Research in Business and Social Science

IJRBS ISSN: 2147-4478

Contents available at www.ssbfn.net.com/ojs

Doi:

Complexities and Constraints Influencing Learner Performance in Physical Science

Mavhungu Abel Mafukata

Vhutali Management and Leadership Institute, Makhado, Republic of South Africa

Corresponding Author, Telephone: +27729098608

Abstract

This paper explores complexities and constraints affecting performance and output of physical science learners in Vhembe District, Limpopo Province, South Africa. The study was motivated by the desire of the researcher to establish, profile and characterise the complexities and constraints reminiscence of poor performance of learners in physical science as measured through end-of-year Grade 12 (final year of high school education) examination results. Twenty six schools (n=26) were purposively selected from three circuits of education (n=3). From these schools, two learners were randomly selected (n=52) for interviews. In addition, two circuit managers (n=2) were conveniently selected as part of Key Informant Interviews (KII). For the Focus Group Discussions (FGDs), twelve (n=12) parents were randomly selected to form two groups of six members each. Multi-factor complexities and constraints impeding performance of learners were discovered. Intensive teacher in-service programme is recommended. Community engagement should be encouraged to educate parents on the value of involvement in the education of their children. Free access learner support structures such as Homework and Extra-lessons Assistance Centre (H&EACs) should be established.

Key Words: *Circuit Managers; Physical SCIENCE; Teacher In-Service Training; Laboratory*

JEL classification: G2

Introduction

Physical science is amongst school subjects in South Africa with poor performance and output amongst high school learners. Mavhungu (2004) provides general subject performance and output in physical science using end-of-year Grade 12 examination results in South African high schools. From what Mavhungu (2004) found, it is evident that physical science is one of the poorly performing subjects in the majority of South African schools. Mavhungu (2004) further postulates that in general, failure rate in physical science in most South African schools varies from region to region. For instance, there was high failure rate amongst learners from poorly and under-resourced schools in the rural and peri-urban or township areas. As a response to poor results, there is an emerging trend where schools discontinue the subject from their curricula. Discontinuation of the subject leaves some highly qualified physical science teachers idle or redundant – teaching other subjects just to retain those teachers in government employment.

The issue of poor learner performance in South African schools has been receiving growing attention of educational and related sciences with researchers wanting to unearth solutions to the challenge – especially in the past two decades. Since the emergence of such empirical research, it has become evident that literature seeking for strategies and mechanisms in the improvement of output and performance of teacher-learners in the subject of physical science in South Africa in particular are skewed towards teacher-based factors such as poor and lack of proper teacher training and lack of subject content knowledge as the major complexities and constraints against good performance and output of the subject physical science in most South African schools. The assumptions of such literature are that improvement of science education in South Africa would in totality emanate from improved teacher pedagogical and professional training and development. The majority of such literature argue that inadequate teacher professional training and poor subject content knowledge development (Ramnarain & Fortus, 2013) culminates in low and poorly qualified physical science teachers in the country – with the same negatively impacting on the learners' performance and output in physical science (Kriek & Grayson, 2009). The shortcoming of this assumption however is that impeding factors to learner performance and output in the subject have been erroneously narrowed to single-dimension factors. On the one hand however, established critics, commentators and analysts of the South African education policy persistently contend that teacher development and training should surpass mere pedagogical and content knowledge if real improvement in science education were to be achieved. The majority of these commentators and critics argue instead that above teacher development and training in pedagogical and subject content knowledge – especially for the new teachers under training there should amongst others be “knowledge of learners (psychology), knowledge about knowledge (epistemology), knowledge of communities from which the learners come (anthropology, Sociology of learning) and knowledge of classroom organisation and discipline (managerial knowledge)” (Jansen in Mbeki (2011) imparted into the teacher as part of the broader development and training of teacher development curriculum.

Based on these assumptions, lack of availability of new teacher training and development programmes and lack of teacher in-service training in particular for already practising teachers (Brynard & Netshikhophani, 2011) are therefore opined to be aggravating the poor state of science education in South Africa. However, there are those who attach this challenge with South Africa's apartheid past (Kriek & Grayson, 2009; Rakumako & Langsch, 2010; Manyoo et al., 2014) arguing that racial inequalities of the apartheid education system that characterised South African education system prior to liberation from apartheid in April 1994 was the main cause of this current scenario. Other complexities include learner-based challenges such as poor reading ability and skills – especially those learners whose primary language of communication was anything-else other than English (Lambani & Van Niekerk, 2014; Mudzielwana, 2013). Linguistic limitations as a result of low levels of reading and writing literacy levels in South African schools have been identified as a major concern of learner performance and output as early as primary educational level as reported in government's National Systematic Evaluations on Literacy and Numeracy levels of 2001 and 2004 reports (Lafon, 2009; Singh, 2011).

The Post-Apartheid Framework to Develop and Improve Science Education in South Africa

The desire of the post-apartheid South African authorities to improve the state of science education culminated in the so-called National Strategy for Mathematics, Science and Technology Education of 2001 (Kriek & Grayson 2009). From the National Strategy for Mathematics, Science and Technology Education of 2001 emerged programmes such as DINALEDI Focus Schools Project which amongst others sought to increase the number of learners in sciences – especially from Grade 10-12 while simultaneously increasing learner pass rate in those grades. In addition, targets were also set in this regard to improve teacher pedagogical and content knowledge capacity in the sciences in general (Mji & Makgato, 2006; Muzah, 2011). A multi-factor approach in improving science education was adopted and employed.

