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A Comparison of Teachers' and Students' Perceptions of the Factors Contributing to Poor Performance in Physical Sciences: A case of South Africa

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ABSTRACT

Students' poor performances of Physical Sciences are a major problem in South Africa, particularly the district of Motheo. Even though the Department of Elementary Education in South Africa has invested a great deal of money for Physical Sciences in the new curriculum called the Curriculum Assessment Policy Statement (CAPS) to train teachers through workshops and in-service education, students have not still been well performing for this subject. Studies have been conducted on reasons and possible solutions/treatments of students' poor performances in Physical Sciences, but little progression has been achieved yet. This study aimed at comparing the teachers and students' perceptions of the factors contributing to poor performance in Physical Science, and discussing how to improve such performance. The sample of the current study consisted of seventy nine grade 11 students and seven teachers selected via convenient sampling method. Within a quantitative research method, a survey research design was used. The teachers' and students' responses to the questionnaire were compared to find out whether they have similar perceptions of the factors contributing to poor performance in Physical Sciences. This study revealed that they had varied perceptions of the factors under investigation. For example; teachers regarded instructional language (English) and students' poor mathematical backgrounds as great contributors to students' poor performances, whereas students saw a lack of practical work as a great contributor to their poor performances in Physical Sciences. The teachers and students also suggested different ways on how to improve students' performances in Physical Sciences.

Keywords: Curriculum assessment policy statement, New curriculum, Physical sciences, Poor performance, Science Education, Science Teachers and Grade 11 students.

INTRODUCTION

Curriculum Assessment Policy Statement (2011) states that "Physical Sciences prepare learners for future learning, specialist learning, employment, citizenship, holistic development, socio-economic development, and environmental management" (p.8). "Physical Sciences play an increasingly important role in the lives of all South Africans owing to their influence on scientific and technological development, which are necessary for the country's economic growth and the social wellbeing of its people" (CAPS, 2011, p.8).

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"Physical Sciences use scientific inquiry, application of scientific models, theories and laws to investigate physical and chemical phenomena in order to explain and predict events in the physical environment" (CAPS, 2011,p.8). "It also addresses the needs of society, and society must be able to understand the physical environment to be able to care for and benefit from it responsibly" (CAPS, 2011,p.8).

"Physical Sciences play an important role in society in terms of economic growth and the social well-being of its people, and prepare learners for future learning, specialist learning, employment, citizenship and environmental management" (CAPS ,2011, p.8).

O'Connell (2009, p.4) depicts that South Africa's education system is facing a major challenge in increasing the number of matriculated students into Mathematics and Physical Sciences. The South African Government has invested a great deal of money in developing teachers' and students' skills and interests of Mathematics and Physical Sciences. The country has seen spectacular growth in secondary school enrolment since 1994, however, the focus has been shifting to empower the quality of education and an increase in the number of matriculated students, who have strong foundations in Mathematics and Science (O'Connell,2009).

The Minister of Basic Education, Angie Motshekga, addressed that the grade 12 class of 2016 saw a 72.5% pass rate – up from the previous year's 70.7%. She further revealed that the Free State had surpassed the Western Cape as the best performing province in the country (i.e., a pass rate of 88.2%, up from 81.6% in 2015) (Matric, 2016). The results also revealed that students, who excelled in such "gateway subjects" as Maths and Science, were much lower than the expectation. In Science, 3.7% of students (a total of 7 043 students), who wrote the paper, earned a distinction (Matric, 2016).

Investigating teachers' and students' perceptions of the factors contributing to poor performance in physical sciences gives an opportunity to compare and advance their views with each other. Comparing the teachers' views (N: 7) with the students' ones (N: 49) gives a chance for the teachers to relate their experiences to explain the reasons of poor performance in physical sciences. Any similarity between teachers' and students' perceptions of poor performance in physical sciences provides valuable different experiences for schools. Improving teachers' and students' performances in physical sciences is more important than prescribing them. Involving the teachers as collaborators of any research would discover new ideas to help the students improve their results. In addition, taking ownership of these ideas would also be transformed into the learning process.

Perceptions of the factors contributing to poor performance in physical science

Tswanwani, Harding, Engelbrecht and Maree (2014), who focused on the teachers' and students' perceptions of the factors facilitating the students' performances in Mathematics, found that such factors as students' and teachers' commitment and motivation, attitudes and self-concepts, career paths, perceptions of peers and teachers; and teachers' perceptions of students influenced disadvantaged students' decisions to persist and achieve in Mathematics. Makgatho (2007) (cited by Tswanwani et al., 2014) found that the factors contributing to the students' poor performances of Mathematics and Physical Sciences included the teacher's content knowledge, time management, teaching strategies, parent's commitment to student's education, student's motivation and interest. This study compared students' and teachers' perceptions of the factors contributing to poor performance in Physical Sciences rather than the actual factors involved. Further, its interest concentrated their perceptions on how to improve their performances of this subject.

Lesotho, Khanyane, Mokuku and Nthathakane (2016) investigated perceived gender differences in science performance. The study indicated that students and teachers had

complicated views about which gender outperforms science. The study reported that the principals perceived boys as out-performing girls in this regard, and depicted such perceived performance reasons for gender differences as self-efficacy; attitudes towards science gendered thinking and aptitude; diligence and perseverance; home experiences and culture; language proficiency; socio-economic challenges; and the use of discussion as a learning strategy.

