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Factors that Contribute to Poor Learner Performance in Physical Sciences in KwaZulu-Natal Province with Special Reference to Schools in the Pinetown District*

P.J.H. Heeralal[1] and T. Dhurumraj[2]

Department of Psychology of Education, University of South Africa, South Africa
E-mail: [1]<heerapj@unisa.ac.za>, [2]<thasmai@hotmail.com>

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ABSTRACT The National Senior Certificate Examination results for Physical Sciences have recently declined, particularly in the province of KwaZulu-Natal. This paper identified the causes of poor learner performance in Physical Sciences in grade 12 in the Further Education and Training (FET) phase in public schools in the Pinetown District, KwaZulu-Natal. The study employed a mixed method approach. Two public schools in the Pinetown District participated in this study. Upon analysis of the results, several contributory factors for poor performance were identified; no single factor was accountable for the poor performance in Physical Sciences. Recommendations for improvement in the areas identified were provided and topics for future research on the curriculum of grade 8 and 9 Natural Science were suggested.

INTRODUCTION

For the last number of years, South Africa has seen a gradual decrease in the National Senior Certificate results for the subject Physical Sciences. South Africa's poor performance in Physical Sciences can be seen both nationally and internationally. In 2001 and 2003 the Trends in Mathematics and Science Study (TIMSS) was conducted globally and South Africa was part of this study (Howie 2003). In 2001, 38 countries participated in the study with a view to determining learner performance in the sciences; in 2003, 58 countries participated and in both instances South African learners were placed last (Makgato and Mji 2006: 253). From 2005 to 2007, the number of learners who passed Physical Sciences at the higher grade level had steadily decreased and this affected their entry into science based programs at universities (Kriek and Grayson 2009: 185). According to Kriek and Grayson (2009: 185-186) in 2005 a total of 29,965 learners passed Physical Sciences, in 2006 this figure dropped to 29,781 and in 2007 it dropped to an alarming 27,122 learners who passed Physical Sciences. Clearly South African learners are not performing in the science field

In the 2009 Senior Certificate results, the national pass rate for Physical Sciences dropped from fifty-five percent to thirty-seven percent. In 2009 all nine provinces across South Africa recorded a decline in Physical Sciences. The most alarming decline was in KwaZulu-Natal where the pass rate in Physical Sciences halved compared to the previous year (Keeton 2010). The poor performance of learners in Physical Sciences is a serious cause for concern considering the fact that KwaZulu-Natal traditionally provides a high number of successful maths and science students.

A number of possible factors contribute to the poor performance of learners in Physical Sciences. Based on the researchers' own experience over the last four years, learning Physical Sciences is more challenging for African learners who speak English as a second language and attend English medium schools. Due to the legacy created by segregation and differentiated schooling systems, the majority of parents of grades 10, 11, and 12 learners lack English proficiency. This makes it difficult for them to assist their children in the Physical Sciences related tasks.

Physical Sciences is a subject with an extensive quantitative component. Cognitive prerequisites for Physical Sciences involve scientific as well as analytical thinking. Hence, learners

Address for correspondence:
P.J.H. Heeralal
Associate Professor
Department of Psychology of Education,
College of Education,
University of South Africa, South Africa
*E-mail:*heerapj@unisa.ac.za

require mathematical and problem solving skills. However, many learners at grade 12 level take Physical Sciences and mathematics literacy as a combination with the view to tertiary education. Mathematics literacy is not as complex as pure mathematics and merely provides learners with a general background in mathematics, which differs from pure mathematics. As a developing country, South Africa has the potential for great achievement in the science and technological sectors and evidence of this is South African Largest Telescope (SALT) situated in Sutherland (Kelder 2007: 35-110). The South African Largest Telescope is the greatest single optical telescope project in the southern hemisphere and among the largest in the world. These achievements contribute to the economic sector and are a step closer to becoming a developed country.

Physical Sciences as a subject is important as it focuses on investigating physical and chemical phenomenon through scientific enquiry, as can be seen in SALT project above. Through the application of scientific models, theories, and laws it seeks to explain and predict events in the physical world. This subject also looks at how society can benefit from the environment, care for it and use it responsibly (Department of Education 2003).

Since 2008 the KwaZulu-Natal Senior Certificate pass rate has fluctuated between 57.8 percent and 61.1 percent in 2009. In 2010, 61.1 percent of grade 12 learners passed the Senior Certificate examination; in 2011 the pass rate increased to 68.1 percent (Daily News 2012: 2). The pass percentage in Physical Sciences in 2011 was 51.9 percent and in 2012 it was 53.3 percent (Department of Education 2012b).

Furthermore, even if grade 12 learners in KwaZulu-Natal pass the Senior Certificate, they are unlikely to obtain admission to Bachelors studies. In 2010 only 26 percent of 122,444 learners enrolled at schools in the KwaZulu-Natal province managed to obtain university entrance (Department of Education 2010). The situation was even worse in 2011 when 53.4 percent of learners who passed Physical Sciences (obtaining between 30 to 40%) could not access tertiary education (Department of Education 2012a). A thirty percent pass is a low standard by measure. Universities accept a forty percent pass; better universities offering programmes in the health and science fields only select students which much higher passes (City Press 2011: 18). In 2011 only 22.4 percent of grade 12 learners who passed Physical Sciences obtained admission to institutions of higher learning (Department of Education 2012b). Thus, attaining forty percent cannot be regarded as an automatic admission to tertiary education.

