MATHEMATICS TEACHING CHALLENGES IN THE SECONDARY SCHOOLS OF THE EASTERN CAPE PROVINCE: *A TEACHERS' PERSPECTIVE*

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Abstract

Forty-seven Grade 12 mathematics teachers of Butterworth district participated and responded to a questionnaire that asked them to identify challenges that make their teaching of mathematics at secondary schools impossible or difficult. These teachers represented more that 80% of Grade 12 mathematics teachers in the district. Lack of relevant support from the district and provincial offices, poor school management and organization, lack of classroom resources and poor learner academic background were identified as the leading challenges that makes their teaching difficult. This study concludes by a word of caution that the results should be read with understanding that they represent the opinion of one interest group, the secondary school mathematics teachers.

KEYWORDS: Mathematics teaching, secondary schools, district, teachers' opinion

Introduction

Performance and achievement of the Eastern Cape Province in mathematics in some national and international surveys is less than desired at all tested school levels. During South Africa's last participation in TIMSS this province was among the three least performing provinces in mathematics in the country (Reddy, 2006). Eastern Cape Province had been the lowest achieving province in the national Grade 12 final mathematics examination for the last five years. Preliminary analysis of the current Annual National Assessment (ANA) for Grade 3, Grade 6 and Grade 9 is not showing any signs of positive results. Different national, provincial and localized interventions in the province seem not to have yielded positive results since the poor performance persists. This paper attempts to contribute to the pursuit of understanding of this problem. It will shed some light to the broader question of: W*hy the Eastern Cape Province continues to underperform, especially in the area of mathematics*? A number of factors have been identified and argued that they may explain these performance patterns. These ranged from broader policy-related factors, school-, classroom-, and learner background and resources factors, to the instructional practices in the classroom. Different interest groups (politicians, government officials, parents, researchers, teachers, professional bodies, learners etc.) have advanced explanations from different perspectives. The research question for this paper is: **What are challenges that**

made mathematics teaching in the rural secondary schools of the Eastern Cape Province difficult? It is believed that different interest group may give different responses to this question. This current research confined itself to one critical group: the mathematics teachers.

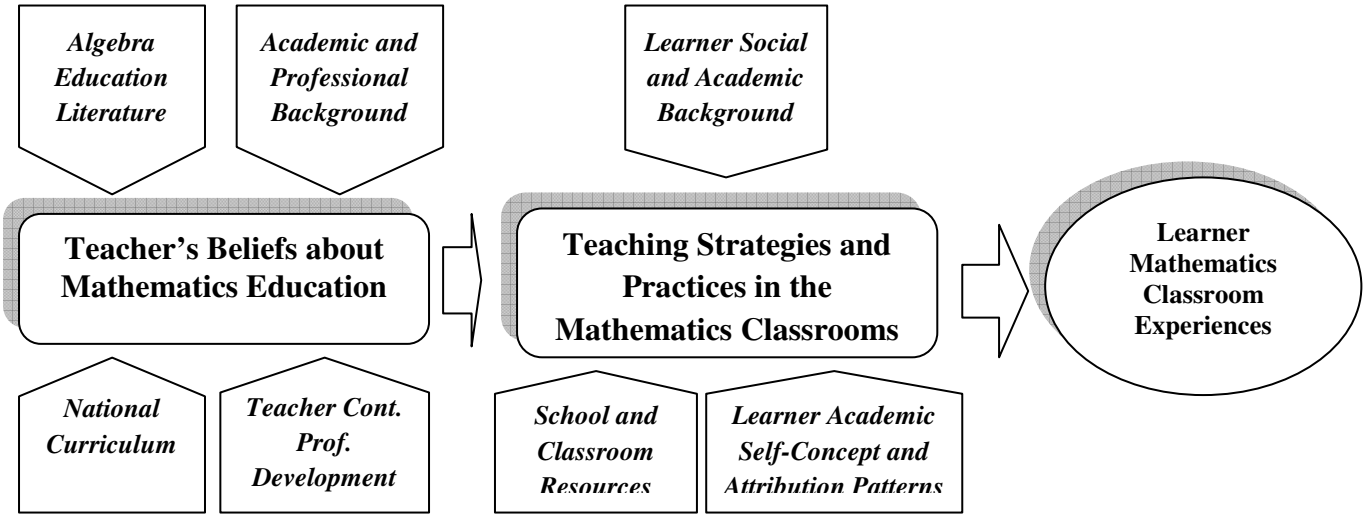
CONCEPTUAL FRAMEWORK

Ingvarson, Beavis, Bishop, Peck and Elsworth (2004) presented a theoretical framework that described the relations between factors associated with effective mathematics teaching in secondary schools. They grouped those factors into five broad groupings:

- Opportunities for teacher learning
- School capacity
- Teacher capacity
- Student opportunity to learn
- Learning Outcomes

They argued that the first four of these broad groupings represent independent variables, and the fifth – *Learning Outcomes* – represents the dependent variable.