However, the post-apartheid government had to first acknowledge that there were indeed various constraints and complexities affecting government strategic approach in the prioritisation of science education in South Africa. Various studies were therefore needed to opine empirical solutions to the constraints and complexities facing government vision of science education improvement in South Africa. The National Teacher Education Audit of 1996 and the so-called Mathematics and Science Audit of 1997 respectively emerged from such efforts (Mji & Makgato, 2006). In the process, with regard research work, a plethora of single-dimensional theories emanated wanting to provide amicable solution(s) to the improvement of science education in South Africa. However, despite a few considerable strides made to finding the solution(s), it is clear that much still has to be explored towards finding a better approach. The premise of this paper is based on the fact that a study conducted by Mji & Makgato (2006) had found and concluded that despite previous efforts by stakeholders to improve science education in South Africa, there seems to be minimal in-roads and breakthrough made and achieved so far considering the recurring and persistent status quo negative factors in science education in the country. For instance, some low pass rates are still persistent even in reasonably well-resourced areas in the Gauteng Province for example. Learners in this province are reasonably expected to produce good passes in physical science considering the province's better teaching-learning resources such as laboratories, technological advancement and qualified teachers as compared to the largely rural and poorer provinces such as Eastern Cape, Limpopo, Mpumalanga, KwaZulu-Natal, North West and Northern Cape for example. However, to the contrary, a plethora of literature instead concede that there even in such better equipped provinces such as Gauteng, there has been a down-ward movement of both quality of passes and the number of enrolled learners in the subject. Compounding the concern further is the fact that it has been widely reported that South African physical science learners were amongst the poorest performers in the subject on international science education rating scales and benchmarks year after year. South Africa science learners performed way too far lower than other African countries such as Morocco and Tunisia for example (Mji & Makgato 2006). In this context, Mji & Makgato (2006) in fact cited this scenario a “gloomy picture of the state of teaching-learning of mathematics and science in South Africa” in South Africa while Muzah (2011) presented this as a “deepening crisis related to under-achievement in science at secondary school level” in South Africa.

The state in science education in South Africa should be worrisome considering the needs of the post-apartheid state. To show that the South African science education system is deficient is the fact that the country is unable to produce medical practitioners, engineers and other scientists across sectors. In education for example, post-apartheid South Africa has to be aiming at reducing its reliance on foreign national science and technology teachers as is currently happening by developing its own science teachers (Mji & Makgato, 2006). It has been widely believed in development disciplines that a country which needs to improve itself with regard technological and economic development as South Africa would need to, needs to first improve its science education systems. However, it seems South Africa has failed to satisfy this target. South Africa could learn from post-independence Nigeria. Nigeria put into place a solid programme for science system development way back in 1969. Nigeria developed its approach on science education development through a comprehensive learner-based approach. Student enrolments post-school educations were structured at university, polytechnics and colleges of education (60%) for science-orientated education while 40% was reserved for the Arts (Oludipe, 2014). South Africa does not have a

clear policy mandate in this regard. The South African science education system is highly stressed instead. For example, it has been already indicated in this paper that the science education system heavily relies on import teachers – especially those from other African countries such as Zimbabwe to compensate on the massive shortage of (quality) science teachers. There are according to Meier (2011) already approximately 7 961 foreign teachers registered with the South African Council for Educators (SACE) – the majority of them having been recruited for physical science and mathematics teaching. Recruitment of foreign teachers is aggravated by the fact that there was a teacher short-fall of approximately 18 000 personnel in South Africa at least by 2010. The short-fall was resultant of amongst others high drop-out rates of student teachers in universities and factors such as teacher university graduates who completed teacher training but would thereafter opt out of the system to seek for employment in other sectors of the economy and of late, early teacher resignations from the profession – especially in the second half of 2014 and 2015 school calendar after some muted policy changes with regard public service pension fund (Mafukata, 2015; Mokoena, 2012).

A brief Narration of the Subject Physical Science in South Africa

This section looks into two crucial issues; performance and output (mainly pass rate) in physical science and how the same impacts on learner enrolment trends in the subject mostly in high schools in South Africa.

Subject Performance and Output

While pass percentages in the subject physical science Grade 12 in Limpopo Province, South Africa has shown some improvements from 48.9% to 66.9% between 2009 and 2012 respectively, the improvement should be viewed against the background of decreasing number of learners enrolling in this subject for the same period. Mudau (2014) reported that pass rates in physical science in South Africa in general were improving – especially in 2013 end of year examinations where the pass rate rose to 67.4% in 2012 from 61.3% in 2009. However, despite the fact that government is buoyant of the pass rate in end-of-year Grade 12 examinations (Manyoee et al., 2014) the quality of the passes remains a subject of debate with critics arguing that there has been lowering of assessment standards for learners by Umalusi in order to accelerate pass rate (Mudau, 2013). For example, only 25.6% of the learners who passed physical science in 2013 obtained subject pass score of 50% and above with the rest of the passes having attained low grade passes (Mudau, 2014). In fact, it has been widely reported that South African science learners – especially mathematics and physical science showed some serious deficiencies and short-comings in the subjects because compared to their counterparts; 38 countries in 2001 and 50 countries in 2003 in the so-called Trends in Mathematics and Science Study (TIMSS), South African learners were rated last for the two years respectively (Kriek & Grayson, 2009). Even-though the numbers of learners passing the subject of physical sciences increased during domestic assessments, the same could not be said of such grades' quality comparatively with other international countries.

Learner Enrolment in Physical Science

With regard decreasing learner enrolments in physical science, Kibirige & Hadi (2013) reported that enrolments in the subject dropped by approximately 18% per annum between 2009 and 2012. Mudau (2014) further corroborated the dwindling learner enrolments in the subject where 48 000 fewer learners sat for the end of year examination in 2013 than in 2009. However, there seems to be high drop-out rates of learners from the subject as early as grade 10 and 11 (Mudau, 2014). It is however well known that South Africa has very high learner drop-out rates in schools in general (Mafukata 2012). In other words, the high drop-out rate of learners in physical science could also be linked to the learner drop-out trends in the country in general. With regard physical science, Mudau (2014) explained high learner drop-out rates on multiple factors. First is the myth that physical science is a difficult subject for learners (Kibirige & Hadi, 2013) A plethora of literature (Basson & Kriek, 2012; Kibirige & Hadi, 2013; Mudau, 2014; Muzah, 2011; Onwu & Stoffels, 2005; Rammala, 2009) reported on the factors negatively impacting on the performance of learners and output of teachers in the subject physical science in South Africa. Most critically, poor performance and output in the teaching and learning of physical science defeats the focus and objectives

of the South African post-apartheid government. It has been government's objective to reform and improve education as a whole – and (physical) science and technology education in South Africa post-apartheid in particular.