Most learners in KwaZulu-Natal are found in the Pinetown District. The Pinetown District comprised 334,672 learners in 2010 and is still regarded as one of the largest education districts in KwaZulu-Natal. The district had the highest number of learners (140,873) in 2010 in the Further Education and Training phase (Department of Education 2010: 19).

Problem Formulation

In the light of the above discussion, the main research question is formulated as follows: *What are the contributory factors for the poor performance of learners doing Physical Sciences in the FET phase in public schools in the Pinetown District, KwaZulu-Natal?*

Although this study is limited to Physical Sciences teachers, learners and subject specialists, the results of this study provide insights not only about the reasons of poor performance in Physical Sciences but also about the problems faced by teachers and learners during the Physical Sciences teaching-learning process. The results of this study suggest possible solutions to make science teaching and learning more meaningful to learners and teachers. The study further aims at suggesting ways to eliminate problems which continue to detract from the performance of Physical Sciences learners in grade 12. The value and importance of science is increasing yet the pass rate in grade 12 in Physical Sciences has shown very little or no improvement in some of the public schools in the Pinetown District. A number of factors contribute to the failure rate and the numbers of learners who pass but do not obtain university entrance.

RESEARCH METHODOLOGY

Choice of Research Design

A mixed research design was used. In this design both quantitative and qualitative data were collected at approximately the same time. The research design included a non-experimental de-

sign and a survey design type using questionnaire and interviews and personal observations.

Data Sources

Both primary sources (for example, articles, dissertations, class registers, and statistics of Senior Certificate results) and secondary sources (for example, books) were used.

Data Collection Techniques

Data collection involved the use of several data collection tools. Both quantitative and qualitative techniques were used during this study, as it strengthened the study by providing triangulation. The approaches used in this study towards the data collection involved experiencing, enquiring and examining.

Questionnaires were used to get personal information (age, gender, race, home language, and years of teaching experience or attending tuition, learner participation in pure mathematics or mathematics literacy) from educators and learners. The researchers chose the survey because they were interested in the learners' views, beliefs, ideas and fears about Physical Sciences as a subject. Surveys are used in various sectors such as education, politics, government and social studies, since accurate information can be obtained for a large number of people by just using a small sample (McMillan and Schumacher 2006: 223). The incidence, distribution and frequency for a large population can be described by using only a small sample of participants from that population with surveys (McMillan and Schumacher 2006: 223). Surveys are versatile, cost effective and efficient. In this study, questionnaires were printed and distributed to all learners during a registration period or break, thus saving time and not disrupting the teaching and learning process.

Interviews were also used to collect data. The advantage of interviews is that the interviewer can adapt the questions (if necessary) during the interview process (McMillan and Schumacher 2006: 203-206). Also, signs of nonverbal communication can be observed and taken into account. Interviews allow for the interviewer to probe and get a clearer response to questions; and the questions for interviews can be structured, semi-structured or unstructured (McMillan and Schumacher 2006: 203-206). Questions can be adapted during the interview process. All interviews were conducted in the lunch breaks and minutes were taken. Analysis of examination results was also done.

Literature Review

Stakeholders at all levels wait in anticipation at the end of every academic year for the release of the grade 12 National Senior Certificate results. Over the past several years the pass rate for Physical Sciences has created cause for great concern as there has been a steady decrease in performance (Kriek and Grayson 2009). In spite of the efforts undertaken by the Department of Education (DoE), there have been little or no improvements in some public schools in KwaZulu-Natal. It is vital for learners and parents to understand that in order to succeed in Physical Sciences, a mathematical metacognition (Schoenfeld 1987) is required by the learner.

Kriek and Grayson (2009: 185-186) state that the national pass rate in science learning (particularly mathematics and Physical Sciences) has decreased since 2003. Some of the variables that have contributed to the decline in the pass rate include the educators' poor understanding of the syllabus, a negative attitude and arriving late to class. Bad attitudes can be linked to a poor understanding of the policy documents that the educator is required to implement; in this case the National Curriculum Statement (NCS). The science learning field is a complex one. Physical Sciences involve experimentation which is difficult in large classes. Makgato and Mji (2006: 256) mention that in 2003 the Gauteng province had a fifty percent failure rate in Physical Sciences at the higher grade in grade 12. These results were of great concern as Physical Sciences is considered a critical subject.

Teachers must be familiar with the subject content to be taught. Research conducted in many primary schools in Australia have shown that despite a lack of resources, many primary school teachers did not teach Physical Sciences because of a poor understanding and thus lacked confidence to teach the subject (Appleton 2003: 2). Many teachers use out-dated teaching practices and lack basic content knowledge (Makgato and Mli 2006: 254). This has contributed to the poor performance of learners.