In this paper it is assumed that classroom mathematics teaching is the key factor among those that impact on achievement and performance of learners in poor, rural and disadvantaged areas. The mathematics teacher has major influence in the structuring of mathematics classroom instructional environment. It is these classroom environments that shape learners experiences. Teachers' beliefs about the nature of mathematics, about mathematics teaching, about learners and learning, and about the overall teaching and learning environment play a huge role in influencing the teachers' attempts to construct a conducive mathematics learning environment. The teachers' beliefs are also influenced by mathematics education research and adopted curriculum. The diagram below gives the described conceptual framework.



Research Design and Methodology

In this study the researchers were interested in the mathematics teachers' beliefs about challenges that made mathematics teaching difficult in secondary schools of the rural Eastern Cape Province. The data collected represented the views of teachers at that time

hence the research design could be said to be cross-sectional. This research was exploratory and sought to provide a description of a particular area with respect to mathematics teaching. Where possible this study generalized claims to larger population. It contains both quantitative and qualitative elements.

Sampling

The data presented in this research was collected from one Eastern Cape education district, Butterworth. The Eastern Cape Province has twenty-three (23) education districts grouped into three clusters (Cluster A, B, and C). In selecting this district a critical-case sampling was used. Cohen, Manion and Morrison (2000) define this type of sampling as identifying a district (in my case) that display a set of characteristics in their entirety in a way that is highly significant for their behavior. The statistical sampling was ruled out for the following reasons:

- The characteristics of districts in the Eastern Cape Province are unknown. It is therefore impossible to argue that a particular district is a representative of which wider population.
- There are no straight forward differences between districts in the province.
- Generalizability was not the primary goal of this study.
- The researcher did not have access to all districts in the province

Butterworth district was selected because it is one of the poor performing districts in the province and in the country. All Grade 12 school mathematics teachers in the district were invited to participate in the study. A total of forty-seven (47) secondary school mathematics teachers participated in this study. These forty-seven teachers represented more than 80% of Grade 12 mathematics teachers of Butterworth district.

Research Instrument and Data Collection

A special questionnaire was designed for this study. This questionnaire had three sections:

Section A: Mathematics Teacher Academic and Professional Background
Section B: Mathematics Teacher Professional Development
Section C: Teachers' Beliefs about Mathematics Teaching Challenges

In Section A and Section B there were straight forward objective questions where the respondents were required to fill in their: academic qualifications, years of experience, number of Professional Development activities attended etc. In Section C there were open-ended subjective questions where the respondents were asked for their opinion as to what were mathematics teaching challenges in their secondary schools.

The questionnaire was designed by the researcher and was piloted on the mathematics teachers in the neighboring district. In January 2011 the Butterworth Grade 12 mathematics teachers were invited to a curriculum-related teacher development three-day workshop. This workshop was organized by the district subject advisor and facilitated by Walter Sisulu University, and the researcher was one of the facilitators. As part of registration process on the first day the participants were requested to complete the questionnaire. The participants were advised that the information required was going to be used for research purposes and their identities were not going to be revealed. The participants completed the questionnaire in the presence of the researcher and were also able ask clarity-seeking questions.

Data Analysis

The results presented in this paper are based on the analysis of the teachers' responses to Section C of the questionnaire. The analysis was done in two stages: quantitative stage and qualitative stage. The researchers identified the number of challenges mention by each teacher and the number of teachers who had mentioned each challenge. Some interesting patterns were observed. At qualitative stage the researchers grouped the challenges into themes, and critically analysis was made in terms of the details provided the teachers as

they mentioned those challenges. In this study the researchers were also committed to identifying those regularities and patterns that could be extend to other similar districts.

