS). Curriculum and Assessment Policy Statement. Mathematics. Further Education and Training Phase*. Pretoria: South Africa.

Department of Basic Education. (2011e). *National Curriculum Statement (NCS). National Protocol for Assessment Grades R-12*. Pretoria: South Africa.

Department of Basic Education. (2011f). *Report on the National Senior Certificate Examination Results 2011. Technical Report.* Pretoria: South Africa.

Department of Basic Education. (2009*). Report on the National Senior Certificate Examination Results 2009. National Examinations and Assessment*. Pretoria: South Africa.

Department of Education. (2009a) *Report of the Task Team for the Review of the Implementation of the National Curriculum Statement.*

Department of Education. (2009b). *Trends in Education Macro-indicators Report*. Pretoria: Department of Education.

© University of Venda

University of Venda

Department of Education. (2005a). *Guidelines for Inclusive Learning Programmes.* Pretoria: Department of Education.

Department of Education. (2005b). *Teachers For The Future: Meeting Teacher Shortages To Achieve Education For All.* Pretoria: Department of Education.

Department of Education. (2002). *Revised National Curriculum Statement Grade R-9 (Schools) Policy. Mathematics.* Pretoria: Department of Education.

Department of Education. (2001). *National Strategy for Mathematics, Science and Technology Education in General and Further Education and Training.* Pretoria: Department of Education.

De Vause, D.A. (2001). *Research Design and Social Research.* London: SAGE

De Vos, A., Strydom, H., Fouche, C.B. & Delport, CSL. In: De Vos (Ed). (2002). *Research at Grassroots. For the Social Sciences and Human Service Profes*sions. (2nd Edition). Pretoria: Van Schaik Publishers.

Dilotsothle, K.E., Smit, J.J.A., & Vreken, N.J. (2001). The Perceived Roles and Functions of School Science Subject Advisors. *South African Journal of Education,* 21(4): 305-310.

Doorman, M., Drijvers, P., Dekker, T., van den Heuvel-Panhuizen, M., de Lange, J. & Wijers, M. (2007). *Problem Solving as a Challenge for Mathematics Education in the Netherlands.* ZDM Mathematics Education, 39: 405-418.

Draper, R.J. (2002). School Mathematics Reform, Constructivism, and Literacy: A case for Literacy Instruction in the Reform-Oriented Math Classroom. *A Journal of Adolescent & Adult Literacy* 45(6): 520-529.

© University of Venda

University of Venda
Creating Future Leaders

Eastern Cape Department of Education. (2007). *On-site Curriculum Support: Districts, Schools and Classrooms*. Provincial Curriculum Guidelines (PCG) 08.

Eastern Cape Department of Education. (2006). *On-site School Support – Organising and Conducting Support Programmes for Schools and Teachers*. Provincial Curriculum Guidelines (PCG) 05.

Eastern Cape Department of Education. (2005*). Guidelines for Phase Committees and Learning Area/Subject Committees*. Provincial Curriculum Guidelines (PCG) 03.

Education for All (EFA). (2008). Country Report: South Africa.

Education for All (EFA) (2005). The Quality Imperative. EFA Global Monitoring Report.

Education White Paper 6. (2001). Special Needs Education. Building An Inclusive Education and Training System.

Effandi, Z., Chin, L.C., & Yussof , D.M. (2010). The Effects of Cooperative Learning on Students' Mathematics Achievement and Attitude Towards Mathematics. *Journal of Social Sciences,* 6(2): 272-275.

Eisen, M.J. (2000). The many faces of team teaching and learning: An overview. *New Directions for Adult and Continuing Education,* 87:5-14.

Ellerton, N., & Clements, M. (1992). *Some Pluses and Minuses of Radical Constructivism in Mathematics Education.* Deakin University.

Engelbrecht, P., Kriegler, S. & Booysen, M. (1996). *Perspectives on Learning Difficulties. International Concerns and South African Realities*. Pretoria: Van Schaik

© University of Venda

University of Venda

Ernest, P. (1991). *The Philosophy of Mathematics Education*. London: The Falmer Press

Ewing, B. (2006) "Go to the Page and Work It from There" Young People's Experiences of Learning Mathematics from Text. *Australian Senior Mathematics Journal,* 20(1): 8-14.

Fan, L., & Zhu, Y. (2007). Convergence to Divergence: The Development of Mathematical Problem Solving in Research, Curriculum, and Classroom Practice in Singapore. *ZDM Mathematics Education,* 39(5-6): 491-501.

Fox, N. (2006). *Using Interviews In a Research Project.* The NIHR RDS for the East Midlands/ Yorkshire & the Humber.

Felman-Nemsen, S. (2003). What New Teachers Need to Learn. *Educational Leadership* 60(8): 25-29.

Fisher, D., Koul, R., & Wanpen, S [Eds]. (2008). *Science, Mathematics and Technology Education: Beyond Cultural Boundaries.* Proceedings of the Fifth International Conference on Science, Mathematics and Technology Education. Udon Thani. Thailand.

Gall, M.D., Borg, W.R. & Gall, J.P. (1996). *Educational Research: An Introduction (6th ed.).* NY, England: Longman Publishing.

Gardiner, M. 92008). *Education in Rural Areas. Issues in Education Policy Number 4.* Centre for Education Policy Development.

Garet, M.S., Porter, A.C., Desimone, L., Birman, B.F. & Yoon, K.S. (2001). What Makes Professional Development Effective? Results from a National Sample of Teachers. *American Educational Research Journal* 38: 91.

Gauteng Department of Education. (2009). *Gauteng Mathematics, Science and Technology education improvement Strategy 2009-2014.* GDE. Johannesburg.