Limited resources are a factor that may affect underperformance in schools. According to

Goodrum et al. (2001: 11) in Australia resource limitations are a significant constraint on the quality of teaching and learning. Learner performance is not solely dependent on the availability of resources but also on the effective use of the available resources by the educators (Naidoo and Lewin 1998: 729). South Africa has implemented many post-apartheid policies to address the issues surrounding science education. According to Naidoo and Lewin (1998), the focus of these policies have been on increasing investment in science education through educating more science teachers, providing more access to students to study science at schools, and supplying more science equipment to schools. However, after their research in Kwazulu-Natal schools, they concluded that each of these policy initiatives could be questionable.

The other factor that plays a role in underperformance of learners in schools has to do with strategies that science teachers use to teach Physical Sciences. For a science learner to engage in observation as a science skill, a learner needs to see a practical situation which illustrates the lesson. The strategy of teaching Physical Sciences cannot be a text book one only. Demonstration of lessons and chemical reactions should be an integral part of the teaching and learning process in a Physical Sciences classroom. Testing of ideas is not confined to pen and paper, but rather active involvement of learners in investigative lessons (Vhurumuku 2010).

A key feature of science education is the ability of the learner to select that which is important for the task at hand and discard that which is not required (Hindal et al. 2009: 199). According to Hindal et al. (2009: 189), the idea of convergency-divergency is central to science education and its learners; learners who are more divergent are able to take a concept or idea and relate it to various other concepts and ideas, while the more convergent learner tends to bring ideas together to form some form of conclusion. Research shows that learners who think divergently perform better at chemistry (Hindal et al. 2009: 189).

Many learners in the FET phase are currently not even at the formal operational stage as described by Piaget, a theorist who shaped the understanding of how a child's cognition changes in a predictable manner (Genovese 2003: 128). Piaget believed that children have the ability to solve different types of problems; these problems are categorised into developmental sequences and it is these sequences that define the discrete stages of cognitive development (Genovese 2003: 128-129). He identified four stages of cognitive development in children, with the formal operation stage being the last. This stage occurs from the ages of 11 years to adulthood. According to Piaget (1952), the formal operational stage is characterised by adult patterns of thought which involves logical, rational and abstract thinking.

Thus, during the formal stage learners are able to think logically about tangible situations; they are able to demonstrate, conserve, classify, and reverse (for example, they can solve hands-on problems in logical forms; understand reversibility; and understand the laws of conservation) (Woolfolk 2007: 29-31). At this stage learners develop the ability to reason by hypotheses based on logic; the learner has the ability to construct theories and make logical deductions about their consequences without having had any direct experience on the subject being dealt with (Simatwa 2010: 369-370).

The slow cognitive developments of learners are contributory factors to the poor performance displayed by learners in Physical Sciences. As explained by Giannakopoulos and Buckley (2009: 327-328), the cognitive skills (critical thinking, creativity and problem solving) of learners are of vital importance for learners to succeed as they are used in the creation and application of knowledge in real life situations. Physical Sciences lessons should be learner-centred, and should allow for the active participation of learners. By developing lessons that are demonstrative and investigative the cognitive ability of learners is enhanced. Also the different views and ideas of each learner can be developed through sharing of ideas, allowing for constructivism. Through this type of lessons the convergent and divergent skills of learners are shared with each other, advancing into effective teaching and learning of Physical Sciences.

Physical Sciences as a subject requires an active learning strategy instead of a passive learning. Active learning involves students and teachers; education becomes a two-way process with both the teacher and the child learning from each other. Outcomes Based Education (OBE) placed tremendous emphasis on making learning a two-way process. But learner performance cannot solely depend on active learning, for

those that have taught Physical Sciences and are aware of the content of the subject will agree that at times the educator is required to adopt a more passive strategy. However, the educator must be aware and deliver the information in a manner that is still able to capture the attention of the learner.

According to the cone of learning principal, active learning will take place when the learner is directly and actively involved in his/her learning process (Dale 1969). During this process of active learning the learner not only takes in the information, but also actively engages with the learning material in some way. According to Woolfolk (2007: 487) active teaching is teaching characterised by high levels of teacher explanation, together with demonstrations and student interaction.

The advantages of active learning are that a larger quantity of information is assimilated by the learners at one time, interaction amongst learners is improved, learners' academic performance improves, it allows for stimulation of higher order thought as well as developing respect for the views and opinions of others (Unisa Study Guide for Physical Science SDPSCO-8 2007). Active learning requires not only a hands-on approach but it also needs for learners to have an inquiring mind and engage in the process of inquiry learning. Inquiry learning is defined as an approach in which the educator presents the learner with a rather puzzling situation and the learner then attempts to solve the problem by collecting data and then testing his/her conclusion (Woolfolk 2007: 351).

In many schools worldwide science education is practiced in a traditional age-old manner, that is, dictative, and authoritarian which has eliminated all forms of imagination. According to Christensen (1995), when this form of teaching approach was used in American schools, critical analysis of the results of learners indicated clearly that this system had failed. Thus, for the transformation of science learning, Christensen (1995) points out there must be a change in the strategies and methods used in the classroom.