The Context of this Paper

It is based on some of the factors elaborated on here that this paper argues that piecemeal and one-dimensional solutions based on assumptive deductions to the challenges facing the teaching and learning of physical science in particular would not provide any meaningful way-forward for teachers, learners and policy makers in as far as how physical science is taught and learnt in schools in South Africa. Lidzhegu (2012) also raised similar sentiments. A comprehensive and integrative approach is imperatively needed to improve on the teaching and learning of physical science targeting improved performance and output in the subject if the country wants to attain meaningful progress of an effective science education system helpful to its post-apartheid mandate. As a departure from existing literature on science education this paper therefore adopts a Whole System Analytical Framework (WSAF) to meets its objectives. This study is based on the premise that performance and output in physical science as measured by end-of-year examination performance and results of learners informs for interventionist strategies and mechanisms to improve the subject. The study was undertaken in the Vhembe District of Limpopo Province.

The choice of Vhembe District is informed by the fact that in South Africa, complexities and constraints in the teaching and learning of physical science are mostly focusing on urban and peri-urban school environments because of, amongst others, lack of interest on rural education at empirical research level. Lack of empirical research interest based on rural environments affects the improvement and development of the subject in such areas – and above all a situation where “one size fits all” approach (Mudau, 2014) is adopted by authorities. Often, rural education systems receive biased policy frameworks and interventionist mechanisms not based on their characterisation since very few scholars study rural education in South Africa (Mukeredzi 2013). Vhembe District being one of the most deeply rural regions provides that opportunity to redress this research limitation. In addition, however, this paper intends to provide a universal approach in the teaching and learning of physical science as complexities facing this subject are not only unique to South Africa. This factor is addressed by reviewing regional literature on the subject because it could not be possible to measure the factors there as a result of the several limitations affecting the study. Reviewed literature (Muzah, 2011; Ozden, 2007) confirm that the complexities expressed by teachers and learners in physical science are also common elsewhere the world over – maybe excluding intensity rates of the complexities which might reasonably differ from region to region. The context of this paper is that some urgent interventions; some sort of national prioritisation in the form of teacher development and in-service training programme development are needed to address teacher shortages; teacher subject knowledge advancement and pedagogical skills transfer in science education. This paper looks at unearthing factor complexities and constraints affecting learner performance in end-of-year examination in physical science first before suggesting what needs to be done to address the circumstance. Firstly, this paper presents the introduction and background to the study followed by literature review, research design and methodology, results and finally conclusions drawn from the study with the recommendations thereafter.

Research and Methodology

This section describes the research design and methodology employed in undertaking the study. Firstly, the section describes the statement of the problem, main objective of the study, data collection instruments and methods, data analysis and instruments and finally presents the results and the recommendations.

The Study Area

This study was motivated by persistent poor performance of learners in physical science in South African high schools when measured against end-of-year examinations for Grade 12 learners. The case study was undertaken in Vhembe District, Limpopo Province, South Africa. This study was conducted in three circuits of education. All of the participant schools (n=26) in this study are classified under what is known as

Quantile One. Quantile One schools are poor schools, and such schools are therefore “no fee paying schools”

Statement of the Problem and Main Objective of This Study

The premise of this paper is based on the fact that there were some complexities and constraints impeding development and improvement of science education in South Africa in general notwithstanding the minimal in-roads and breakthrough made in the improvement of science education in general – and physical science in particular. This assertion considers the recurring and persistent status quo negative factors in science education reflected, demonstrated and displayed in schools across the county. This paper explores these complexities and constraints with a view of providing relevant solutions.

Theoretical Framework

This paper employs the Whole System Analytical Framework. Whole System Analytical Framework is an extension of the Input-Process-Outcome Framework of Howe (2003) – widely adopted and cited by Muzah (2011). The adoption of the Whole System Analytical Framework (WSAF) posits that improvement and development of physical science teaching and learning should first recognise that there were multiple, intertwined and complex factors contributing to poor performance and output in the teaching-learning of the subject. These intertwined factors might include socio-economic factors such as household poverty, availability of resources, teaching-learning cultures, availability of infrastructure and teacher-based factors such as qualifications and competence amongst others (Kriek & Grayson, 2009; Rammala 2009). The paper furthermore posits that the significant number of these factors would transcend inside school factors mentioned in the Input-Process-Outcome Framework of Howe (2003) and Muzah (2011). This paper adopts an integrative approach which seeks to present a holistic model of theoretical framework and analysis of the problem under investigation. The integrative approach creates a paradigm shift which argues that instead of strengthening a single component analysis and approach in problem solving – just like in the case of Kriek & Grayson (2009) whose emphasis was mainly on teacher development, science education development should instead seek to strengthen the entire physical science teaching and learning systems and processes rather than the teacher, learner and other domains – as single entities. This assertion is corroborated by Rammala (2009) who opined that “factors are collaborative in lowering the standards” in science subjects. In other words, this paper goes a step further away from Kriek & Grayson (2009) postulation thus “schools are only as good as their teachers”

Sample Size and Sampling Techniques

Lists of schools offering the subject physical science in Grade 12 were obtained from the three circuits. From the lists supplied, twenty six (n=26) schools were randomly selected. From each of the twenty six participant schools, the Grade 12 physical science teacher (n=26) was requested to participate in the study on behalf of the school. Lists of the Grade 12 physical science learners were obtained from subject teachers of participant schools. Two learners from each school were randomly selected for the surveys (n=52). Twelve parents (n=12) of the learners in each participating school were also randomly selected from the lists provided by school principals. In addition, five principals (n=5) and two circuit managers (n=2) were also randomly selected.

Data Collection and Analysis

Two data sets were collected. First, some data were collected through document analysis. This paper used past examination summary of results data (2013 end-of-year examination) constructed by the circuit managers after the examination results were released. Most importantly, data of the learners and teachers were obtained through semi-structured set of questionnaires collected through face-to-face interviews. This study also employed Key Informant Interviews (KII) on the principals and the circuit managers. One on one interviews were held with these participants to collect data. Two Focus Group Discussion (FGDs) meetings comprising parents of learners of the participant schools were held to collect additional data. Data from the KII and FGDs interviews were recorded as field notes for analysis. Data were analysed in two sets. Firstly, data from the semi-structured interviews of the learner-teacher respondents were entered into separate

Excel spreadsheets for analysis. Simple frequencies and percentages in respect of the measured variable of interest were obtained. Secondly, data from the Key Informant Interviews (KII) and the Focus Group Discussions (FGDs) were analysed by similarity of ideas (Mji & Makgato, 2006). The data were mapped to the theoretical framework of the study.

Results and Discussion

The results of this paper are structured and presented in four categories. The first category regards subject performance and output trends from a poorly performing school. The second category reports on the results of the socio-demographic characterisation of physical science teachers while the third category reports on the socio-demographic characterisation of physical science learners. Finally, the results report on the trends in the output of physical science.