© University of Venda

Gilbert, L. (2005). *What Helps Beginning Teachers? Six Districts Partners Gathered Data from New Teachers about What Helped Them Most. They Used the Results to Fine-tune Their Induction Processes.* Educational Leadership.

Ginsburg, A., Leinwand, S., Anstrom, T. & Pollock, E. (2005). *What The United States Can Learn from Singapore's World Class Mathematics System and What Singapore Can Learn from The United States: An Exploratory Study. Prepared for U.S Department of Education Policy and Program Studies Service (PPSS).* American Institute for Research.

Goe, L., Bell, C., & Little, O. (2008). *Approaches to Evaluating Teacher Effectiveness: A Research Synthesis.* National Comprehensive Center for Teacher Quality.

Goe, L. & Stickler, L.M. (2008). *Teacher Quality and Student Achievement: Making the Most of Recent Research.* National Comprehensive Center for Teacher Quality.

Goodwin, D.M. (2010). The Importance of Mathematics Teachers knowing Their Mathematics History. *Journal for the liberal Arts and Sciences,* 14(2): 87-90.

Government of Western Australia Department of Education. (2004). *Pathways to the Future: A Report of the Review of Educational Services for Students with Disabilities in Government schools.* East Perth.

Graham, K.J., & Fennel, F. (2001*). Principles and Standards for School Mathematics and Teacher Education: Preparing and Empowering Teachers,* 101(6): 319-327.

Gray, L.R. & Airasian, P. (2003*). Educational Research: Competencies for Analysis and Applications.* New Jersey: Pearson Education, Inc.

Grouws, D.A., & Cebulla, K.J. (2000). *Improving Student Achievement in Mathematics.* Geneva, Switzerland: International Academy of Education.

© University of Venda

Harwell, M.R. (2011). Research Design: Qualitative, Quantitative, and Mixed Methods. In Conrad, C., & Serlin, R.C. (Eds.). *Handbook for Research in Education: Pursuing Ideas as the Keystone of Exemplary Inquiry (Second Edition).* Thousand Oaks, CA: Sage.

Hattori, K & Wangeleja, M.J.N. (2007). Teachers Understanding of The Conceptual Strategy for Primary Mathematics Teaching In Tanzania and Japan. *NUE Journal of International Educational Cooperation,* 2: 45-49.

Haylock, D., & Thangata, F. (2007). *Key Concepts in Teaching Primary Mathematics.* SAGE Publications.

Hiebert, J., Gallimore, R. & Stigler, J.W. (2002). A Knowledge Base for the Teaching Profession: What Would It Look Like and How Can We Get One? *Educational Researcher,* 31(5): 3-15.

Hightower, A.M., Delgado, R.C., Lloyd, S.C., Wittenstein, R., Sellers, K., & Swanson, C.B. (2011). *Improving Student Learning By Supporting Quality Teaching: Key Issues, Effective Strategies.* Bethesda, Maryland: Editorial Projects in Education.

Ho, K.F. & Hedberg, J.G. (2005). Teachers' Pedagogies and Their Impact on Students' Mathematical Problem Solving. *Journal of Mathematical Behaviour,* 24(2005): 238-252.

Howie, S. (2005). Contextual Factors At The School and Classroom Level Related To Pupils' Performance In Mathematics In South Africa. *Educational Research and Evaluation,* 11(2): 123-140.

Howie, S. (2004). A national Assessment in Mathematics within an International Comparative Assessment. *Perspectives in Education,* 22(2): 149-162.

© University of Venda

Howie, S. (2003). Language and Other Background Factors Affecting Secondary Pupils' Performance In Mathematics In South Africa. *African Journal of Research In SMT Education,* 7: 1-20.

Howie, S. (1997). *Mathematics and Science Performance In The Middle School Years In South Africa: A Summary Report On The Performance Of South African Students In The Third International Mathematics and Science Study (TIMSS).* HRSC: Pretoria.

Huffman, D., Thomas, K & Lawrenz, F. (2003*). Relationships Between Professional Development, Teachers' Instruction Practices, and the Achievement of Students in Science and Mathematics.* Professional Development, Instruction and Student Achievement. Volume 103(8): 378-388.

Hull, T.H., Balka, D.S & Miles, R.H. (2009). *A Guide to Mathematics Coaching. Process for Increasing Student Achievement.* Thousand Oaks, CA: Corwin Press.

Hunter, J & Back, J. (2011). Facilitating Sustainable Professional Development through Lesson Study. MTED, 13(1): 94-114.

Ingersoll, R., Merrill, L. & May, H. (2012). Retaining Teachers: How Preparation Matters. *Educational Leadership,* 69(8): 30-34.

Ivankova, N.V., Creswell, J.W. & Plano-Clark, V.L. In Maree, K. (Ed). (2010*). First Steps in Research.* Pretoria: Van Schaik Publishers.

Jang, S.J. (2006). Research on the Effects of Team Teaching Upon Two Secondary School Teachers. *Educational Research,* 48(2):177-194.

Janish, C. (2009). *Assessment and Moderation Policy*. BANKSETA.

© University of Venda

University of Venda
Creating Future Leaders

Johnson, B. (2010). Teacher Collaboration: Good for Some, Not Good for Others. *Educational Studies,* 29(4): 337-350.

Johnson, D. W., Johnson, R. T., & Stanne, M.E. (2000). *Cooperative Learning Methods: A meta-analysis.* University of Minnesota, Minneapolis: Cooperative Learning Center.

Kanjee, A. (2009). Enhancing Teacher Assessment Practices in South African Schools: Evaluation of the Assessment Resource Banks. Centre for Education Quality Improvements. Human Sciences Research Council, South Africa. *Education As Change,* 13(1): 67-83.