Mathematics Teaching Challenges in the Butterworth District

The results presented in this paper are based on one interest group: the mathematics teachers. The following challenges were identified by the Grade 12 mathematics teachers of this district:

- Poor Learner Academic Background
- Lack of Support at District Level
- Poor School Management and Organization
- Inadequate Classroom Resources
- Lack of Support at Provincial Level

Poor Learner Academic Background

More than ninety percent (90%) of the respondents identified learner academic background as the major challenge to mathematics teaching at their secondary schools. They all argued that the learners coming to their Grade 10 classes from primary schools lack basics. Some of the areas of concern were that these learners:

- Cannot add, subtract, multiply or divide fractions
- Do not know order of operations (BODMAS)
- Do not know basic algebraic operations (adding like terms, factorizations etc)

When the researchers engaged with this matter some interesting facts emerge. Firstly, secondary school mathematics teachers seemed to have some expectations. The question is whether these expectations are realistic and fair. South Africa's schooling is guided by the national curriculum as far as the delivery of the subject matter is concerned. For example the table below is an extract from the latest Grade 9 curriculum statements. It states that learners in Grade 9 are expected to have covered the indicated mathematical content.

9.2.3.3. Simplifying algebraic expressions by: o using laws of exponents o using factorization **9.2.3.4. Factorization:** o common factor o difference of two squares o trinomials of the form: $x^2+ bx+c$ and $ax^2+ bx+c$ if a is a common factor.

(DBE, 2004, Pg.12)

Therefore in terms of the curriculum the secondary teachers' expectations are realistic and fair. The researchers were also interested in why did the 'system' waited until these learners were at Grade 10 before this poor academic background was noticed. It is believed that discovering these at Grade 10 may be too late for some of these problems to be rectified. Some of teachers further indicated that they usually spend the first term of every academic year teaching Grade 8 and Grade 9 to their Grade 10 group. The researchers discussed this problem with teachers, and with some district and provincial education officials. There seemed to be some agreement that the Eastern Cape school structural arrangement may account for this problem. According to South Africa's School Act (SASA 84/1996) primary schools refer to those school education institutions that are responsible for Grade R to Grade 7 schooling. Secondary schools are those responsible for Grade 8 to Grade 12

schooling. In most of the rural areas of the Eastern Cape Province there is different school structural arrangement. In the former Transkei and Ciskei primary schools are responsible for Grade R to Grade 9 schooling and secondary schools are responsible for Grade 10 to Grade 12 schooling. We have learnt that similar school structural arrangements also existed to a small scale in Mpumalanga Province. The Eastern Cape schooling structural arrangement is not recognized by the South Africa's Schools Act, and this lack of alignment has huge implications. The secondary schools of the rural Eastern Cape have only three years to intervene or correct what has gone wrong in lower grades. Teachers reported that the secondary schools are unable to intervene earlier (before Grade 10) because they do not have control of primary schools. Moreover, with such structural arrangement it would difficult for secondary schools to benefit from some of the national interventions since they are usually guided by SASA that recognizes that secondary schools are responsible for the last five years of schooling.

Furthermore this lack of alignment has some implications for the teacher professional development. The institutions of higher learning in the province are in the process of implementing the new teacher education and development framework, *The National Policy Framework For Teacher Education and Development In South Africa (NPFTED)*. Among the changes this framework proposes that some of the initial teacher development programmes should BEd or ADE specializing in Senior Phase and Further Education and Training (DHET, 2006). This, it is argued, is in recognition of the fact that Grade 8 and Grade 9 (Senior Phase) and Grade 10-12 (FET) are in the same school education institution. Therefore the teacher in secondary schools should be able to teach at Senior and FET phase. This is a challenge for institutions like Walter Sisulu University whose BEd programme have always been designed in response to the current school structure.

It must be noted though that Eastern Cape Department of Education is embarking on the process of 'rationalization of schools' (ECDoE, 2011) and it was confirmed by the MEC for Education, Honorable Mandla Makupula, that the alignment of schools with the rest of the country is one of the aims of this rationalization. He conceded though that the alignment of schooling structure depends heavily on the capacities and availability of extra resources for schools. In some cases the alignment will mean physical relocation of Grade 8 and Grade 9 classes and teachers to another school. In other cases it may mean different administrative and management arrangements where a secondary school may take up responsibility for Grade 8 and Grade 9 located in another school.

