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Factors Influencing Poor Performance in Grade 12 Mathematics: A Case Study of Bohlabela Cluster of Limpopo

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Abstract

It is generally believed that mathematics is for the gifted few. Consequently, many people feel the tension and anxiety related to the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situation. This study aims to investigate anxiety as the determinant of poor performance in grade 12 Mathematics. Data was drawn from Bohlabela cluster in Sekhukhune district of Limpopo province through qualitative research approaches. The findings reveal that, while fear is a major determinant of poor performance in mathematics, other factors such as lack of time, material, financial and human resources also play a significant role in the performance of learners. We concluded that as long as learners continue to study under deficient conditions their performance will continue to slide down.

Keywords

mathematics anxiety, poor performance, language competence, content knowledge, resources

1. Introduction

It appears that across the world many people struggle to achieve academically in Mathematics. For instance, in the United States of America and other European countries many learners experience poor performance in mathematics in grade 12. A study performed in the United States (US) by Ysseldyke (2003, p. 1) revealed that more than two third of students living in United States' low income urban areas have not demonstrated basic levels of mathematics achievements. Similarly, in South Africa many learners experience poor performance in mathematics in grade 12.

A closer scrutiny of learner academic performance in Mathematics show similar patterns as experienced elsewhere in the world. Generally, South African learners perform badly in matric examinations. According to Reddy (2006, p. 127) the poor performance is highest among Black

Africans. In an attempt to improve performance, "Dinaledi" initiative was introduced at selected schools which later raised mathematics eligibility from 6 to 12 percent between 1998 and 2003, Reddy (2006, p. 105). Jansen (2012) in sowetan (2012, p. 7) argued in his "*celebratory orgy of mediocrity*" that the 50% common standard of passing the subject across the world means the 18,5% of students who wrote mathematics, passed, translates into 8,38% of all students who sat for 2011 National Senior Certificate (NSC) examinations. He argued that the pass percentage of Matriculants should be measured against the pass percentage of mathematics.

According to Julie, Angelis and Davis (1993, p. 299), some mathematics teachers with junior secondary endorsements are sometimes called as professional leaders whilst some are being called at schools to become mathematics subject advisors. This practice signifies shortage of Mathematics teachers and the employment of unqualified teachers instead.

Bohlabela cluster in Sekhukhune district of Limpopo province is comprised of four circuits, being, Tubatse, Mabulane, Bogwasha and Drakensbegk with a total of 47 secondary schools. The cluster is most predominantly in underdeveloped rural areas some without electricity. The district itself has been neglected by previous regimes as seen by its offices located in another district.

The cluster has been performing poorly in mathematics grade 12 and has been declared to be "a killer subject" and as such learners begin to fear Mathematics. Newstead (2011) determined that maths anxiety is related to poor performance in Mathematics and directly connected with Maths avoidance. Maths avoidance result in less competency, exposure and maths practice, Ashcraft (2002). In addition to teachers' contribution towards anxiety, Newstead (2011) added that anxiety may be a function of the teaching methodology, especially in traditional classrooms. Reddy (2006, pp. 121-123) showed that an average of 27% pass rate of black learners in 2002 was obtained as opposed to 70% Coloured, 72% Indians and 87% Whites, respectively in the same year. It was also in the same year where the performance was at 17% in terms of analysis obtained from the circuit office.

2. Conceptualization

For many years national department of education has been committed to education and production of learners in Mathematics, Science and technology. It has been evident through creation of a department called "*Department of Science and Technology*". Those efforts were evident in the establishment of "*Dinaledi*" schools which are focusing on Mathematics and Science (Reddy, 2006).

Despite those efforts, Bohlabela cluster under Sekhukhune region of Limpopo has been under-performing for a long period of time. Kapp (1991, p. 45) indicates the problem of language in Mathematics as one of the contributing factor to the learning of Mathematics. He said that Mathematics language does not form part of a person's vocabulary.