Kauffman, D. (2005*). Curriculum Support and Curriculum Neglect*: Second-Year Teachers' Experiences. NGT Working Paper. Cambridge, MA: Project on the Next Generation of Teachers.

Kaur, B. (2010). Towards Excellence in Mathematics Education- Singapore's Experience. *Procedia Social and Behavioural Sciences,* 8: 28-34.

Kazu, I.Y. (2009). The Effect of Learning Styles on Education and the Teaching Process. *Journal of Social Sciences,* 5(2): 85-94.

Kerekes, J. (2005). Using the Learners World to Construct and Think In a System of Mathematical Symbols. *College Teaching Methods and Styles Journal,* 1(2): 17-25.

Kersaint, G. (2001). Improving Middle School Mathematics Achievement in Florida: Voices from the Field. *Florida Journal of Educational Research,* 41(1): 43-78.

Klingborg, D.J., Moore, D.A., & Varea-Hammond, S. (2006). What is Leadership? Leadership and Professional Development. *JVME* 33(1): 280-283.

© University of Venda

University of Venda
Creating Future Leaders

Koh, L.S. (2002). Mathematics Education in Singapore: Looking Back and Moving On. *The Mathematics Educator,* 6(2): 1-14.

Kruger, D.J., De Vos, A.S., Fouche, C.B. & Venter, L. (2005). In De Vos, A.S. (Ed). Research at Grassroots. *For the Social Sciences and Human Service Professions. (3rd Edition).* Pretoria: Van Schaik Publishers.

Kwang, T.S. (2002). An Investigative Approach to Mathematics Teaching and Learning. *The Mathematics Educator,* 6(2): 32-46.

Larson, M. (2002*). Essential Characteristics of Effective Mathematics Instruction.* Houghton Miffin Mathematics.

Le Cornu, R. & Peters, J. (2005). Towards Constructivist Classrooms: The Role of the Reflective Teacher. *Journal of Educational Enquiry,* 6(1): 50-64.

Legotlo, M.W., Maaga, M.P., Sebego, M.G., van der Westhuizen, P.C., Mosoge, M.J., Nieuwoudt, H.D. & Steyn, H.J. (2002). Perceptions of Stakeholders On Causes of Poor Performance In Grade 12 In A Province In South Africa. *South African Journal OF Education, 22(2)*: 113-118.

Leithwood, K. , Jantzi, D. , Earl, L. , Watson, N. ,Levin, B & Fullan, M. (2004). *Strategic Leadership for large-scale reform: The case of England's National Literacy and Numeracy Strategy.* School Leadership and Management, 24(1): 57-79.

Lemmer, M., Edwards, J., & Rapule, S. (2008). Educators' Selection and Evaluation of Natural Sciences Textbooks. *South African Journal of Education,* 28: 175-187.

Lerman, S. (1992). *Can We Talk about Constructivism*? Centre for Mathematics Education South Bank University, London.

© University of Venda

University of Venda

Lewis, C.C., Perry, R.R & Hurd, J. (2009). Improving Mathematics Instruction through Lesson Study: A Theoretical Model and North American Case. *Journal of Mathematics Teacher Education*, 12: 285-304.

Lianghuo, F. (2004). *Improving Mathematics Teaching through Effective Classroom Assessment: Experiences and Perspectives from Singapore Schools.*

Limpopo Department of Education. (2011*). Curriculum Strategy to improve Education In Limpopo Province. Curriculum Strategy: Curriculum Branch Document.*

Limpopo Department of Education. (2012*). National Curriculum Statement (NCS). Mathematics. Curriculum & Assessment Policy Statement (CAPS).* CAPS Orientation. Intermediate Phase: Grade 4-6.

Lim-Teo, S.K. (2002). Pre-Service Preparation of Mathematics Teachers in the Singapore Education System. *International Journal of Educational Research,* 37:131-143.

Linchevski, L., Liebenberg, R., Sasman , M.,& Olivier, A. (1998). *Assessment in Support of Planning Teaching to Improve Learning.* Paper Presented at the 4th Annual Congress of the Association for Mathematics Education of South Africa (AMESA), Pietersburg.

Little, O., Goe, L., & Bell, C. (2009*). A Practical Guide to Evaluating Teacher Effectiveness.* National Comprehensive Center for Teacher Quality.

Loucks-Horsley, S., Stiles, K., & Hewson, P. (1996). Principles of Effective Professional Development for Mathematics and Science Education: A Synthesis of Standards. *National Institute for Science Education,* 1(1): 1-6.

© University of Venda

Louis, K.S., Leithwood, K., Wahlstrom, K.L. & Anderson, S.E. (2010). *Investigating the Links to Improved Student Learning: Final Report of Research Findings*. Center for Applied Research and Educational Improvement.

Louw, J., Muller, J & Tredoux, C. (2008). *Time-On-Task, Technology and Mathematics Achievements*. Evaluation and Program Planning, 31: 41-50.

Maree K, Aldous C, Hattingh A, Swanepoel A & van der Linde M. (2006). Predictors of Learners Performance in Mathematics and Science According to a Large –Scale Study in Mpumalanga. *South African Journal of Education,* 26(2): 229-252.

Maree, K. & Pietersen, J. (2010). In Maree, K. (Ed). *First Steps in Research*. Pretoria: Van Schaik Publishers.

Maxwell, G. (2006). *Quality Management of School-Based Assessments: Moderation of Teacher Judgments*. Paper presented at the 32nd IAEA conference, Singapore.

McBer, H. (2000). *Research into Teacher Effectiveness. A Model of Teacher Effectiveness*. London: Department for Education and Employment.