Physical Sciences as a subject requires educators to have a good understanding of the subject and to be able to display foundation competence, practical competence and reflexive competence in the subject. According to Gough (2009: 183) there is a shortage of qualified science educators and this is expected to worsen over the years as very few students are taking up careers in science teaching. When there is inadequate preparation on the part of the teacher and a limited academic background, the result is poor teaching and in schools (Van der Westhuizen et al. 2002: 115). Research shows that although educators can sometimes master the theory of Physical Sciences, putting the theory into practice is a major problem. The pedagogical knowledge that teachers gain through their qualifications must be applied to their teaching of science, thereby narrowing the gap between theory and practice (Appleton 2003: 2-4).

Parent involvement plays a pivotal role in educational issues. Schwartz (2001) reiterates the fact that school communities and families should continually give support to the performance and achievement of their children. Schwartz (2001) explains that the role of the family is to develop a home atmosphere conducive to learning, participate in homework completion and meet performance standards or anything related to contributing to educational success (Adell 2002).

Learners tend to get frustrated and lose hope when they are unable to get the help they require at home and as a result their performance levels start to drop. However, one has to keep in mind that many black parents were victims of the apartheid regime and because of this their knowledge of Physical Sciences is poor, as a result affecting their role in assisting their children in the subject. Lemmer and Van Wyk (2008: 261) explain that parent involvement was regarded by the apartheid government as a means of financing schools. It was perceived as a means of paying school fees and fund-raising for the school. The actual involvement of parents in academic matters was not of top priority.

Investigating the attitude of learners towards science was the other factor that TIMSS (1999) explored. TIMSS reported that the generation of a positive attitude towards science, is an important and integral goal of science education. Many learners tend to avoid Physical Sciences because of their fear of the subject and a lack of self-confidence. This negative attitude can result learner underperformance and as a result being unable to get the required results for university entrance (Mullins 2005). The fear of Physical Sciences has resulted in a decrease in the number of learners taking the subject both at the secondary and tertiary level (Gough 2009: 183). During the researchers' experience as a Physical

Sciences teacher at a public school in the Pinetown District in KwaZulu-Natal, a discouraged grade 8 pupil described Physical Sciences as "a killer subject". Okoye (2002: 562) mentions that those learners who come from a higher socio-economic status family are more motivated to study and show a positive attitude towards their studies.

According to Baker and Jones (2005: 149), there is an association between low socio-economic status and poor performance in science in school. However, evidence has suggested that it is not the socio-economic status per se but factors associated with home resources and background experiences that affect the learners' performance in science. According to Saiduddin (2003: 22), factors such as unstable homes, drug abuse and teenage pregnancy contribute to the poor performance among learners. Teenage pregnancy in South African schools is on the increase; consequently, the learner tends to drop out of school, resulting in an on-going cycle of poverty in the home, community, province and country.

When learners learn in a language that is not of their mother tongue, learning then becomes more difficult. The Trends in Mathematics and Science Study (TIMSS) indicates a correlation between lower achievement levels in science and home language which is different to school language (Baker and Jones 2005: 149). When learners are required to learn content in a second language, they are faced with the problem of content literacy (Van der Poll and Van der Poll 2007). When learners have to use a language that they are not proficient in, then mastering content (both practical and theoretical) of a subject becomes very difficult (Van der Poll and Van der Poll 2007). This in turn affects the learners' performance in Physical Sciences because language plays an important role in the understanding of technical terms in a subject (Van der Poll and Van der Poll 2007).

For learners who are not taught in their mother tongue, the practical aspects of Physical Sciences become important. With the availability of the right resources educators are able to demonstrate experiments which can help these learners as well as those who are being taught in their mother tongue to gain a visual experience of the events that are taking place, and thereby improve their understanding.

A number of other factors could contribute to the poor performance of learners in Physical Sciences. According to Okoye (2002: 562) a number of factors (other than the motivating forces at home, scholastic ability and academic values) affect a learner's academic behaviour. One such factor is the social pressure placed on the learner by the participants in school settings.

Based on Van der Westhuizen et al. (2002: 116) a lack of students discipline and commitment is a direct link to poor learner performance. Learners with poor behaviour (such as ignoring all instructions by the educator, failing to do and or complete work given, showing disrespect to the educator) tend to spend more time being reprimanded or outside the classroom. As a result the contact time of actual teaching and learning is diminished (Van der Westhuizen et al. 2002: 115-116).

Lack of school-based or home-based resources is also another factor that can affect poor performance at school level. In many public schools in South Africa, there is a lack of proper laboratory facilities; thus learning of Physical Sciences can become very difficult for learners. As a result Physical Sciences remains at a very theoretical level without any experiments to enhance the understanding and application of knowledge (Makgato and Mli 2006: 254). Not all public schools in KwaZulu-Natal are equipped with sufficient resources (for example, textbooks); as a result, in some schools learners are not given a textbook to take home. Those who are of a higher socio-economic status are more likely to buy a textbook for themselves.