Lack of Support at District Level

Subject advisors in the form of Chief Education Specialist (Curriculum), Deputy Chief Education Specialist, and Senior Education Specialist are usually located at district levels. They are responsible for providing support to teachers in their specific subject. The post of Subject Advisor in a district is a specialist post that requires the incumbent to be a subject specialist in their field, demonstrating both depth of content knowledge as well as its pedagogy. The position of Subject Advisor exists to ensure that for every subject there is specialist capacity 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 and
- support teachers in organizing relevant/related co-curricular activities.

(DBE, 2011, pg. 41)

The teachers reported that they did not get the support from their subject advisors. Preliminary analysis of academic qualifications of Butterworth teachers indicated that some of these teachers were either under-qualified or not qualified. The changes in the curriculum and introduction of new topics added extra strain to these teachers. The respondents confirmed that indeed they had some curriculum areas they were struggling with and they needed support. The teachers reported that they not provided the support they require. What demoralizes the teachers more was that sometimes they are invited to mathematics development workshops and find that the facilitator is one of the teachers. Sometimes the facilitators had less credentials than them. One does get a sense issue of not supportive subject advisors is a general concern in a number districts. Perhaps the subject advisors are not properly briefed. It is reported that when they visit schools it is usually about files and paper work.

Poor School Management and Organization

The respondents reported that the School Management Teams and School Governing Bodies were generally supportive. There were many issues of school organization that mathematics teachers reported but most of these issues affected other teachers equally. Mathematics teachers reported that they were not happy about mathematics being allocated periods at midday or afternoon. They believe that mathematics period should always be in morning or late morning because it needed a fresher mind. We have not seen any scientific evidence that confirm this claim but in our teaching experience we have noticed that mathematics period are usually in the morning or late morning. Unfortunately this debate always raises questions from other teachers about mathematics and mathematics teachers being given a special treatment. We believe that mathematics concepts build on each other in a way that is different from History or English for example. There seemed to be at least some agreement that mathematics is one the critical subjects; even those teachers who are not mathematics teachers generally accept that. We are of the view that putting mathematics periods in the morning or midmorning protects it from disturbance in schools which usually occurs in the afternoon. This view is not based on any scientific evidence. There is a need for scientific evidence to confirm this position.

Lack of Support at Provincial Level

The mathematics teachers and schools reported that they were allocated few teachers to deliver a range of subjects at school. The teacher post provisioning, known as PPN, in the province uses the national agreed concept of number of *weighted learners*. The weighted learner is calculated using a tricky and complicated Peter Morkel formula which stated that:

$$\textit{Weighted Learners} = \left(2\times\left(\frac{40}{37}\times\frac{1}{0.84}\times\frac{4.5}{27.5}\right)+\left(\frac{40}{35}\times\frac{1}{0.84}\times\frac{4.5}{27.5}\right)+\left(\frac{40}{37}\times\frac{1}{0.84}\times\frac{2}{27.5}\right)\right)\times l_g$$

Weighted Learner in Group A Subject

Where:

40 is highest ideal maximum class size in relation to others
37 and 35 are ideal maximum classes size per subject or group
0.84 is proportion of period load
4.5 and 2 are time allocation per subject per week
27.5 is proportion of allocation from the redress pool
l_g is number of all learners per grade

According to this formula a small school with 76 learners qualifies for 2 to 3 teachers irrespective of the number of subjects offered. This is obviously absurd and that is what had created a stalemate between teacher unions and provincial department of education. It must

be noted though such formula has been used in other provinces with a degree of success. The national Department of Basic Education is embarking on a process to see how the current post-provisioning model can be reviewed.

Overcrowding was reported by fair number of teachers as problem in this study. Generally FET classes were overcrowded in the Eastern Cape Province, especially in the Transkei. In the former Transkei the formula that was used for provision of schools to villages was that: a primary school for every village and a secondary school for every 8 to 10 villages (Ngubentombi, 1988). It is rare to find a Grade 10 mathematics classroom in the Butterworth district that was not over crowded. Unfortunately most families could not afford to send their children to any other schools. Nearby schools found it difficult to chase away learners. They admit many learners and squeeze in as many learners as possible in few classrooms. This will naturally present challenges for teachers. Some of challenges identified by literature as associated with overcrowding are:

- Teachers are unable to control their classrooms. Regardless of how great the learners are, having too many of them can be impossible to handle. Bad behavior is like a domino effect; once one learner begins acting out, most of the classroom can turn chaotic in a matter of minutes.
- Well-behaved learners are overlooked and thus under-served. Their unruly peers are receiving all the attention. Good learners miss out on the education they deserve.
- Learners cannot concentrate with many distractions. Even good good can become distracted when classrooms are overcrowded. There's just too much going on to focus on a lesson. (SEREF, 2012)

Inadequate School and Classroom Resources

Most teachers (90%) reported that there were no computers and computer laboratories in their schools. One of the advantages of computers and other technologies is that they promote self-learning.