Mc Graner, K.L., Van Der Heyden, A., & Holdheide, L. (2011). *Preparation of Effective Teachers in Mathematics. A TQ Connection Issue Paper on Applying the Innovation Configuration to Mathematics Teacher Preparation*. National Comprehensive Center for Teacher Quality.

Mc Intosh, R & Jarret, D. (2000). *Teaching Mathematical Problem Solving: Implementing the Vision*. Mathematics and Science Education Center.

McMillan, J.H. & Schumacher, S. (2006). *Research in Education. Evidence-Based Inquiry (6th edition)*. Boston: Pearson Education Inc

© University of Venda

University of Venda
Creating Future Leaders

Migiro, S.O. & Mangangi, B.A. (2011). Mixed Methods: A Review of Literature and the Future of the New Research Paradigm. *African Journal of Business Management,* 5(10): 3757-3764.

Ministry of Education, Singapore (MOE). (2000). *Primary Mathematics Syllabus. Singapore: Curriculum Planning and Development Division*, Ministry of Education.

Mji, A & Makgato, M. (2006). Factors Associated with High School Learners' Poor Performance: A Spotlight on Mathematics and Physical Science. *South African Journal of Education,* 26(2): 253-266.

Mohammad, R.F., & Harlech-Jones, B. (2008). Working as Partners for Classroom Reform. *International Journal of Educational Development*.

Morony, W. (1999*). Teacher Professional Associations as Key Contributors to the Effectiveness of Teachers' work*. Paper Presented to the fifth UNESCO-ACEID International Conference. Reforming Learning, Curriculum and Pedagogy: Innovative Visions for the New Century.

Morrow,W., & Keevy, J. (2006*). The Recognition of Teacher Qualifications and Professional Registration Status across Commonwealth Member States*. SAQA. Pretoria.

Muijs, D. (2008). *Doing Qualitative Research in Education with SPSS*. London: Sage Publications Ltd.

Murata, R. (2002). What Does Team Teaching Mean? A Case Study of Interdisciplinary Teaming. *The Journal of Educational Research,* 96(2): 67-77.

National Council of Teachers of Mathematics (NCTM). (2007). *Mathematics Teaching Today*. Reston, VA: Author.

© University of Venda

University of Venda
Creating Future Leaders

National Council of Teachers of Mathematics (NCTM). (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.

Nelson, B.S. & Sassi, A. (2000*). Shifting Approaches to Supervision: The Case of Mathematics Supervision*. Educational Administration Quarterly, 56(4): 553-584.

Nevo, D. (1994). How Can Teachers Benefit from Teacher Evaluation? *Journal of Personnel Evaluation.* 8: 109 – 117.

New Zealand Ministry of Education. (2001). *Support for Beginning Teachers*. Research Division. Wellington .

Nieuwenhuis, J. (2010). In: Maree, K. (Ed). *First Steps in Research*. Pretoria: Van Schaik Publishers.

North West Province Department of Education. (2003). *Assessment, Certification and Accreditation. Provincial Moderation Model for Continuous Assessment Grades 1-12.* North West Extraordinary Provincial Gazette Vol. 246 No. 5927.

NYC Department of Education. (2000). *Project-Based Learning: Inspiring Middle School Students to Engage in Deep and Active Learning*. Division of Teaching and Learning Office of Curriculum, Standards, and Academic Engagement.

Ontario Ministry of Education. (2005). *Mathematics. Curriculum Grades 1-8: Mathematics*. Ontario: Ministry of Education.

Ontario Education. (2004). *Teaching and Learning Mathematics*. The Report of the Expert Panel on Mathematics in Grade 4 to 6. Ontario: Ministry of Education.

© University of Venda

University of Venda
Creating Future Leaders

Owston, R. (2007). *Teachers Can Make A Difference: Professional Development As A Policy Option for Improving Student Learning with ICT.* Paper Prepared for the CERI-KERIS International Expert Meeting on ICT and Educational Performance.

Perez, K., Swain, C. & Hartsough, C.S. (1997). *An Analysis of Practices Used to Support New Teachers.* Teacher Education Quarterly.

Pitsoe, V.J. (2007). *A Conceptual Analysis of Constructivist Classroom Management.* Thesis Submitted in Fulfilment of the Requirements for the Degree Doctor of Philosophy. Pretoria: University of Pretoria.

Postlethwaite, T.N. (2005). *Educational Research: Some Basic Concepts and Terminology.* Ross, K.N. (Ed). International Institute for Educational Planning. UNESCO.

Price, J.H Editor PhD, MPH and Murnan, J. Assistant. (2004). Research Limitations and the Necessity of Reporting Them. *American Journal of Health Education,* 35(2): 66-67.

Protheroe, N. (2007). "What Does Good Math Instruction Look Like? *Principal,* 7(1): 51-54.

Puchner, L.D. & Taylor, A.R. (2006). *Lesson Study, Collaboration and Teacher Efficacy: Stories from Two School-Based Math Lesson Study Groups.* Teaching and Teacher Education 22: 922-934.

Quinell, L. (2010). Why Are Mathematical Investigations Important? *amt* 66(3): 35-40

Rakumako, A & Laugksch, R. (2010). Demographic Profile and Perceived INSET Needs of Secondary Mathematics Teachers in Limpopo Province. *South African Journal of Education,* 30: 139-152.

© University of Venda

University of Venda
Creating Future Leaders

Reddy, V. (2006). *Mathematics and Science Achievement at South African Schools in TIMSS 2003.* HSRC Press: Cape Town.

Reeves, D. (2010). *Finding Your Leadership Focus: What Matters for Students Results.* Teachers College, Columbia University.

Renard, L. (2003). Setting new teachers for failure or success. *Educational Leadership,* 62-64.