TIMSS (1999) documented detailed information about learners' home backgrounds. The study explored how learners spent their time out of school and also investigated their attitudes towards science. The TIMSS research report stated that students from homes with pricey educational resources have a tendency of performing well as compared to those that are coming from less advantaged backgrounds. The home resources that were referred to in the TIMSS (1999) report included: books in the home, educational study aids in the home study desk, dictionary and a computer.

DISCUSSION

For many learners English was not their mother tongue. Only forty percent of learners' home language corresponded to the Language of

Learning and Teaching (LoLT). Fifty-five percent of learners who are predominantly Zulu-speakers are taught in English, which was their L2. The LoLT plays a vital role in understanding the content of knowledge.

Based on the responses to the learner questionnaire, the majority of learners (56%) especially those whose home language differed from the LoLT felt that if Physical Sciences was taught in their home language, their performance would improve due to a better understanding of the subject. Learners said that being taught in their mother tongue facilitates understanding and the "why's, when and how and what" would be easier for them to understand. The interpretation of questions becomes difficult when it is given in L2, thus making explaining difficult. Learners' confidence is based on their ability to understand; when learners understand, they have more confidence and take more interest in the subject.

The following question was posed to grade 12 Physical Sciences learners: "If Physical Sciences were taught to you in your home language, would you have a better understanding of the subject and would your performance improve?" These are some of their responses:

I believe that I would have a better understanding if it [Physical Sciences] was taught in my home language.

Yes, I think it [teaching in vernacular] would help us to improve because I understand my own language better than I understand the language we use at school.

Yes, I would have a better understanding and my performance would increase drastically.

Yes. Because there are words in physics which I don't understand so if physics were taught in isiZulu I think I would be doing good in the subject because it's my home language.

Yes, English is not home language for some of us. If physics were taught in isiZulu I could get an "A" symbol.

Through observations of the learners it was clear that for some learners whose home language differed from the medium of instruction, their ability to communicate with the teacher was not as clear as those whose home language matched the medium of instruction. Their ability to express themselves was poor and very often required the assistance of a friend to translate what the teacher was saying.

More than fifty percent of learners believed that activities such as peer tutoring provided them with a tremendous amount of help as they were able to converse in their home language. Very often the meaning of words in English was difficult for them to understand during lessons, and this hindered their understanding of the work.

Learners responded to the question: "Are extra lessons in Physical Sciences outside school an affordable option for you?" They also mentioned if they prefer to converse in their mother tongue during peer tutoring. Responses from learners were as follows:

Well I think so, because I have tried that last year. Our teacher spoke Zulu and so it make it easier.

Yes, a lot, because my classmate explain in our home language. I understand the subject better and able to respond to him/her. But my teacher I find it hard to even answer sometimes in proper English so it will be much better if it's taught in my home language"

I think they should make the theory/textbook be written in isiZulu like it is written in Afrikaans...

Based on the responses from the teachers and the subject specialist, language also affects the reading and understanding of learners, particularly when it comes to reading textbooks and examination questions. From the past experience some teachers noted that learners complained of not understanding what the question required. Also it has been noted in the National Diagnostic Report on Learner Performance (2012) that many learners had problems with interpretation of questions in Physical Sciences (Department of Education 2012: 165-198). A plausible reason is the language problem. The subject specialist for Physical Sciences as well as a teacher agreed that language affected the performance of learners and their responses were as follows:

It may affect the reading and understanding of material from the textbook (Subject specialist).

Yes, many have complained they did not understand the question, like what is it asking for (Educator).

Based on the responses to the learner questionnaire, question 10 over fifty percent of learners, especially those whose home language differed from their medium of instruction, felt that if Physical Sciences was taught in their home language, performance levels would improve great-

ly, due to a better understanding of the subject content.

Fifty-six percent of learners have a problem with the understanding of concepts in Physical Sciences. One has to remember that only forty percent of learners in the two schools were taught in their home). Those learners, whose home language corresponds to the LoLT, firmly believed that the above link plays a very important role as understanding the lesson was vital to succeed in a subject that is deemed "difficult" by the society in general. However, to improve on their understanding, many learners attended additional lessons outside of school. But this luxury of additional classes was not affordable to every child.

The socio-economic status of learners from the schools under investigation was grouped into three categories: those from high income homes, average income homes and below average income homes. High income homes in this study refer to those which have surplus funds available at the end of each month. Average income homes refers to homes that are just able to meet their demands, with no extra money left over for luxuries, such as additional lessons, textbooks, extra travel and fancy accessories. Below average income homes are those that can hardly meet the financial requirements of daily life and rely on child support grants and foster care grants. Most of the learners are coming from average income homes

Eight-one percent of learners were from average income homes, while twelve percent were from high income homes and a very small seven percent come from below average homes. The family background of a learner plays a very important role in the learner's learning process, family background includes factors such as socio-economic status, two-parent versus single parent household, divorce, family size and neighbourhood (Majoribanks 1996). The home environment of a learner influences his/her performance at school. Barry (2005: 7) mentions that a low socio-economic status negatively affects academic achievement because it prevents the access to vital resources. International research has shown that learners whose parents have better jobs and higher levels of educational attainment are able to expose their children to more educational and cultural resources at home; as a result these learners perform better than their counterparts at school (Udida et al. 2012).