Subject Performance and Output Trends from a Poorly Performing School

Table 1: Subject performance and output trends from a poorly performing school

Examination Year	Enrolment	Pass	Pass %	Fail	%
2013	Subject Discontinued				
2012	6	0	0	6	100
2011	8	1	12.5	7	87.5
2010	15	1	6.6	14	93.4
2009	13	1	7.1	13	92.9
2008	28	5	17.5	23	82.1

Socio-Demographic Characterisation of Physical Science Teachers (N=26)

Table 2: Socio-demographic characteristics of physical science teachers

Measured Variable	Frequency	Percentage
Gender Distribution		
Male	22	84.6
Female	4	15.4
Age Distribution		42-53 years; 48 years (mean)
Experience		17-23 years; 23.7 years (mean)
Qualification		
Degree	1	3.8
Diploma	25	96.2
Further Training		
Yes	13	57.7
No	11	42.3
Specialisation		
Yes	9	34.6
No	17	65.4

Socio-Demographic Characterisation of Physical Science Learners (N=52)

Table 3: Socio-demographic characterisation of physical science learners

Measured Variable	Frequency	Percentage
Gender Distribution		
Male	19	36.5
Female	33	63.5
Age Distribution		
16-18	41	78.8
19 and over	11	21.2
Number of Years in class		
One (1)	42	80.8
Two (2) and more	10	19.2
Attitude towards physical science		
Positive	16	30.8
Negative	36	69.2
Class Attendance		
Good	33	63.5
Bad	19	36.5
If not in class		
Home	3	15.8
Beer halls	7	36.8
Other places	9	47.4
Homework		
Does homework regularly	21	40.4
Does not do homework regularly	31	59.6
Involvement of parents		
Yes	14	26.9
No	38	73.1

Discussion

Trends in the Performance of Physical Science Learners in a Poorly Performing School

The results illustrated in table 1 revealed that performance and output trends of learners in physical science have been illustrative of a dire situation of a highly stressed school where in 2008, 82.1% of the learners wrote end-of-year examination in physical science but failed. In 2009, the failure rate increased to 92.9% with a further rise to 93.4% in 2010. However, the results revealed an upward movement of the results with the failure rate reduced to 87.%% in 2011 from 93.4% the previous year. However, this result might not necessarily be a numerically real improvement since the number of learners who passed the subject was still the same as the previous year – only one learner had passed the subject. The so-called improvement is effected by the little number of learners (n=8) who had enrolled in the subject and also wrote the end-of-

year examinations. In 2012, the results revealed that the school achieved a 100% failure rate which leads to the discontinuation of the subject in 2013. Another critical trend displayed by the results of this paper is that from 28 learners having had enrolled and wrote examinations in 2008, the number continued to decrease up to, and including the year 2012. Instead of the smaller number of the learners providing advantage to the teacher for possible individual attention for learners which might have improved the pass rates, the opposite instead took place. Clearly, managerial efforts – if there were any to that effect to manage and control this challenge dismally failed. It suggests therefore that the complexities and constraints impacting on learner performance and output in physical science at this case model school might be further away from mere teacher-learner based factors.

Socio-Demographic Characterisation Of Stakeholders

Teacher socio-demographic characterisation

As illustrated in table 2, the results of this paper revealed that the larger majority of physical science teachers in the study area were males (84.6%) followed by females (15.4%). On average, the youngest teacher was aged 42 years while the oldest was aged 53 years with an average age of 48 years in the district. The results revealed that the teachers had long teaching experience averaging 23.7 years having been teaching for between 17 and 28 years respectively. The majority of the teachers had attained Diploma in Education (96.2%) while a further 3.8% held university degrees. In addition, 57.7% of the teachers had further qualifications in addition to college diplomas and university degrees while 42.3% of the teachers had no further qualifications or specialisations. Furthermore, 34.6% of the teachers had undergone special training in physical science while the larger majority (65.4%) had no such specialised training.

Learner socio-demographic characterisation

The results of this paper as illustrated in table 3, revealed that the larger majority of learners in physical science Grade 12 in the study area were females (63.5%) or males (36.5%) whose age distribution were from 16-18 years old (78.8%) and those who were over-age at 19 years old and above (21.3%). The majority of the learners confessed that they held negative views on physical science (69.2%) characterised by skipping of lessons (36.5%) while a few (30.8%) had displayed positive views on the subject characterised by good attendance of physical science lessons.

Discontinuation of the Subject Physical Science In Some Schools In The Study Area

During Key Informant Interviews (KII) with school principals, circuit managers and respondent teachers it was established that there were schools in the study area which had discontinued the subject of physical science. This paper tried to establish the circumstances leading to the discontinuations in such schools. As a result, this study analysed documents at the circuit offices and found that indeed there were schools which had discontinued the subject. The implication of the discontinuation of the subject at some of the schools in the study area is that students who still have passion in the subject from the communities served by these schools wanting to enrol for physical sciences therefore have to go to neighbouring schools in other villages – at very high cost for both learner and parent. The parent has to foot the bill for transportation of the child to another school whilst there is a school nearby. Meanwhile on the one hand, this school is keeping a highly qualified teacher in physical science who is deployed to other subjects whereas the subject that provided the teacher's employment is no longer in existence. This teacher could as well be effectively used at a school with physical science in its curricula than at this one. By the end of 2012 academic year, approximately 12% of schools in the study area had discontinued the subject to concentrate on the perceived less-difficult social sciences – leaving only 88% Grade 12 physical science offering schools. On probing further from the circuit managers and principals of the affected schools, this paper opined that reasons for such discontinuations varied from school to school, and the factors revealed:

Persistent learner high failure rate in physical science

High failure rate in the subject and persistent poor performance and output of learners were some of the compelling reasons for the discontinuation of physical science in some schools of the study area. Looking

at the trends as displayed by the results (table 1), it is obvious that during that period of five years, there was no effective intervention strategy meant to arrest the situation or at least to improve it. But on the one hand, the high learner failure rate in the subject was blamed mainly on the teacher. For example, interviews with the principal of this school revealed that the problem was with the teacher's incompetence in subject content. However, the assertion of the principal with regard teacher (in)competence remained largely speculative, and could not be reliable because not a single day has the principal ever paid classroom visit to observe the proceedings of lessons in order to determine the nature of professional assistance the teacher might need – as it should be under normal school management approach. This study instead found that the assumed incompetence of the teacher in the subject was contrary to the professional qualifications held by the teacher because the teacher had a Diploma in Education with specialisation in physical science teaching. In addition, there was another teacher at the school with better qualifications capable of teaching the subject as discussed earlier. Indeed, the teacher's lack of competence in teaching physical science is one of the critical factors which might negatively impact on learner motivation in the subject (Mji & Makgato, 2006) resulting in abstinence from the subject.