Reyneke, M., Meyer, L., & Nel, C. (2010). School-based Assessment: The Leash Needed to Keep the Poetic 'Unruly Pack of Hounds' Effectively in the Hunt for Learning Outcomes. *South African Journal of Education*, 30: 277-292.

Reys, B.J., Reys, R.E., & Chavez, O. (2004). Why Mathematics Textbooks Matter? *Educational Leadership,* 61(5): 61-66.

Rezat, S. (2009). *The Utilization of Mathematics Textbooks As an Instrument for Learning.* Proceedings of CERME.

Ricketts, K.G. (2009). *Competent Leaders: What Effective Leaders Do Well?* Community and Leadership Development.

Ruhana, E. & Tirosh, D. (1995). Subject-Matter Knowledge and Knowledge about Students as Sources of Teacher Presentations of the Subject Matter. *Educational Studies in Mathematics,* 29: 1-20.

Sam, L.C., White, A.L. & Mon, C.C. (2005). Promoting Mathematics Teacher Collaboration through Lesson Study: What Can We Learn From Two Countries' Experience? The Mathematics Education into the 21st Century. *Reform, Revolution and Paradigm Shifts in Mathematics Education.*

© University of Venda

University of Venda
Creating Future Leaders

Sapsford, R. & Jupp, V. (Ed). (2006). *Data Collection and Analysis (2nd* edition). London: Sage Publishers Ltd.

Scheaffer, R.L.(1999). *Sampling Methods and Practice.* NCSSM Statistics Leadership Institute.

Schifter, D. (1996). A Constructive Perspective on teaching and Learning Mathematics. *Phi Delta Kappan, 77:492-499*

Schumer, G. (1999). Mathematics Education in Japan. *Journal of Curriculum Studies,* 31(4): 399-427.

Septimi, K. (2004). *Enhancing Mathematics Teachers' Pedagogical Content Knowledge and Skills In Tanzania*. Enschede: Inskamp.

Shepard, L.A. (2000). The Role of Assessment in a Learning Culture. *Educational Researcher,* 29(7): 4-14.

Shimahara, N.K. (1998). The Japanese Model of Professional Development: Teaching As Craft. *Teaching and Teacher Education,* 14(5): 451-462.

Shimuzu, Y. (1999). Aspects of Mathematics Teacher Education In Japan. *Journal of Mathematics Teacher Education,* 2: 107-116.

Shulman, L.S. (1987). *Knowledge and Teaching: Foundations of the New* Reform. Harvard Educational Review, 57(1): 1-21.

Sieborger, R. (2004*). Transforming Assessment. A guide for South African Teachers .(2nd edition), Cape Town: Juta .*

© University of Venda

University of Venda
Creating Future Leaders

Simpson, C. & Du, Y. (2004). Effects of Learning Styles and Class Participation on Students' Enjoyment Level in Distributed Learning Environments. *Journal of Education for Library and Information Science,* 45(2): 123-136.

Sjoberg, S. (2010). *Constructivism and Learning*. University of Oslo, Oslo. Norway.

Smith, K.A., Sheppard, S.D., Johnson, D.W., & Johnson , R.T. (2005). Pedagogies of Engagement: Classroom-Based Practices. *Journal of Engineering Education,* 94(1): 87-101.

Southern Region Education Board (2010). *The Three Essentials: Improving Schools Requires District Vision, District and State Support, and Principal Leadership*. Learning Centered Leadership Program.

Stansbury, K & Zimmerman, J. (2000). *Lifelines to the Classroom: Designing Support for Beginning Teachers*. A WestEd Knowledge Brief. San Francisco, CA: WestEnd.

Supovitz, J. (2008). Melding Internal and External Support for School Improvement: How the District Role Changes When Working Closely With External Instructional Support Providers. *Peabody Journal of Education,* 83(3): 459-478.

Sutton, J., & Krueger, A (Eds). (2002). *EDthoughts: What We Know About Mathematics Teaching and Learning.* Aurora, CO: Mid-Continent Research for Education and Learning.

Syh-Jong, J. (2006). Research on the Effects of Team Teaching upon Two Secondary School Teachers. *Educational Research,* 48(2): 177-194.

Taylor-Powell, E. & Renner, M. (2003). *Analysing Quantitative Data*. Program Development and Evaluation. University of Wisconsin- Extension.

© University of Venda

University of Venda
Creating Future Leaders

The Higher Education Academy. (2009*). Enhancing Learning Through Technology.* A Guide to Resources Provided by the Academy and JISC Collaboration Network.

The Inspectorate. (2004). *A Guide to Subject Inspection at Second Level.* Evaluation Support and Research Unit.

The New Teacher Project (TNTP). (2010). Teacher Evaluation 2.0. New York: Author

Trautwein, U., Koller, O., Schmitz, B. & Baumert J. (2002). Do Homework Assignments Enhance Achievement? A Multilevel Analysis in 7th Grade Mathematics. *Contemporary Educational Psychology,* 27: 26-50.

Treffers, A. (1987). *Three Dimensions. A Model of Goal and Theory Description in Mathematics Instruction.* The Wiskobus Project, D. Riedel Publ. Co, Dordretcht.

Tsanwani, A.R. (2009). *Tracing Factors that Facilitate Achievement in Mathematics in Traditionally Disadvantaged Secondary Schools.* A Thesis Submitted in Fulfillment of the Requirements for the Degree of Doctor of Philosophy. Pretoria: University of Pretoria..

Turnukhu, E.B., & Yesildere, S. (2007). The Pedagogical Content Knowledge in Mathematics: Pre-Service Primary Mathematics Teachers' Perspectives in Turkey. *IUMPST: The Journal,* 1: 1-13.