More than eight percent of learners from the two schools were from an average income home. This implied that not every child may have the advantage of attending extra lessons outside school or buying textbooks and study guides. The views of the teachers and subject specialist was that those learners who were from higher income homes tended to perform at an above average level, as some of them attended private lessons and got the individual attention they needed to help improve their performance. They also tended to have access to several text books and study guides as well as visual media.

According to the results obtained, clearly not every child attends extra lessons in Physical Sciences; the poor family background of learners is thus a factor which contributes to the underperformance. Based on the responses of learners from the interviews, many learners pointed out that extra lessons were not an affordable option to them for the following reasons: very large families and working parents. Some families comprised orphans, pensioners and in most cases these families did not afford to enrol learners for extra classes. Furthermore, extra science classes occurred in places that were far from their homes and transportation costs were high. This is illustrated by the following:

There is only one parent working in the family and it becomes very costly.

My mother is a cleaner so she has to support me and my two smaller brothers.

My parents cannot afford it, they've already spent much since I started matric.

I live with my pensioner grandmother who supports a family of 8 with the little money we receive.

I have never tried them before; I always find them expensive because my mother is a pensioner.

They are very costly and also transport to the venue where Physical Sciences classes are taking place is costly. It's R150 an hour so it's hard to afford.

A further constraint that was identified was those learners who can afford to attend extra lessons outside school did not have sufficient time as they attend extra lessons in several subjects. A learner had the following to say:

I won't have time to attend extra lessons on weekends as we also have extra lessons on weekends at school for maths and life sciences.

Thus, poor time management on the part of learners can lead to poor results as learners fail to spend that additional focus on Physical Sci-

ences. The researchers' observation was that many learners in these schools have over the years developed a negative attitude towards the subject;

they believe that if they could understand the subject at school, extra lessons would not help. Not only did learners possess a negative attitude but have a very low self-esteem of their capabilities.

Some learners are not willing to allow themselves the opportunity to try and understand.

According to Maslow's Hierarchy, it is only when these lower level of needs or deficiency needs are met and satisfied does motivation for them decrease and the higher level needs of intellectual development and self-actualisation are met (Woolfolk 2007: 375). Responses of learners indicated that many have yet to fulfil their lower level need of self-esteem, before achieving intellectual development.

Other reasons for not attending Physical Sciences extra classes were that extra lessons do not give them that individual attention they required; the classes were also big. Where individual lessons are available, they are very expensive. Supporting statements for the above findings were based on the responses from interviews:

A large number of students attend extra lessons which makes it very hard to understand.

Too little time is spent on other sections and I don't get the individual attention I need.

Resources

In the following section, findings about the effect of resource provisioning will be described.

Resources provisioning are an essential component of any working environment. School A and School B experienced problems with regards to the provision of text books. Based on the learner responses on question 8 which requires them to indicate whether they do have a Physical Sciences textbook to take home daily, 62 learners did not possess a text book that they could take home. According to the researchers' observation as a science teacher, only worksheets were provided. Evidence of this was given by learners in their response to question which states: "Does your school provide you with the required textbooks or did you have to buy your own?" Learners' responses were as follows:

You have to buy your own; we only get worksheet.

The school only provides worksheets sometimes.

The few text books available were used in class but learners had to share either one between two and one between three, depending on the attendance of the class for the day. However, for many learners the worksheets did not do justice in helping them. In School A, learners were requested to purchase a study guide for Physical Sciences. Most learners were unable to afford a study guide as it was not within the budgets of the parents. They also indicated that Physical Sciences was not the only subject that required a study guide. One learner remarked:

The school makes us buy a text book for each and every subject that needs a book and for physics as it is I had to pay R130.00 for a book which I could hardly afford. It's really hard because it's not the only subject that needs such attention.

School B suffered the same fate in terms of text book availability. Learners were not provided with text books by the school due to insufficient stock; so many learners took it upon themselves to purchase a study guide. However, it was only those who could afford to do so. One learner said:

We buy our own text books; however, not all my friends could afford to do so.

Based on the poor background that learners were coming from, not every child was able to purchase the study guide for Physical Sciences, which costs approximately R80.

Physical Sciences is a subject that requires hands-on work as well. This subject consists not only of a theoretical component but also a practical component. Based on observations, School A, did not have a well-equipped laboratory; however, the basic needs such as running water, fire extinguishers and charts were evident. The laboratory rules were clearly displayed on the walls of the laboratory.

Practical work is of great importance; based on the responses from learners in School A, the few practicals that they conduct, not only capture their attention in class but also improves their understanding of the section being taught. Learners tend to find the subject more enjoyable when practical lessons are done. Most learners responded that practical lessons forced them to undertake their own research and take the

time to read and improve their understanding. Learners were expected to respond to whether they engage in practical work and if so, why do they think such an engagement is important. They responded as follows:

Yes, I do engage in practical activities and they do help me understand the most fundamental concepts in Physical Sciences.

Yes, it does improve my understanding to the subject.

Yes, and yes it does help us understand better, lot of theory is put in, we get to understand the laws being used...