Rural schools in the Eastern Cape Province are poorly staffed in terms of qualifications of mathematics teachers. These schools hardly meet the basic requirements for a properly functioning school. It is common to find a school that is relying on a mathematics teacher who has never been trained for teaching of mathematics. The qualification of the Grade 10 mathematics teacher at one high school was National Diploma (Analytical Chemistry). The purpose of Nation Diploma (Analytical Chemistry) qualification is not to train graduate for teaching of mathematics or any other school subject. This mathematics teacher did Technikon Mathematics up to level 3, but this mathematics is more for engineers than for teachers and teaching. In terms of standard this mathematics is much lower than what South African Teacher Development policy prescribes a second year university level. Good and properly qualified mathematics teachers preferred not to teach in the rural outskirts.

All teachers reported that at most there was only one mathematics textbook per learner. Since in most schools there were no libraries this meant that these learners have only one source of information. The advantage of different sources is that they give learners alternative definition and explanation. In our own experience we have learnt that different textbooks have different strength. Some textbooks have good definitions, explanations and others present good and wide range of examples. Access to different books assists one to benefit in their respective strengths. Learners from rural areas are usually with a less qualified teacher and at most have one textbook. These learners will have limited mathematical experiences compared to their counter parts in well-resourced schools. In most cases the rural secondary schools had limited resources. That is what led to some Eastern Cape institutions like NMMU coming up with some form of interventions. In 2006 a decision was taken to explore the use of technology in the teaching of mathematics and the DVD technology was decided on as the most appropriate technology (GMMDU, 2006). As part of the ISP, in 2006 a series of twenty grade 12 mathematics DVDs covering the various mathematics topics in the then grade 12 mathematics syllabus was developed.

In her research Padayachee (2010) revealed that using the DVD approach within a blended learning environment did lead to an improvement in learners perceptions about mathematics, an improvement in the manner in which they learned mathematics, an extension in their mathematics knowledge and provided learners with a supportive environment in which to learn mathematics. Her findings suggested that the DVD approach impacted favourably on the mathematics learning and enhanced the mathematics learning and performance of these learners.

Discussion

The secondary school mathematics teachers believed that odds are stack against them. They were presented with learners of poor academic background. They did not get any necessary support from the district and provincial offices and they were further disadvantaged by poor management at school. They observed that instead of support there were strong tendencies to demand that they should account for poor performance. Taylor, Muller and Vinjevold (2003) distinguishes between the support measures and accountability measures and the importance of striking the balance. It is important to balance our systems such that support measures are as much as accountability measures. We believe that a system that is dominated by accountability measures is likely to be characterized top-down approach and lack of consultation. Unfortunately such system is likely to arouse hostility and experience resistance especially from the organized labour.

Whilst I agree with Biddle (2001) that schools can mitigate against the deleterious effect of family disadvantage but given the type and level of resourcing in the Eastern Cape I do not see rural schools in the province intervening with some programmes to assist impoverished children. Unless the province try and develop the current crop of teachers and improve the level of resourcing in the schools it is unlikely to mitigate against the effect of family disadvantage.

As stated in the introduction this presentation was a one-sided account as it reports on the analysis of responses of one interest group. What was of particular interest was that there was no respondent who mentioned anything about teacher unions. We are convinced that if we had used a different interest group factors such as the one of teacher unions could have come out. This is recommended as another avenue for research.

Conclusion

The challenges to mathematics teaching are multi-faceted and multi-dimensional. What was observed was that in each of the identified dimensions the secondary schools in the Eastern Cape were disadvantaged to the extreme such that a one-dimensional intervention is unlikely to yield any positive results. Based on these results one can conclude that may be what is needed in this province is a multi-dimensional intervention, that may mean an overhaul of the whole system.

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