Uzel, D. & Uyangor, M. (2006). Attitudes of 7th Class Students toward Mathematics in Realistic Mathematics Education*. International Mathematical Forum,* 1(39): 1951-1959.

Van den Heuvel-Panhuizen, M. (2000*). Mathematics Education in the Netherlands: A Guided Tour.* Freudenthal Institute Cd-rom for ICME9. Utrecht: Utrecht University.

© University of Venda

University of Venda
Creating Future Leaders

Van Dijk, E.M. & Kattman, U. (2007). A Research Model for the Study of Science Teachers Pedagogical Content Knowledge and Improving Teacher Education. *Teaching and Teacher Education,* 23(6): 885-897.

Van Driel, J.H., Verloop, N & DE Vos, W. (1998). Developing Science Teachers' Pedagogical Content Knowledge. *Journal of Research in Science Teaching,* 35(6): 673-695.

Van Zoest, L.R., & Stockero, S.L. (2006). *The Role of Curriculum Materials in New Teacher's Practice.* Paper presented at the annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, TBA, Mérida, Yucatán, Mexico.

Villegas-Reimers, E. (2003). *Teacher Professional Development: An International Review of the Literature.* UNESCO: International Institute for Educational Planning.

Vincent, J., & Stacey, K. (2008). Do Mathematics Textbooks Cultivate Shallow Teaching? Applying the TIMSS Video Study Criteria to Australian Eighth-grade Mathematics Textbooks. *Mathematics Education Research Journal.* Vol. 20, No. 1, 82-107.

Vithal, R & Jansen, J. (2010*). Designing Your First Research Proposal. A Manual for Researchers in Education and Social Sciences.* Claremont: Juta & Company Ltd.

Von Glasersfeld, E.V. (1995). *Radical Constructivism: A Way of Knowing and Learning.* The Falmer Press, London.

Wagner, J.F., Speer, N.M., & Rossa, B. (2007). Beyond Mathematical Content Knowledge: A Mathematician's Knowledge Needed for Teaching an Inquiry-Oriented Differential Equations Course. *Journal of Mathematical Behavior,* 26: 247-266.

© University of Venda

University of Venda
Creating Future Leaders

Walshaw, M., & Anthony, G. (2008). The Teacher's Role in Classroom Discourse: A Review of Recent Research into Mathematics Classrooms. *Review of Educational Research,* 78 (3): 516-551.

Wang, A.H., Coleman, A.B., Coley, R.J., & Phelps, R.P. (2003). *Preparing Teachers Around the World*. Princeton, NJ: Education Testing Service.

Wei, R.C., Darling-Hammond, L., Andree, A., Richardson, N & Orphanos, S. (2009). *Professional Learning in the Learning Profession. A status Report on Teacher Development in the US and abroad*. Dallas, TX. National Staff Development Council.

Welman, C., Kruger, F. & Mitchel, B. (2005). *Research Methodology*. Cape Town: Oxford University Press Southern Africa.

Wenger, M.S. & Homyak, M.J. (1999). Team Teaching for Higher Level Learning: A framework of Professional Collaboration. *Journal of Management Education,* 23: 311.

White, C.J. (2003). *Research: an introduction for educators*. Pretoria: C.J. White Publishers.

Wilmot, D. (2003). The Inception Phase of a Case Study of Outcomes-Based Education Assessment Policy in the Human and Social Sciences Learning Area of C2005. *South African Journal of Education,* 23(4): 313-318.

Windschitl, W. (2002). Framing Constructivism in Practice as the Negotiation of Dilemmas: An Analysis of the Conceptual, Pedagogical, Cultural, and Political Challenges Facing Teachers. *Review o Educational Research,* 72(2): 131-175.

© University of Venda

University of Venda
Creating Future Leaders

Wise, A.E., Darling – Hammond, L., Mc Laughlin, M.W. & Bernstein, H.T. (1985). Teacher Evaluation: A Study of Effective Practices. *The Elementary School Journal,* 86(1): 60-121.

Woolfolk, A. (2007). *Educational Psychology. (10th edition).* Boston: Pearson Education, Inc.

Wubbels, T., Korthagen, F. & Broekman, H. (1997). Preparing Teachers for Realistic Mathematics Education. *Educational Studies in Mathematics,* 32: 1-28.

Yoong, W.K., Yee, L.P., Kaur, B., Yee, F.P. & Fong, N.S. (Ed). (2009). *Mathematics Education, the Singapore Journey.* Series on Mathematics Education Volume 2. World Scientific Publishing Co Ptd. Ltd. Singapore.

Young, R.A. (2004). Introduction: Constructivism and Social Constructionism in the Career Field. *Journal of Vocational Behaviour,* 64: 373-388.

Zambo, R & Zambo, D. (2008). *The Impact of Professional Development in Mathematics on Teacher's Individual AND Collective Efficacy: The Stigma of Underperforming.* Professional Development in Mathematics.

Zulkardi, Z. (2002). *Developing a Learning Environment On Realistic Mathematics Education for Indonesian Student Teachers.* Thesis University of. Twente, Enschede.

Retrieved items

(http:www.thirteen.org/endonline/concept2class/constructivism/index_sub1.html)

(http://www.fischlerschool.nova.edu/Resources/uploads/app/35/files/ARC-Doc//intro.RD

© University of Venda

University of Venda
Creating Future Leaders

APPENDICES

APPENDIX 1

1. SCHEDULE A: SURVEY QUESTIONNAIRE

2. SCHEDULE B: FOCUS GROUP INTERVIEW QUESTIONS

3. SCHEDULE C: INDIVIDUAL INTERVIEWS QUESTIONS

SCHEDULE A: SURVEY QUESTIONNARE

TO BE COMPLETED BY FET BAND MATHEMATICS EDUCATOR

The purpose of this questionnaire is to establish the role of subject advisors in supporting FET mathematics educators. Answer all questions by putting a cross (X) in the appropriate block. You are humbly requested to provide genuine responses about each question. The information you provide will be treated as strictly confidential. Please, use black or blue ink to complete this questionnaire. There is no right or wrong answer. Answer all questions.