These case study's research aim and objective was to investigate anxiety as the determinant of poor performance in grade 12 Mathematics. Various assumptions have been created by various stake-holders in the execution of their duties and responsibilities. The government's assumptions were that teachers

can implement changes in curriculum content of Mathematics without training them intensively. The statement was confirmed by Jansen (1998:99) when he argued against OBE and said that, "*OBE is destined to fail because it is based on the flawed assumptions about what happen inside schools, how classrooms are organised and what kinds of teachers exist within the systems*". This left teachers who were expected to be trained stranded and anxious to teach certain topics of Mathematics which they avoided because of poor knowledge. Literature captures this problem with the concept of Mathematics anxiety.

Mathematical anxiety is defined by Curtain-Phillips (1999, p. 1) as "*feeling of tension and anxiety that interferes with manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situation*". Common beliefs in the United States, is that mathematics is for the gifted few (Wikipedia). Studies by Legotlo, Maaga, Sebego, Van der Westhuisen, Mosoge, Niewoudt and Steyn (2002) are that learners are not motivated to study the subject because they observe high failure rate and are scared off.

Teachers' own anxiety emanating from having obtained minimum requirements of 51 percent, as it applies in other countries, might be transferred to learners, due to the content knowledge that teachers lack. Curtain-Phillips (1999, p. 1) confirmed the transference and said that students' home and class' negative experiences are often transferred and cause lack of understanding. The anxiety is exacerbated by Language Of Learning and Teaching (LOLT).

Kapp (1991, p. 45) said that language is a multidimensional system of symbols that intentionally originate in the psychological-spiritual dimensions of human existence and his dialogue with his world. English is the language of learning and teaching in all the schools of Bohlabela cluster whilst many children use Sepedi as their home language. Studies show that English is spoken as first language by less than ten percent of the population of 43 million people of South Africa and is said to be the language of business and government, Howie (2003, p. 1). Howie (2003) and southern and eastern Africa Consortium for Monitoring Education Quality (SACMEQ) explored the relationship between language competency and mathematics achievement as follows:

Table 1. Percentage of Pupils Reaching Competence Level

	Reading Mean Score	Level 1 %	Level 2 %	Level 3 %	Level 4 %	Level 5 %	Level 6 %	Level 7 %	Level 8 %
Eastern Cape	447.8	14.1	24.5	25.8	16.7	9.7	3.9	3.7	1.7
Free State	491.1	6.9	15.4	24.7	18.5	11.2	10.2	9.0	4.0
Gauteng	573.1	4.0	7.6	10.5	10.2	12.6	16.2	23.8	15.1
KwaZulu Natal	485.6	9.0	19.4	26.1	14.7	8.9	7.9	7.5	6.7

Mpumalanga	473.6	9.4	19.0	24.1	19.0	12.0	8.8	5.0	2.7
Northern Cape	505.6	7.7	13.7	19.4	16.0	14.6	12.1	11.1	5.4
Limpopo	425.3	22.5	26.5	25.4	13.1	6.8	3.3	1.7	0.7
North West	506.3	6.9	15.0	19.4	17.4	12.3	11.4	10.8	6.7
Western Cape	483.4	1.2	3.9	8.1	13.7	16.0	20.7	22.3	14.1
Total	494.9	9.9	17.3	21.1	14.7	10.6	9.6	10.2	6.6

According to the Table, about 74, 5 % of learners in Limpopo are in competence level of 1-3. The Table also shows that Limpopo has the lowest reading mean score of 425, 3 with no learner reaching level 8. It is also realised that Gauteng, Northern Cape and Western Cape have highest reading mean score—a trend continuing in mathematics competence level.

Table 2. Percentage of Pupils Reaching Mathematics Competency Level

	Mean	**Level1 %**	**Level 2 %**	**Level 3 %**	**Level 4 %**	**Level 5 %**	**Level 6 %**	**Level 7 %**	**Level 8 %**
Eastern Cape	468.5	7.9	42.4	30.3	11.7	3.5	1.8	2.3	0.0
Free State	491.6	3.8	34.3	34.7	14.4	7.2	4.3	1.1	0.1
Gauteng	545.0	3.1	17.4	24.6	21.4	16.1	13.5	3.1	0.7
KwaZulu Natal	485.2	5.7	38.3	29.6	14.5	5.1	5.1	1.3	0.4
Mpumalanga	476.1	5.4	38.4	34.9	13.9	4.2	2.3	0.5	0.3
Northern Cape	498.7	4.6	32.5	31.7	16.5	6.2	5.7	2.0	0.7
Limpopo	446.7	9.6	51.0	28.2	8.6	1.7	0.9	0.0	0.0
North West	503.1	3.6	34.5	30.2	15.3	6.0	6.7	2.3	1.3
Western Cape	565.7	0.9	14.1	23.4	26.2	14.1	13.3	4.6	3.2
Total	494.8	5.5	34.7	29.0	15.4	7.1	5.9	1.9	0.6

Source: SACMEQ III (2007, p. 19).