Poor disciplinary standards amongst learners

However, furthermore, learners were also mentioned as being highly ill-disciplined. The school principal alleged that his role and responsibilities on learner behaviour in particular were largely curtailed by his limited intervention mechanisms since there were too many restrictions of behaviour preventive and corrective measures principals could adopt and employ on learners according to the provisions of the South African Schools Act. Students were aware that although teachers and principals operated *in-loco parentis*, such prerogatives were not absolute, and students would from time to time exploit this policy gap. Nakpodia (2009) extensively reported on the principle of *in-loco parentis* in schools in Nigeria – and how the same could apply in education systems elsewhere. Over-all, ill-discipline spills over to generally lower standards of performance and output – and in physical science the circumstances are further aggravated by high disciplinary standards expected of science learners. The subject requires self-discipline, hard work, focus – and with the kind of learners here, it might have to be other subjects in the perceived easier social sciences – and hence the discontinuations.

Desire to increase the over-all school results through other subjects such as social sciences

High failure rate in physical science and other subjects such as mathematics and life science, schools discontinue those subjects for social sciences in order to improve the overall school passes as the social sciences were generally well passed. School principals and teachers have various punitive measures or threats directed at them in case of over-all school results at end-of-year examinations – especially in Grade 12. So, in order to increase the pass percentage to avoid the consequences, the so-called difficult subjects such as physical science are discontinued.

Anxiety of the learners in the subject physical science

During interviews with the learners, it became evident that learners developed anxiety in physical science as a result of the subject's numerous negatives – poor pass rates, stigma of it being difficult and poor teachers amongst others which resulted in the majority of the learners avoiding the subject. This behaviour has been found common in other sciences such as mathematics where learners were not doing well (Karimi & Venkatesan, 2009). For example, the results of this paper (table 1) revealed very poor learner enrolments of learners ranging between six and 28 learners per annum from 2008 to 2012. From 2008, subject performance and output in physical science at this particular school revealed a downward spiral in performance and output of the subject as the astronomical failure rate started from 82.1% in 2008 to 100% in 2012. However, the trends at this school were in sharp contrast with those of the district in general over the same period. Contrary to the the results of this school, the Vhembe District has during the same period instead increased its pass rate in physical science (Brynard & Netshikhophani, 2011; Mudau, 2014). Probing further for reasons of the downward spiralling of results at this school through face-to-face interactions with the teacher and the school principal, it emerged that there were multiple factors to the high failure rate in this school in physical science. From the side of the teacher, there were pedagogical limitations and poor subject content knowledge to cope with modern subject curricula expectations despite

the fact that the teacher was professionally qualified to teach the subject at this level. What makes the discontinuation of the subject in this school more fascinating is the fact that the school has been provided with another better qualified physical science teacher who was imported from Zimbabwe who holds an Honours Degree in physical science and mathematics education. This could explain that the issues of poor subject performance and output in physical science might be extended beyond mere subject-related complexities and constraints. For example, the teacher cited that the complexities and constraints had to do with the general issues of the dysfunctionality of the school. The impact of the dysfunctionality of the school on teacher performance and output is beyond the teacher's professional prerogatives and competence to address. School management structures had virtually collapsed, and there was a leisurely fare for all; learners and teachers.

Lack of teacher support – especially in-service programmes

The teacher decried lack of support by school management regarding a variety of constraints and complexities affecting teaching and learning in the subject. The only crucial and positive intervention the teacher received was through curriculum advisers sent to the school, however rarely so by the circuit manager in charge, and such intervention was in-fact focused on whole school improvement; not necessarily physical science focused as this school was also performing poorly over-all. There were only four curriculum advisers in physical science the district who must service all the schools. One of the four is the division manager – meaning that for him to get involved as it would be required might be difficult because of other administrative responsibilities. This corroborates the principal's version that the school management sought for assistance from curriculum advisers with little success.

One Deputy Principal remarked that for his entire eight year period at his school had never seen a visiting curriculum adviser; invited or just visiting. In addition, the curriculum advisers were also limited in the knowledge of subject content, and could not assist the teacher and the school. It is evident that the teaching-learning environment at this school was seriously compromised, and school management was not sufficiently and effectively assisting in creating good environment for teaching and learning to take place. This view is corroborated by Singh & Singh (2014) who opined in this regard that creation of conducive environment for teaching and learning has been “one of the most difficult tasks to master” The assertion by Singh & Singh (2014) has been confirmed true and corroborated by the trends at this school. Most critically, this paper established that there was virtually no programme running at the district for teacher in-service training. Teachers depend on cluster groups which meet intermittently at times organised by the curriculum division in the district. This is compounded by lack of efficient, effective and functional teacher in-service training programmes to refresh the teachers – especially with regard new areas of subject matter in the subject.

Previously, in this region, there used to be some teacher development and in-service training centres such as Ramaano Mbulaheni In-Service training centre for teachers providing full-time teacher in-service training and development programmes. Those centres were in the current system rationalised and discontinued – without provision of equivalent service to teachers. Instead, teachers are left all by themselves or at most with the so-called curriculum advisers. What is challenging however with regard curriculum advisers is that the majority of them were not necessarily experts of the subject but those former college lecturers at the discontinued teacher training colleges who could not be absorbed into the new education system during their rationalisation – and such personnel were retained as subject advisers. In fact there is no difference between these subject advisers and ordinary classroom-based teachers in terms of subject knowledge as stated by teachers during interviews. It emerged during the process of this study that post-apartheid government in South Africa intended to run a new innovation in general education even if it means in science education ever since the dawn of the new democratic era. What the post-apartheid education planners failed to acknowledge is the submission by Mathevula & Uwizeyimana (2014) who hinted thus “any innovation requires new set of skills, attitudes and pedagogical approaches – continuous training to build capacity”. This should have received implacable prioritisation by the education planners in South Africa – especially with regard science education because one obvious factor was that the apartheid era education planners had provided the education system in South Africa with an “over-supply of non-science teachers in schools” (Onwu, 1999) – especially black schools (Mji & Makgato, 2006).