SCHOOL NUMBER: .....

RESPONDENT NUMBER: .....

SECTION A: PERSONAL INFORMATION

Please mark with a cross (X)

1. Indicate your gender

Female	
Male	

2. Indicate your age

© University of Venda

Less than 25 years	
25 - 35 years	
Above 35 years	

3. Indicate years of experience in teaching Mathematics in the FET band (i.e. grades 10, 11 and 12

Less than 5 years	
5 – 10 years	
11 - 20 years	
Above 20 years	

4. Indicate when you started working as an educator

Before 1998	
After 1998	

5. Indicate your highest qualification in Mathematics

Std 10 or Grade 12	
JSTC	
STD	
Bachelor's Degree	
Honours Degree	
Master's Degree	
Doctorate	
Other (specify)	

6. Indicate the FET grade that you are currently teaching Mathematics.

Grade 10 only	
Grade 11 only	
Grade 12 only	
Grade 10 and 11 only	
Grade 10 and 12 only	
Grade 11 and 12 only	
Grade 10, 11 and 12	

© University of Venda

University of Venda

SECTION B: PROFESSIONAL DEVELOPMENT

7. Have you ever observed a subject advisor demonstrating a Mathematics lesson?

Yes	
No	

8. Have you ever been observed or evaluated by a subject advisor offering Mathematics lessons to your students?

Yes	
No	

9. How often do subject advisors engage you and your Head of Department on academic improvement plan of Mathematics

Always	
Sometimes	
Never	

10. When Mathematics advisors visit your school for monitoring purposes, do they

		Yes	No
10.1	Establish pace, depth and sequencing of content		
10.2	Check the availability of content framework		
10.3	Check the availability of text books		
10.4	Check the availability of examination guidelines		
10.5	Check lesson preparations		

11. Do subject advisors provide you with guidelines on how to select Mathematics textbooks?

Yes	
No	

12. How often do subject advisors provide you with assessment strategies?

Always	
Sometimes	
Never	

© University of Venda

13. Do you receive training on how to develop Mathematics assessment tasks and the corresponding assessment tools?

Yes	
No	

14. Does your school receive assessment documents like templates of marking rubrics and record sheets?

Yes	
No	

15. How often do subject advisors monitor the management of Mathematics class work and homework?

Always	
Sometimes	
Never	

16. Please indicate to which extent you agree or disagree with the following statements.

SA – Strongly Agree

A – Agree

D – Disagree

SD – Strongly Disagree

		SA	A	D	SD
16.1	Regular visits by Mathematics subject advisors increase your confidence in teaching mathematics.				
16.2	It is difficult to get access to Mathematics subject advisors when the need arises.				
16.3	Subject advisors support should also emphasise pedagogical knowledge?				

17. Have you attended in-service training in Mathematics in the past 5 years?

Yes	
No	

© University of Venda

University of Venda
Creating Future Leaders

18. Have you ever received training on using different teaching approaches?

Yes	
No	

19. How often do you use the following Mathematics teaching and learning approaches?

	Regularly	Occasionally	Never
Cooperative			
Project – based			
Problem –solving			
Investigative			

20. Do you make use of real life contexts when teaching Mathematics?

Yes	
No	

21. Do you meet other teachers in your cluster to share knowledge on best practices in Mathematics teaching?

Yes	
No	

22. Do you and your colleagues engage in Mathematics team teaching at your school?

Yes	
No	

23. Do you receive sufficient feedback from subject advisors after moderation of Mathematics continuous assessment?

Yes	
No	

© University of Venda

University of Venda
Creating Future Leaders

24. Do subject advisors provide support on how to deal with learners experiencing barriers to learning and development with regard to Mathematics learning?

Yes	
No	

25. What do you suggest is the most needed support that can enhance learners' performance in Mathematics?

.....

.....

.....

.....

.....

.....

© University of Venda

SCHEDULE B: FOCUS GROUP INTERVIEWS: EDUCATORS

1. What support do subject advisors give in your day to day activities regarding teaching and learning of Mathematics?

2. How do subject advisors influence your commitment to teaching and learning of Mathematics?

3. How do subject advisors support you in your effort to support learners experiencing barriers to learning and development in Mathematics?

4. How do subject advisors support you in developing credible assessment tasks?

5. How do subject advisors support you in accommodating different learning styles of learners?

6. How do subject advisors support you in using different teaching strategies and methodologies to enhance achievement in Mathematics?

7. How do subject advisors support you in choosing textbooks?

8. How do you relate achievement in Mathematics with the support given by subject advisors?

9. How do subject advisors support you to work in collaboration with other Mathematics teachers in your cluster?

10. What kind of support do you think is needed in order to enhance improvement in Mathematics?

11. How do you relate general performance of learners in all subjects to the support rendered by subject advisors?

THANK YOU

© University of Venda

SCHEDULE C: INDIVIDUAL INTERVIEWS: SUBJECT ADVISORS

1. What support do you provide to educators with regard to their day to day activities regarding teaching and learning of Mathematics?

2. What do you do to support educators in their effort to support learners who are experiencing barriers to learning and development in Mathematics?

3. How do you support educators in using different teaching strategies and methodologies to enhance achievement in Mathematics?