As reflected in the Table, majority of pupils n Limpopo are in levels 1 to 3, making about 88, 8% and none reaching levels 6 to 8. A conclusion can be drawn from the two tables above which show a

consistent trend between language competency and mathematics achievement. In a scientific language one can say that language competency is directly proportional to mathematics achievement as the two tables are juxtaposed.

According to TIMSS (1995), pupils in grades 7, 8 and 12 showed a lack of understanding of both mathematics questions and ability to communicate their answers. Further research and conclusions in as far as the relationship between language and mathematics achievement are drawn from Howie (2003, p. 6) who showed the results of mathematics test which revealed that South African pupils achieved 275 points out of 800 with an international average of 487. In terms of the test, Western Cape obtained 381 whilst Limpopo obtained 226. Howie (2003) ascribe language difficulty experienced by second language learners to them staying in monolingual society where they hear only the first language, which is the case in Bohlabela cluster.

Mji and Makgato (2006, *26*(2), p. 253) reflected an average grade 12 pass rate in 2003 which was at 70 percent of Limpopo, though 55 percent failed mathematics. A learner was quoted, saying "*... all this things are abstract, like speed, velocity and acceleration. How can you see a difference... speed is speed, it is moving fast*". According to Mji and Makgato (2006) the pupil associates speed with "*moving fast*". The confusion in language can be associated with code switching.

Literature also attributes poor performance in Mathematics to Teachers' content knowledge. Mogari's (2004) reveal that teachers blame the new system which fails to train them properly on the newly introduced topics of mathematics which they have to teach learners at an exit point (grade 12). In this case teachers avoid teaching crucial topics that they are not familiar with, then adding towards poor performance of learners annually. According to Mogari (2004, p. 102), lack of interest that teachers display can end up being transferred to learners. A teacher interviewed in this study was constantly indicating that he was still relying on the information he got from the teacher training college where he obtained his Secondary Teachers Diploma (STD) majoring in Mathematics and Biology. The assumptions which are also expectations of teachers with regard to their training in new topics created Maths anxiety as identified by Curtain-Phillips (1999, p. 1) in this study.

Upon investigation, department of education curriculum 2005 review (2005, p. vi), it was discovered that the implementation of curriculum 2005 was confounded by inadequate orientation, development and training of teachers and hence a shift to a new curriculum called National Curriculum Statement (NCS). According to Darling-Hammond (1990, p. 41) many analyst attribute policy failing to teacher and/or administrators' resistance, the phenomenon that Elmore has called "*the power of the bottom over the top*".

Another set of literature argue that poor performance in Mathematics is caused by lack of resources which are required in learning and teaching. They start from material resources in the form of textbooks and computers, to human, financial, infrastructure and time. Sadovnik (2007) argued that if human resource was important, teacher development would be a central element of reform activities. They were creating impression that the government was not doing enough in terms of providing in-service

training for teachers. As a result of Maths anxiety experienced by teachers, it is then transferred to their learners.

Human resource, particularly teachers, has been dealt with earlier in this study. Kachelhoffer (1995, p. 51) reflected that there is generally a high shortage of mathematics and science teachers in South Africa. The shortage started long during the apartheid era when Verwoed, the then president of South Africa, said, "*what is the purpose of teaching Bantu children mathematics when it cannot use it in practice*"?. Liebenberg and Spies (1993, p. 326).

The government as an employer is responsible for hiring of teachers according to the existing models which determine teacher pupil ration and as per its financial muscles. This models impact on teachers' workload and learner achievement. Chisholm (2003, pp. 30-31) pointed out that teachers are expected to teach subject which are not their specialities, as caused by increased workload, freezing of posts, budget cut and frustration with teaching as a career.