Identified Complexities and Constraints Affecting Performance of Physical Science Learners

The identified complexities and constraints affecting performance and output of learners in physical science are hereunder discussed:

Lack of proper subject background from junior grades

The majority of physical science learners lack proper junior phase background in the subject, and therefore struggle to cope with the demands of the subject in the higher grades. Poor preparation of learners at lower grades brings learners of lower confidence and bad attitude to physical science in the higher grades - leading to increased failure rates amongst learners.

Shortage of suitably qualified teachers in physical science

There is shortage of suitably qualified teachers to offer the subject of physical science. This result is consistent with similar studies (Meier, 2011; Mokoena, 2012). Shortage of teachers is also compounded by large number of teachers who are resigning from the department of education – allegedly as a result of limited career development opportunities in the field of education (Lumadi 2014), and other service-related factors such as low remunerations. In addition, lack of new teachers joining the profession because of the rationalisation of teacher training colleges, old-age teachers who are no longer relevant to modern curriculum in physical science but are listed as active physical science teachers. For example, the results of this study revealed that the teacher average age in physical science was 48 years with the youngest teacher being 42 years old while the oldest was 53 years old. With the majority of these teachers having had been teaching for over 20 years, they proved exhausted and uninspired. The majority submitted that they could even retire given the hard work with too much workload expected from them. In addition, none of these teachers are modern-era teachers but old order teachers trained by the apartheid education system who struggle with most modern approaches and subject content. In some cases, too large teacher-pupil ratio because physical science teachers also teach other subjects in under-staffed schools further compound the challenges in the teaching and learning of physical science in the study area. The results of this paper revealed an average 35 periods per teacher per week from an expected week of 55 periods. Loosely translated, this teacher has 20 other periods out of class but required to be doing heavily loaded administrative work which has become increasingly demanding because of too much paper work. However, on the short-term, the Limpopo Department of Education hires teachers from Zimbabwe to address teacher shortages. Within the hiring of Zimbabwean teachers, there has been incidences of non-existent or forged qualifications by some of these “teachers”. For now it is not in the interest of this paper to determine if the strategy is effective or not.

Teacher retirement and resignations

A significant number of available teachers are old and have been teaching for twenty years – and above. In addition, as a result of the older teachers' apartheid-era training, these teachers therefore are found to be lacking in proper teaching skills and content knowledge of the subject because of the changes in the content of the subject for the modern dispensation. Old age suggests that the majority might be exiting the system. Worrisomely, the retiring teachers are not being replaced because of the rationalisation of teacher training colleges. There are few teachers available to fill the vacancies. This paper also established that there were approximately 366 teachers who have lodged resignations with the Department – and such teachers were due out of the system from 1 January 2015. There are various factors causing these mass retirements and resignations of teachers – especially in Vhembe District (Mafukata, 2015). The majority of teachers who left the system earlier are mostly demotivated as a result of poor labour conditions of service in the profession (Chireshe & Shumba, 2011). The current scandal announced by the Minister of Basic Education affecting teacher promotional positions where Teacher Trade Unions are implicated in selling and buying of vacant promotional positions such as principalship for example would have further demotivation of teachers who were hoping to get such positions. By any standard, the number of teachers discontinuing their service from the system is far too many leaving the system – especially for a system which would struggle to find replacements.

The effect of language on subject performance and output

The majority of learners and teachers in the Vhembe District – especially in the three circuits use English as a second or third language because the larger majority of these learners speak local Tshivenda as their home language – and therefore first language. It was discovered that the majority of learners struggle to read in English, and therefore their command for the English language is low therefore making it difficult for them to adequately express themselves. Cases of second and third language users finding it hard to master academic content are common (Lambani & Van Niekerk, 2014; Mji & Makgato, 2006). According to Mudzielwana (2013), learners who have difficulty reading or understanding instruction language might find it difficult to understand subject content. This learner short-coming compels teachers to employ vernacular in teaching instead of the proper language of instruction; English. Poor language could also be the cause of low scores during examination as some of these children fail to understand questions and to also express themselves as expected. This result is corroborated by Mudau (2014).

Negative learner-based factors on over-all subject performance and output

The majority of schools also have large numbers of repeat learners who fail in other schools and seek admission in other schools. Usually, the majority of these learners were poor in physical science, and in addition, have had poor lower grades background in the subject. It becomes difficult for the receiving schools to reject those learners because such schools suffer from lower enrolments – consequences being that some of the teachers might have to move to other schools during new staff establishments and re-deployment of personnel. Deployment of teachers as a result of low learner enrolments in schools has been a critical factor of teacher low morale and de-motivation (Chireshe & Shumba, 2011). To minimise redeployment from low enrolment schools, teachers admit these kind of learners into their schools to increase learner enrolments, and some of these learners are in addition persuaded to do physical science. Such learners lack passion and self-motivation in the subject for they do it out of circumstances, not personal motivation.

The results of this paper revealed that a considerable number of the learners were repeat learners (19.2%), and in addition having negative attitude towards the subject (69.2%) which might culminate into various other anti-learning behaviour such as missing and dodging of subject lessons. This assertion is corroborated by the results of this paper which revealed that a considerable number of the learners do not attend all the classes in a particular week (36.6%) and such learners also do not do their homework regularly (59.4%). This behaviour might be emanating from the fact that a high majority of parents (73.1%) were not involved in the monitoring of their children's school work. Firstly, the majority of parents are illiterate. Secondly, the majority of parents are not available as a result of migrant employment away from the children. This compromises the assertion submitted by Taylor (2009). According to Taylor (2009), adequate learner performance and output has to be achieved through work extending beyond school hours which could be by supplementing learner school hours through “official pedagogic time at home, and the home must provide a pedagogic context and control of the pupil to remain in that context” The majority of learners in this study therefore miss that home-based pedagogical environment as a result of the increased cases of parental non-involvement in the education of the child. The issues of performance and output of the learner in this regard transcend teacher-based factors.