4. What kind of intervention strategies would you propose regarding the teaching of Mathematics?

THANK YOU

© University of Venda

APPENDIX 2

1. LETTER REQUESTING PERMISSION TO CONDUCT RESEARCH ACTIVITIES IN VHEMBE DISTRICT.

2. LETTER GRANTING PERMISSION TO CONDUCT RESEARCH ACTIVITIES IN VHEMBE DISTRICT.

3. LETTER GRANTING PERMISSION TO CONDUCT RESEARCH IN TSHILAMBA CIRCUIT.

4. LETTER REQUESTING PRINCIPALS OF SCHOOLS TO CONDUCT RESEARCH ACTIVITIES IN SCHOOLS.

© University of Venda

University of Venda
Creating Future Leaders

OFFICE OF THE DEAN
2012 -11- 12
SCHOOL OF EDUCATION
UNIVERSITY OF VENDA

University of Venda
Private Bag X5050, THOHOYANDOU, 0970

SCHOOL OF EDUCATION

Enq. 015 962 8122

The District Senior Manager: Dr. NG Rambiyana
Vhembe Department of Education
Private Bag X2250
Sibasa, 0970

Sir

Subject: Permission to conduct Research Activities for Masters Degree in Education: Data collection: Tshilamba circuit

1. The matter above refers.
2. Mr. MI Maudu of student number 8400056 is a Masters Degree student at the University of Venda. His topic is: **The role of subject advisors in supporting Mathematics educators in Further Education and Training Band with regard to Pedagogical content knowledge.**
3. Mr. Maudu is at the stage of data collection. I humbly request that you grant him permission to collect data for his studies.
4. I thank you in advance.

Yours truly,

Litshani 05/11/2012

Dr. NF LITSHANI

© University of Venda

University of Venda
Creating Future Leaders

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION
VHEMBE DISTRICT

REF: 16/7/R
ENQ: Matibe M.S
TEL: 015 962 1029

Litshani N.F
University of Venda
Private Bag X 5050
THOHOYANDOU
0970

SUBJECT: PERMISSION FOR MR M.I. MAUDU TO CONDUCT RESEARCH ACTIVITIES FOR MASTERS DEGREE IN EDUCATION: DATA COLLECTION: TSHILAMBA CIRCUIT

1. The above matter has reference.
2. Your request for Mr M.I. Maudu to be granted permission to conduct research on the topic: "The role of subject advisors in supporting Mathematics educators in Further Education and Training Band with regard to pedagogical content knowledge" has been granted.
3. Kindly note that the granting of permission is subject to the following conditions:
   3.1 Data collection must be done after school hours to avoid the disruption of teaching and learning activities.
   3.2 Research ethics must be observed.
   3.3 The Circuit Manager and principals of affected schools must be informed prior to the commencement of data collection.
4. Hoping that you will find this in order.

DISTRICT SENIOR MANAGER

2012 -11- 15
DATE

Thohoyandou Government Building, Old Parliament, Block D, Private Bag X2250, SIBASA, 0970
Tel: (015) 962 1313 or (015) 962 1331, Fax: (015) 962 6039 or (015) 962 2288

The heartland of southern Africa - development is about people!

© University of Venda

University of Venda
Creating Future Leaders

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

TSHILAMBA CIRCUIT

Ref:16/7/R
Enq: Tshisudzungwane E.R

MR. MAUDU. M.I.
P.O.BOX 345
[redacted]
1950
[redacted]2

APPLICATION FOR PERMISSION TO CONDUCT RESEARCH IN SCHOOLS UNDER TSHILAMBA CIRCUIT: YOURSELF.

1. The above matter bears reference.
2. Your application for permission to conduct research in schools under Tshilamba Circuit on the topic **"THE ROLE OF SUBJECT ADVISORS IN SUPPORTING MATHEMATICS EDUCATORS IN FURTHER EDUCATION AND TRAINING BAND WITH REGARD TO PEDAGOLOGICAL CONTENT KNOWLEDGE"**, has been approved.
3. You are kindly requested to observe the following conditions:
   3.1 Inform the principals of affected Schools prior to your visits.
   3.2 Ensure that your interactions with participating principals, teachers and learners do not disrupt teaching and learning activities.
4. Wishing you the best in your academic endeavours.

DEPARTMENT OF EDUCATION
TSHILAMBA CIRCUIT
20 -11- 2012
CIRCUIT MANAGER
PRIVATE BAG X 1195 MUTALE 0956
LIMPOPO PROVINCE

CIRCUIT MANAGER: TSHILAMBA .

20/11/2012
DATE.

Tshilamba. Private Bag X1195, MUTALE 0956 Tel: (015) 9670086 Fax: (015) 96700
The heartland of southern Africa-development is about people!

© University of Venda

University of Venda
Creating Future Leaders

OFFICE OF THE DEAN
2012 -11- 12
SCHOOL OF EDUCATION
UNIVERSITY OF VENDA

University of Venda

Private Bag X5050, THOYANDOU, 0970
SCHOOL OF EDUCATION

Enq. 015 962 8122

THE PRINCIPAL

Sir/Madam

Subject: Permission to conduct Research Activities for Masters Degree in Education: Data collection: Tshilamba circuit

1. The matter above refers.
2. Mr. MI Maudu of student number 8400056 is a Masters Degree student at the University of Venda. His topic is: **The role of subject advisors in supporting Mathematics educators in Further Education and Training Band with regard to Pedagogical content knowledge.**
3. Mr. Maudu is at the stage of data collection. I humbly request that you grant him permission to collect data for his studies.
4. I thank you in advance.

Yours truly,

05/11/2012

Dr. NF LITSHANI

© University of Venda