Generally the problem of lack of financial support to schools is well documented in South Africa. Studies on this aspect show that schools lack a variety of teaching and learning support material despite the huge budget spend on education Maile, 2019 and Mashaba, 2019. In terms of the report of the organisation, governance and funding of schools review committee of DoE (1995, p. 19), "*the vast majority of schools in the rural areas, whether community, state or farm school, are extremely poorly resourced in terms of buildings, equipments, books and other learning resources*".

Masalski and Elliot (2005, p. 263) highlighted the importance of the usage of laptops in a mathematics class. In his study he showed how laptops can enhance mathematics classrooms there by offering suggestions on how to integrate them in mathematics curriculum. Ollerton (2001, p. 21) added that resources are manifestation of classroom culture as well as part of its creation. He added that resources provide with freedom to choose approaches to mathematics tasks.

In term of resources needed in the classroom, Sadovnik (2007, p. 143) argued that, because teachers have the closest contact with the students, they know best what resources are needed to meet student's needs. The government gazette 2 of August 2010 agreed with Sadovnik (2007) and said that computers in the schools are the most important mediums through which learners and teachers access information. Other that textbooks as argued by Quality of Learning and Teaching Campaign (QLTC) in the same gazette, it argued that access to good textbooks amongst learners improves learning outcomes and provides an impetus for exploration of additional information in classroom.

Another aspect as a resource is "time". Sadovnik (2007, p. 143) argued that, generally, research indicates that, more time for teaching result in more learning for students. However, the instability of the political situation in South Africa is characterised by school attendance stoppages. This contradicts national development priorities. In terms of National Education Policy act 27 of 1996, the department of education is providing teachers with time, including the instructional time as per different learning subjects. Furthermore, section 4 of the Employment of Educators Act 0f 1998 provide for a minimum of seven working hours per day and 27 hours and thirty minutes minimum contact time in the Further

Education and Training (FET) band. A study done by Chisholm, Hoadley, Kivulu, Brookes, Prinsloo, Kgobe, Mosia, Narsee, and Rule (2005, pp. 21-22) revealed that teachers in the urban areas spend more time on teaching whilst teachers in the rural areas spend more time in their professional development.

3. Research Design and Methodology

Qualitative research approach was followed in the study because it can investigate the origin, methods and limits of human knowledge (Wiersma, 1995; Opie, 2004). We chose qualitative study to establish the in-depth causes underlying poor performance in Mathematica. The case study design provided a detailed description and in-depth perceptions and meaning held by participants in their unique situation (Cohen, Manion, & Morrison, 2007). In this way data was gathered directly from individuals in their natural environment in order to study their interactions, attitudes and their characteristics (Leedy, 1993). We used purposive sampling as defined by Melville (1996). Creswell (2005). We selected a group of participants from the target population (Bohlabela District) to gain understanding on factors underlying poor performance in Mathematics. The sampled group was as follows:

Table 3. Total Number of Sampled Groups

Grade12 Maths teachers	Grade 12 Maths learners	Maths HODs	Secondary schools' Principal	Maths Curriculum advisor
4	2	2	2	1

We used observation, and a face-to face interview to go deeper into the motivation of the respondents and their reason for responding as they did. In the case of an interview, Thomas (1995) stated that researchers may ask for clarification and can look for any signs of confusion on the part of those people responding to the survey. Before an interview was conducted. We obtained a permission to conduct the interview and to seek co-operation from the school to conduct the interview.

As observers we tried to be as unobtrusive as possible so that they do not interfere with the normal activities (Thomas, 1995). During the observation and interviews part of our attention was also on contextualization of Reponses and what we see in order to understand participant behaviour and the situation in which they teach or learn.

After the interview we transcribed the participants' responses. Upon completion of the transcript there was more reading for a deeper understanding, followed by identification of themes from the transcript. Data was subdivided into codes and generated a larger consolidated picture. There after we divided data into manageable themes, patterns, trends and relationships (Mouton, 2001).