Social factors beyond teacher competence

Eight (30.8%) of the twenty six participant schools were also in proximity of bar lounges which sold liquor to students during school hours. The effect of these bar lounges on student attendance of lessons was also mentioned by some teachers who reasoned that students dodged classes to drink or hang-around at these bar lounges. Therefore, some learners also returned to class intoxicated with alcohol. Learner discipline becomes difficult under these circumstances. This assertion is corroborated by the results of the study (table 3) which revealed that some learners who missed classes in a particular week would visit beer halls next to the schools they attended (36.8%) while others would idle and loiter at home (15.8%) and other unmentioned places (47.4%). Intoxicated learners become difficult to manage while on the one hand, they tend to bully the disciplined learners – and the teachers on the one hand. Bullying other learners and teachers would therefore disrupt effective teaching and learning. There has to be good teacher-learner

relationship for good subject results – and with this kind of teaching-learning environment, the teacher is left vulnerable; unable to provide what Bush (2007) posits as “educational leadership influence” on the learners he teaches. This assertion is also corroborated by Watson (2001) who opined “learning is regarded as a shared social activity, embedded in classroom interactions” As matters are in some of these schools, the poor social relations between teachers and learners “reduced the learner’s active engagement with learning and their teachers’ vital role in helping them to build on” (Watson, 2001) their learning. However, this challenge could be opining that there were bigger problems within the broader society in the study area and in the communities where these schools are based in particular. As has been alluded to earlier, the majority of parents were unable to supervise and monitor their children because they are in migrant employment and as a result spent most of their times away from monitoring their children. Some are also single parents who lack parental authority on the children because of these children are boys who intimidate the parents – especially mothers. In fact some children physically threaten their parents if the parent spoke against unbecoming behaviour. In fact, the results of this paper are consistence with those of Barnett & Gareis (2007) who revealed in a study undertaken in the United States of America that in cases where society in general experiences increased negative parenting behaviour – for example, where parents fail to spend adequate time with their children as a result of work absence, this has been found to have had adverse impact on the socio-emotional outcomes of the children. Based on their findings, Barnett & Gareis (2007) further revealed that these outcomes might reflect in the child through emotional distress, involvement in violence and indulgence in the use of cigarettes; alcohol and marijuana amongst others. The findings by Barnett & Gareis (2007) are in corroboration with the findings of this paper.

On further probing the majority of the learners on the issue of absconding classes, an even deeper and complicated challenge consistent with the Barnett & Gareis (2007) findings was discovered. This paper discovered that a large number of learners who absconded from class would run away from school to join those community members hired by the local community who would be working in the nearby graveyards digging graves for burials of deceased members in the community. Mostly, such funerals take place during weekends and the preparations continue throughout the week. These children find places for truancy. The people working in the graveyards would be supplied with food and alcohol and some children join them to access these. Those hired to work seem to encourage these children because they assist them in doing the job. Even-though local schools provided food to learners during lunch from their government feeding scheme programme some of these learners still absconded and found their way to the cemeteries. Some learners would also find temporary day-to-day work with funeral parlours where they provide service in grave digging, transporting of bodies during the funerals, transfer of bodies from local hospitals to funeral homes and funeral homes to the homes of the deceased where the bodies have to be delivered prior to burials in terms of cultural practices of the locals, building of tombstones and also driving the hearse on the day of the burial. There are also some teachers who do part-time work for funeral homes to earn extra cash. Some of these teachers work with these learners on daily basis. There are teachers who have worked for funeral homes for over ten years. The Department of Education would not allow teachers to do this moonlighting, but poor service conditions – especially with regard low salaries these teachers try to get something extra to earn extra cash.

Affected learners revealed that they did this because they were poor and they had to provide for themselves and siblings – and parents – especially where parents are unemployed and had no income. Some local funeral homes owners who are alleged to hire these children revealed that it becomes difficult for them to refuse these children work because some of them are far older than school going years it becomes hard for them to recognise that they were school children. In some cases, the children are desperate because they are poor and would, anyway not afford going to school without this crucial income earned from the funeral homes. Some parents are aware of what their children are engaged with, but they have little to do because they too benefit from these activities. Looking at the household income of the surveyed parents, this paper discovered that the majority of the parents lacked formal employment and consistent household income source to support their families. It is difficult for teachers to cope with the pressure of teaching extremely poor children (Chireshe & Shumba, 2011).

Lack of teacher in-service training programmes and weak curriculum adviser structure

Except a few workshops held from time to time however irregularly, and conducted mainly by curriculum advisers, teachers do not have any in-service programmes organised for them. During the workshops that are designed to serve the purpose of in-service programmes for teachers, it is instead teachers themselves who conduct discussion groups amongst themselves mainly because the so-called curriculum advisers facilitating these workshops lack subject content knowledge to a point of being no better than the teachers they are meant to be assisting. In other words, there is poor support linked with poor teacher-support programmes. Key Informant Interviews revealed that the so-called curriculum advisers were instead ineffective, inefficient and therefore poor with regard expected service to teachers. Some of these curriculum advisers were mere former school principals from dysfunctional schools which were discontinued or were chased away from their schools by communities. In order to protect their employment in the department, authorities – circuit managers in particular absorbed them as curriculum advisers to join another band of colleagues from the rationalised former teacher training colleges. “These people act as mere facilitators of workshops because they too know nothing in the subjects they were supposed to be assisting teachers in..they are only there to receive teachers' records such as mark sheets...I really do not understand how they assist the system” Remarked one principal.

Conclusion

This paper investigated complexities and constraints impeding performance and output of Grade 12 learners in physical science in Vhembe District, Limpopo province, South Africa. Intertwined factors involved in the poor state of affairs were discovered as elaborated in the main report. In addition, this paper discovered that a new trend was developing amongst poorly performing schools. The subject is instead being discontinued. The discontinuations continue unabated. The discontinuation undermines government prioritisation of national science education for the country's growth and development strategy. Authorities should intervene by disproving all discontinuations of physical science in schools. There should be increased support to assist the schools in finding solutions to their challenges. Provincial or Regional authorities should also design an instrument meant to track learners as early as primary education who reflect good grades in their end-of-year examinations in physical science with a view of encouraging them to pursue the subject throughout basic education, and that instrument should be implemented by all schools which report the same to the province/district over a defined period. Each school has to submit the names of the learners who for example obtain at least 60% and above score and feed the information to the receiving high school in the case of primaries for tracking purposes. Such learners could be grouped together to receive further attention by the best teachers in physical science at circuit level either as weekend or school vacation supplementary teaching programmes. Such learners could also be encouraged to form study groups amongst themselves. All bar lounges located within proximity of schools should be barred from opening for business during the duration of the school hours because apart from selling liquor to school children, they also play noisy music which disturbs nearby schools. Engaging local leadership structures such as traditional chiefs, civic organisations, parents and even local police for monitoring such businesses could minimise the challenge. School-to-school educational campaigns to discourage school children to visit bar lounges should be encouraged amongst youth groups and churches to take this message to local schools. The authorities should revive colleges of education to train more teachers instead of relying on ineffective university teacher training programmes. Alternatively the Kangai & Bukaliya (2011) recommendation of increasing teacher supply through increased and accelerated long distance training programmes might be profitable consideration. In-service training of teachers should receive improved consideration to improve quality of the teacher-in-service programme. Curriculum advisers could also be deployed to assist in a door-to-door approach in schools to assist teachers find solutions to their subject content knowledge challenges for example.