Yes, I do participate in practical activities and it does help to improve my understanding of the subject; especially when the practical activities require you to be in a group.

Yes, we do and honestly it does help and it makes the section even more interesting.

Yes, we do practical activities which make it easy for us learners because we tend to understand things better when we visualise them. We also remember it during examination.

Yes, it does because it makes me understand more and research about it so I can learn something more that my teacher did not teach me.

The problems that have been noted in both schools were that very few practical lessons were conducted. The main reason was a lack of laboratory equipment. Teachers also complained about the lack of equipment in the school laboratory and were trying to do their best with that which was available. With large classes (average 32 learners per class) setting of practical lessons became difficult with limited resources available.

Teachers' responses to the question which required them to reflect on the challenges they faced with regard to conducting practice were as follows:

Lack of Equipment

With large classes we have discipline problems especially in grade 10 (45 learners in a class) and also there is insufficient equipment. Poorly resourced laboratory also pose a challenge.

The subject specialists agreed that a lack of equipment and large class sizes make conducting practical lessons rather difficult. When responding to question 4 on problems they encounter when they perform practical lessons, one of the teachers responded:

The only challenge is setting up practicals for large groups with limited resources. There is a need for laboratory assistance.

Unfortunately School B did not have an operational laboratory. From the researcher's observations there were no water tap facilities, no fire extinguishers nor operational fume cupboard. Learners at this school engaged in practicals that did not require specialised equipment, particularly chemistry practicals. The learning environment itself was not in line with the subject being taught, thus reflecting a poor working and learning environment.

The advantage of practical lessons is that learners are also learning the implicit curriculum, (that is, safety when in the laboratory, the importance of cooperation, listening skills and respecting the views and opinions of others when working with dangerous chemicals and equipment). Weinburgh and Englehard (1994) argue that learners with poor prior academic performance in science should be encouraged to do laboratory activities. During practical lessons scientific concepts are clarified and reinforced. Learners begin engaging with scientific concepts and experiences via the manipulation of materials during laboratory experiences.

Parent involvement plays a vital role in a learner's academic performance. Irrespective of ethnic group, research has shown that parental monitoring leads to higher academic achievement due to the fact that parental attention helps learners remain focused at school (Plunkett and Bamaca-Gomez 2003). Based on the results of studies that have looked at the relationship between parent involvement and academic achievement, "parent involvement is positively related expectations and importance of schooling" and by having a positive attitude towards education, a learner is more likely to excel (Ibanez et al. 2004). Approximately eighty percent of learners were unable to get assistance from their parents in Physical Sciences. Many learners in School A were orphans, living with grand-parents or with parents who have never studied Physical Sciences as a school subject. Almost sixty percent of learners had isiZulu as home language.

Based on the history of the Republic of South Africa, most parents (at some stage of their schooling career) as well as grandparents would have been affected and disadvantaged by the previous government system. Further evidence of weak parent involvement was seen

in the learners' responses to question 8 which stated: "When you are unable to understand something in Physical Sciences, are your parents/brothers or sisters able to assist you at home?" Most (70%) learners responded that they were not assisted. The following were also mentioned:

No, I am the first in my house to do Physical Sciences therefore I wait for tuitions or a day to ask my teacher.

No one at home have done physics so I struggle alone because there is no one to help or explain to me.

No. None from my family did Physical Sciences. They are all helpless.

Nobody assists me because I live with my granny and she doesn't understand a thing I say. I only have smaller brothers and sisters.

I am the oldest sibling and my mother did not do Physical Sciences when she was at school.

Learners, who were living with their parents, said that they were never available to assist them in the Physical Sciences, as they were always working. These are some of the statements they made:

No, at home my books and the grade I do seem to be important to me only, the only time they can assist is when they evaluate my term report and complain on how I'm not getting A's in the subject.

No, my parents are busy or not around.

I don't have access to help at home because the family members who did Physical Sciences don't stay with me.

Learners also mentioned that the only time their parents were involved was when their report card arrived and it reflected poor results. Learners from School B were in a similar situation with no help from parents. Obviously most parents lacked knowledge about Physical Sciences and could not assist their children. Some learners responded by saying:

They don't assist me they always expect me to know everything. I am scared to tell them that I don't understand this subject.

None of my family at home did Physical Sciences in school.

None of them did physics while schooling.

I am the oldest brother at home I don't get assisted and my parents don't know physics they never did it at school.

Those learners (30%) who were able to get assistance at home with Physical Sciences had a brother or sister who had done the subject at school. Few learners thus had received assistance in Physical Sciences from their parents or legal guardians.

The Physical Sciences curriculum is divided into two components, namely physics and chemistry. The contents of each component are rather extensive. Based on the responses, more than fifty percent of learners from School A and School B found one particular section in Physics very difficult: Mechanics. Learners found the use and selection of equations very difficult, as the learners (L2 English speakers) do not understand what is required to be done. Learners' responses to the question which required them to reflect on the major difficulties they experienced in Physical Sciences were as follows:

The language can be a problem for me when it comes to understanding Physical Sciences; the equations being used can be a problem because sometimes you need to change it to get the answer; NOT doing mathematics can be a problem.