4. Findings

4.1 Language of Teaching and Learning (Lolt) [English Second Language]

Learners experienced English as a language barrier which impacted negatively on their understanding of concepts which require interpretation. This was confirmed by teachers interviewed about possible challenges faced by learners. One of them said, "*The major one is the medium through which we are teaching these kids. They are struggling in that English language. They don't understand it*". He further gave an example and said, "*just imagine asking a learner about an account, sinking funds*". He said, "*most of them do not know what an account is*".

In terms of topics which learners themselves experience difficulties, they mentioned linear programming and financial Mathematics. The two topics are word-problems which require interpretation and then usage of correct formulae thereafter. One has to acquaint self with the language of instruction which happen to be English in this case. As a result, poor language proficiency impact negatively on learner achievement causing panic and anxiety.

4.2 Teacher's Curriculum Knowledge and Delivery

Teachers were still relying on the content knowledge they had gained from their college and universities, and were therefore experiencing challenges with newly introduced topics in the new curriculum. Topics which teachers found difficult to put across to the learners were: linear programming, Financial Mathematics, and trigonometry. A teacher was quoted responding to the question of topics which challenge him, saying, "*In my case linear programming is the one giving me a problem*". He further said, "*I find it being myself understanding but being unable to transform or to impart it to learners*".

The same sentiments were raised by the curriculum advisor, who also identified the same topics as challenging to most teachers. Training in the topics was urgently needed, because these topics carry more marks in the final examination. An interview held with the curriculum advisor quoted him saying, "*I discovered that most of our teachers, especially those that are teaching in the higher classes do not have the proper knowledge of the content. Most of them have done SPTD at the college, they have done PTC and also on the issue of content, if you look at the issue of curriculum these days it needs somebody with a thorough background of content. Our teachers lack content and they rarely read*".

Depending on individual teachers, topics that teachers find difficulties in teaching can end up causing fear to the learners and hence contributing greatly to learners' anxiety and ultimately contributing greatly to poor performance of learners.

4.3 Human Resource

The schools in Bohlabela cluster of Limpopo are experiencing high shortage of mathematics teachers. Some schools are still having teachers with Senior Primary Teachers Diploma (SPTD) qualification who teach Mathematics in Grade 12 as a result of this shortage. This was confirmed by the curriculum advisor who is frequently in contact with them and said, "*Most of them have done SPTD at the college, they have done PTC and also ...*". in his argument for teacher development as an important form of

reform, Sadovnik (2007) was supported by Cohen, Manion and Morrison (2007) who argued that recent research on teaching indicate that teachers' knowledge makes a difference to the quality of instruction and in particular to their ability to respond to students.

Teachers who are teaching in the junior phase are unqualified and failed to lay the necessary foundation which ultimately becomes a burden to the teachers in grade 12. As far as challenges of learners are concerned, a teacher replied, "*you find that in most of the higher classes, basic knowledge is not well laid down in the foundation phases or in the previous grades*". She further substantiated that, "*you find them struggling with the basics in most cases*".

The same sentiments were echoed by the curriculum advisor when asked the same question. He replied, "*I think the problems that learners do have is that they do not have proper background from primary schools and that parents do not play proper roles and I have also noticed that study groups are not there in our communities to enhance the performance of this subject in our cluster*". Generally, at the end when learners reach Grade 12, they begin to fear to answer most of the sections. Teachers are recruited through "Fundza Lushaka" bursary scheme which falls outside the competency of schools but the Department of Education.

4.4 Financial Resources

The main source of financial support for Bohlabela schools is money from the government allocated according to "quintiles", with majority of schools falling under quintile 1. Quintile 1 schools are traditionally called "No fee schools". The following Table reflects financial allocation according to quintiles from 2007 to 2011:

Table 4. Annual Financial Per-Learner Allocation

Annual per-learner allocation					
	2007	2008	2009	2010	2011
Quintile 1	R738	R775	R807	R855	R916
Quintile 2	R677	R711	R740	R784	R840
Quintile 3	R554	R581	R605	R641	R687
Quintile 4	R369	R388	R404	R428	R459
Quintile 5	R123	R129	R134	R147	R158

Hall and Sonja (2008, p. 37).