Reference

- Barnett, R.C. & Gareis, R.C. (2007). Shift work, parenting behavior, and children's socio-emotional well-being: A within-family study. *Journal of Family Issues* 28(6): 727-748.
- Basson, I & Kriek J (2012). Are Grades 10-12 physical science teachers equipped to teach physics? *Perspectives in Education* 30(3):110-121.

- Brynard, PA & Netshikhophani AF (2011). Education training challenges in implementing the national Curriculum Statement Policy. *African Journal of Public Affairs* 4(3): 60-72.
- Bush, T (2007). Educational leadership and management: theory, policy, and practice. *South African Journal of Education* 27(3): 391-406.
- Chireshe, R. & Shumba, A. (2011). Teaching as a Profession in Zimbabwe: Are Teachers Facing a Motivation Crisis? *Journal of Social Sciences* 28(2): 113-118.
- Kangai K. & Bukaliya, R. (2011). Teacher Development Through Open And Distance Learning: The Case For Zimbabwe. *International Journal on New Trends in Education and Their Implications* 2 (4): 124-141.
- Karimi, A & Venkatesan S (2009). Anxiety, Mathematics performance and Academic Hardiness in High School Students. *Int J Edu Sci* 1(1): 33-37.
- Kibirige, I & Hodi T (2013). Learners' performance in Physical Sciences using laboratory investigations. *Int. J. Edu Sci.* 5(4): 425-432.
- Kriek, J & Grayson D (2009). A Holistic Professional Development model for South African physical science teachers . *South African Journal of Education* 29:185-203
- Lafon, M (2009). The impact of language on educational access in South Africa. Research Monograph No. 24, CREATE. The Education Policy Unit at the University of the Witwatersrand.
- Lidzhegu, ME (2012). A whole-school approach to managing bullying behaviour among learners in secondary schools in the Vhembe District in the Limpopo Province. Masters Dissertation, University of Johannesburg. Johannesburg.
- Mafukata, MA & Mudau, A.V. (2015). Exploring teacher mass resignation and retirements in public schools. Disarat: Human Social Sciences: 1-30.
- Mafukata, MA (2012). Commercialisation of communal cattle farming systems in the Musekwa Valley. Unpublished Ph.D Thesis, University of the Free State, Bloemfontein.
- Manyooe L, Tjatji M & Mosese E (2014). South Africa's increased matriculation passes: What skunks behind the Rose? *Journal of Education and Training Studies* 2(1): 180-192.
- Mashau, TS & Mutshaeni HN (2013). Implementation of Legislations and Policies: Case Study of Vhembe and Mopani Districts' School Principals in Limpopo Province. *Journal of Education and Human Development* 2(1): 30-41
- Mathevula, MD & Uwizeyimana DE (2014). The Challenges Facing the Integration of ICT in Teaching and Learning Activities in South African Rural Secondary Schools. *Mediterranean Journal of Social Sciences* 1 5(20): 1087-1097.
- Mavhungu AP (2004). Factors influencing the performance in agricultural science in some high schools in the Limpopo Province . Unpublished Minst Agrar. University of Pretoria, Pretoria.
- Mbeki, M (2011). Advocates for change: how to overcome Africa's challenges. PICADOR AFRICA. Northlands, Johannesburg.
- Meier, C (2011). The foundations for learning campaign: helping hand or hurdle? *South African Journal of Education* 31: 549-560.
- Mji, A & Makgato MA (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.
- Mouton, N., Louw, G.P. & Strydom, G.L. (2012). A Historical Analysis Of The Post-Apartheid Dispensation Education In South Africa (1994-2011). *International Business & Economic Research* 11(11): 1211- 1221.

- Mudau, AV (2014). Micro Underpinning for In-Service Philosophy: A Case of the Vhembe District Physical Science Teachers . *Mediterranean Journal of Social Sciences* (5):10: 404-408.
- Mukeredzi, TG (2013). Professional development through teacher roles: Conceptions of professionally unqualified teachers in rural South Africa and Zimbabwe. *Journal of Research in Rural Education* 28(11): 1-17.
- Nakpodia, ED (2009). Perceptions of principals' responsibilities in-LoCo-Parentis in Nigerian Secondary Schools. *Int J Edu Sci* 1(2): 99-107.
- Oludipe, DI (2014). Gender and Science anxiety as predictors of Nigerian Junior Secondary Students' Academic Achievement in Basic Science. *Scholars Journal of Arts, Humanities and Social Sciences* 2(2A): 197-203.
- Onwu, G & Stoffels N (2005). Instructional functions in large, under-resourced science classes: *Perspectives in Education* 23(3): 79-91.
- Patrick, AO (2009). Evaluation of science teaching in secondary schools in Delta State 2 – Teaching of the sciences. *Int J Edu Sci* 1(2): 119-129.
- Singh, AK & Singh M (2014). Multimedia and Classroom Management. *Scholars Journal of Arts, Humanities and Social Sciences* 2(2A): 141-143.
- Singh, P (2011). Foundation Phase educators' knowledge and attitudes towards implementation of the national reading strategy. Unpublished D.Tech thesis, Durban University of Technology, Durban.
- Taylor, N (2009). The state of South African schools part 1: Time and the regulation of consciousness. *Journal of Education* 46(10): 1-24.
- Watson, J (2001). Social constructivism in the classroom . *Support for Learning* 16(3): 140- 147.