Doing calculations in mechanics and interpreting the graphs are difficult.

Some aspects of mechanics, i.e. how to calculate tension incline planes and how to determine how much of work is done using the given formulas.

Mechanics especially the incline plane calculations.

The physics part of Physical Sciences, basically the calculations of problems e.g. falling bodies, momentum.

This trend seems to be ongoing as the National Diagnostic Reports on Learner Performance (2012, 2011 and 2010) expressed similar concerns: learners were unable to substitute and were unable to perform mathematical manipulation. Thus, the mathematics part of this section poses a real problem to many learners.

According to the National Diagnostic Report on Learner Performance (2012), the Mathematics and Physical Sciences curriculum should complement each other. It is suggested that teachers of the respective subjects work together. Based on the responses from the teachers at their respective schools and the subject specialist, time is a limiting factor. With regard to time allocation for the teaching of Physical Sciences, teachers had the following to say (question 10, Annexure B4):

No, too much assessment tasks and too little time.

No, more time is required to teach sections properly.

The subject specialist responded to question 10 as follows:

It seems overloaded because there are a lot of assessments that has to be done e.g. controlled tests, June exams, and trial exams take up a lot of time.

The Subject Assessment Guidelines for Physical Sciences require too many assessments to be covered within a short space of time. This leaves the Physical Sciences teacher with little time to teach the required mathematical skills especially for those learners who do need Mathematical Literacy.

Under the section of Chemistry, the main area identified by the learners as a problem was the section on Chemical Change where learners should calculate the equilibrium constant. Most learners in School A and School B reported difficulty in performing the mathematical calculations especially when they had to compute the value of an unknown variable. A learner said, "I am having difficulty in calculations in the section chemical change."

The trend among learners, as well as teachers and subject specialist was that the Physical Sciences syllabus is 'overloaded' with too much work and too little time left for teaching. Teachers felt that the syllabus needs to be revisited and Physics and Chemistry separated into separate entities which would help to improve the performance. Learners also feel that the separation of Physics and Chemistry would be helpful as some feel they are better in one and not the other.

Teachers' views were as follows:

Reduce the syllabus content, it is too much especially grade twelve, or perhaps the curriculum should be re-evaluated and separate physics and chemistry into two individual subjects.

More periods, Maths. Literacy. Pupils must not do physics; only pupils with above eighty percent in grade nine Maths should do physics'.

I think that the subject should be separated into Physical and Chemistry Sciences. The learners per class should be reduced for better or more teacher and student time.

Do experiments, separate chemistry and physics...

I feel that the separation of mechanics (physics) and chemistry would make it easier for everyone.

Learners' views were as follows:

Understanding physics is hard it's a complicated subject with too many areas to cover in a short space of time.

There is a work overload and too little time.

I think that Chemistry and mechanics (Physics) should be separated as different subjects. It will be easier.

We need to be able to gain access to laboratories and work practically with experiments.

More practical work can be done. Government can provide free tuition in different languages.

The comments indicated by the participants illustrated a need to teach and learn physics and chemistry separately.

CONCLUSION

The conclusions that are drawn are based on the findings. A number of factors have been identified as reasons for poor performance in Physical Sciences in the two schools under investigation. These factors include a lack of resources, language of learning and teaching (LoLT), learners doing Mathematical Literacy instead of Mathematics, the socio-economic status of learners, parent involvement, large classes, the developmental level of learners, and the curriculum.

The home language of a learner and the medium of instruction or LoLT at schools affect learner performance in a subject. Learning a second language is not an easy task for an adult or child; in the case of children it may be more difficult as they may feel incompetent and not want to be embarrassed among friends. Apart from language, the Physical Sciences curriculum, presents learners with a large amount of work to assimilate and accommodate. This can present major obstacles to performance above all when learner cognition is not at the formal operational level as in the case of the schools investigated.

Furthermore the resource availability is going to present further challenges to teachers with the introduction of CAPS in 2014, in particularly when it comes to ensuring standardization with practical assessments. There is likelihood that many other schools in the province are also under-resourced in terms of laboratory equipment. The question can be posed as to how the schools allow for optimum performance and effective teaching and learning with this revised curriculum, if resources are not available.

The financial status of parents drastically affected their child's performance, in terms of affordability for study guides and additional lessons outside school. The involvement parents had in the academic life of the child was limited as these parents spent more time working to ensure that the basic needs are met first.

RECOMMENDATIONS

Based on the findings of this research into the reasons for poor performance in Physical Sciences by schools in the Pinetown District in Kwa-Zulu Natal, the researcher recommends that schools ensure that:

- Text books are made available to all learners. Should funds not be available, the schools need to embark on some sort of fundraising activity to ensure that resources such as text books are available for effective teaching and learning to take place.
- Physical Sciences laboratories are in working order with the necessary equipment.
- The laboratory reflects the subject being taught and creates a positive teaching and learning environment.
- Learners are appropriately assisted with regards to the selection of subjects at the FET phase.
- Children regularly engage with the parents.
- Activities are provided which stimulate the cognitive development of every learner.

NOTE

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