The financial allocations are to a greater extent insufficient to the needs and programmes of schools and the next level is to fund-raise, which is normally unreliable. This was evident from the response of a principal who was asked about external support from either parents, business or NGO and he replied, "*We have one that is Kagiso Trust that is supporting us. They promised to build us laboratory and taking teachers for some workshops*". When asked how far they are with it, he said, "*For this year they*

have suspended it even though they supplied us with calculators".

4.5 Material Resources

In terms of resources, generally, the schools have the basic necessary resources for the teachers of Mathematics, and learners' resources needed for their performance. In all the schools, teachers showed that they had sufficient textbooks for learner performance. DVDs were some of other resources that could have a positive impact reduction of anxiety experienced by learners. A teacher interviewed on the matter confirmed the above statements when asked about availability of resources and replied, "*Yes, partially because I can see few apparatus that we can use. Maths graph grids are not there but only the chalkboards. So usually we are theorizing things than applying them in practical that the learners can see*". The implication of these findings is that the availability of resources would boost learners' confidence in answering questions in examination and thus improving performance.

Teachers were further asked about resources they perceived unavailable but very important and one replied, "*Basically DVDs because what I know is that even at their homes they can just come and take them and use them at their homes*".

According to the curriculum advisor, new resources should be budgeted for by the schools to purchase new resources that are compliant to the current curriculum. In his opinion he said, "*I think the scene in the classroom need to be changed somehow, it's very difficult really if you always see a teacher with a duster and chalk writing on the chalkboard. I turn to believe that if other resources like data projector, TVs, Laptop screens and libraries, I think these resources if brought into the classroom there could be a noticeable change*". The curriculum advisor further mentioned data projectors, laptops and screens as some of the important resources to be utilised in the place of chalk and duster.

4.6 Time as a Resource

Teachers' availability proved several times to be beneficial to learners in terms of performance especially in Mathematics because Mathematics needs more time to practice. Learners become more confident and work harder as teachers extent their contact time. This was evident from the response of a learner who was asked about his confidence towards passing Mathematics and said, "*Yes, I will pass, I will definitely pass because we came up with a strategy that we are going to attend Maths in the morning and after school*".

5. Discussion

Curriculum knowledge and delivery as the central element behind learning and teaching may not be over-emphasised. Failure to deal with it by getting more qualified Mathematics teachers employed may result in continuous poor performance of learners in Mathematics as an element of inheritance of teachers by learners. The study has revealed that anxiety can be passed from teachers to learners as proven by both teachers and learners as they identified similar topics as problematic to them. The concepts, resources, time as resource, language of learning and teaching, teacher qualification and curriculum delivery are interrelated and contribute directly to learners' anxiety.

The study brought new knowledge about teachers who stay in towns and cities but travelling daily to rural areas where they work. The teachers do not spend much time doing extra-lessons because most are using common transport. These teachers also do not spend much time with learners which might impact negatively on the performance of the learners.

The impact of short periods workshops conducted by department aimed at capacitating teachers on newly introduced topics brings a new knowledge considering what they (teachers) are saying, e.g., "*that they still rely on information they obtained from college*". This can be measured against the impact of training offered over a longer period of time. It has been revealed in the study that some teachers avoid teaching certain topics in grade 12 mathematics that they were not familiar with, exposing department's lack of monitoring practice to ensure syllabus coverage. Of course it has been noted that the content which teachers have to teach is the one which is a challenge and in that event the Department could streamline its programmes appropriately.

As recommended by all role players, purchasing of affordable resources which comply with the demands of the new curriculum could be beneficial to learners and teachers alike. These are aids that seek to suggest the removal of "chalkboard-duster" approach which put teachers at the centre while learners learn passively. Teachers should be prepared as well to be life-long learners in this ever-changing curriculum.

6. Conclusion

The study attempted to concentrate on special cases applicable to Bohlabela cluster with regard to anxiety as the determinant of poor performance in grade 12 Mathematics. Apart from language of learning and teaching, resources available to support teaching and learning, time as a resource and financial resources as some of the contributing factors, poor curriculum knowledge and delivery by teachers was identified as the key. That has also been supported by the teachers themselves when they identified some topics in mathematics in grade 12 which they cannot teach to the understanding of the learners also on the basis of them (topics) being new. The findings in the study are mostly applicable to Bohlabela cluster of Limpopo.

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