Mji and Makgato (2006) identified such direct influences on poor performance as teaching strategies, content knowledge and understanding, motivation and interest, laboratory usage, and the completion of the syllabus as well as such indirect factors as parental role and language.

In wealthier homes, students are better prepared for school because school learning is supported by the types of conversations between students and their parents, exposure to books, and the types of responsibilities and their expectations (Criticos, Long, Mays, Moletsane, Mityane Grosser & De Jager ,2012). For these students, both school and home are functionally well in terms of learning. Students come into school very differently prepared for learning formal school knowledge. Many poor students come from homes that cannot always support what they have learned at school (Criticos et al., 2012). Bernstein calls the home as a second site of acquisition, the first being school. As a matter of fact, Aslan (2017) denotes that students' attitudes towards chemistry may influence their academic performance in the subject, their decisions and behaviours within the chemistry content.

Many students have only one site of acquisition (school). Parents may be illiterate and therefore unable to assist students with their school works. There may be few resources such as reading books, Internet or encyclopedias to assist learning. Students need unlikely to have a study desk or electricity at home to facilitate their doing homeworks at night.

Effective science teaching strategies in improving performance

The teaching strategies determining students' existing ideas and conceptions are important for teaching and learning of science (Çýmer, 2007). Hipkins et al. (2002) (cited by Çimer, 2007) argue that effective science teaching requires students' pre-knowledge, values and beliefs that need to be assessed and linked to students' everyday lives and classroom experiences. Çepni, Ülger and Ormanci (2017) found that prospective teachers tended to associate information with daily life and give examples from everyday life. Furthermore, they discovered that prospective teachers focused knowledge transfer on everyday life rather than feeling, seeing or understanding science that they encountered in everyday life (Çepni et al, 2017).

In view of Ausbel (1968), Witrock (1994), Mintzes, Wandersee and Novak (1998) (cited by Çýmer, 2007), effective teaching strategies need to progress from known knowledge to unknown one. Hence, teacher is able to plan subsequent teaching activities that will assist students in linking their pre-existing knowledge to the new one.

Such different teaching approaches as question-and-answer techniques, group discussions, brainstorming, debating ideas and performing experiments can be used to assess the students' existing knowledge (Hewson & Hewson,1998; Çýmer ,2007). Students will change their conceptions if they are dissatisfied with their existing knowledge and become aware of any inconsistency between their pre-existing and new knowledge (Çýmer, 2007). Science teachers may use such different contemporary teaching strategies as peer interaction, to challenge the students' ideas (Posner et al., 1982; Littledyke, 1998).

The majority of students easily learn conceptions in a way relating their sensory channels to audio and visual representations, pictures, charts, models and multimedia (Çýmer,

2007). Visual aids, which provide more concrete meanings than words, show interconnections and interrelationships between the ideas (Çýmer, 2007).

Table1. Pass percentages of Physical Sciences in the Free State Province

Year	AVARAGE	PASS PERCENTAGE
	32.51	44.04
2010	35.82	55.21
2011		
2012	39.93	66.58
2013	41.94	73.96
2014	39.45	69
2015	39.8	69.7

As seen in Table 1, the pass percentage of Physical Sciences in the Free State Province was 44.04 in 2010. These percentages increased from 2011 (55.21%) to 2013 (73.96%). However, this percentage reduced to 69% in 2014, whilst there was a slight increase (69.7%) in 2015.

Table 2. The pass percentages of Physical Sciences in the Motheo District

Year	AVARAGE	PASS PERCENTAGE
2010	35.04	48.67
2011	36.73	54.6
2012	40.93	69.35
2013	43.63	75.78
2014	39.86	67.7
2015	39.2	64.6

As observed in Table 2, the pass percentage of Physical Sciences in the Motheo District was 48.67 in 2010, which was the lowest of all years. The pass percentages increased from 2011 (54.6%) to 2013 (75.78%). However, the pass percentages decreased in 2014 (67.7%) and 2015 (64.6%). This trend has resulted in a concern on the reasons of decreasing rates in Physical Sciences.

The following questions guided the present study:

(1) What are the teachers' and students' perceptions of the factors contributing to poor performance in physical sciences?
(2) Is there any similarity between the teachers' and students' perceptions of the factors contributing to poor performance in Physical Sciences?
(3) How can teachers and students improve their performances in physical sciences?

Theoretical Framework

This study used school effectiveness model as a theoretical framework to provide the research lens for data collectionand data analysis. In view of Ghani, Siraj, Radzi and Elham (2011), the model comprises of input variables, process, context, temporary findings and outcomes (see Figure 1). This study views input variables as best-selected variable to be concurrently applied to the process variable. The temporary intermediate finding acts as a control process (Ghani et al. 2011). If the process variable is not executed or applied concurrently, the structure and culture of the school as an organization will not be

accomplished to redevelop (Ghani et al., 2011). Furthermore, to reach the consensus level among the process variables will call the school for re-implementing the practices of an effective school (Ghani et al, 2011).This kind of analysis is similar to Stoll and Fink's (1996) views of the effective school movement and school improvement (Ghani et al, 2011).

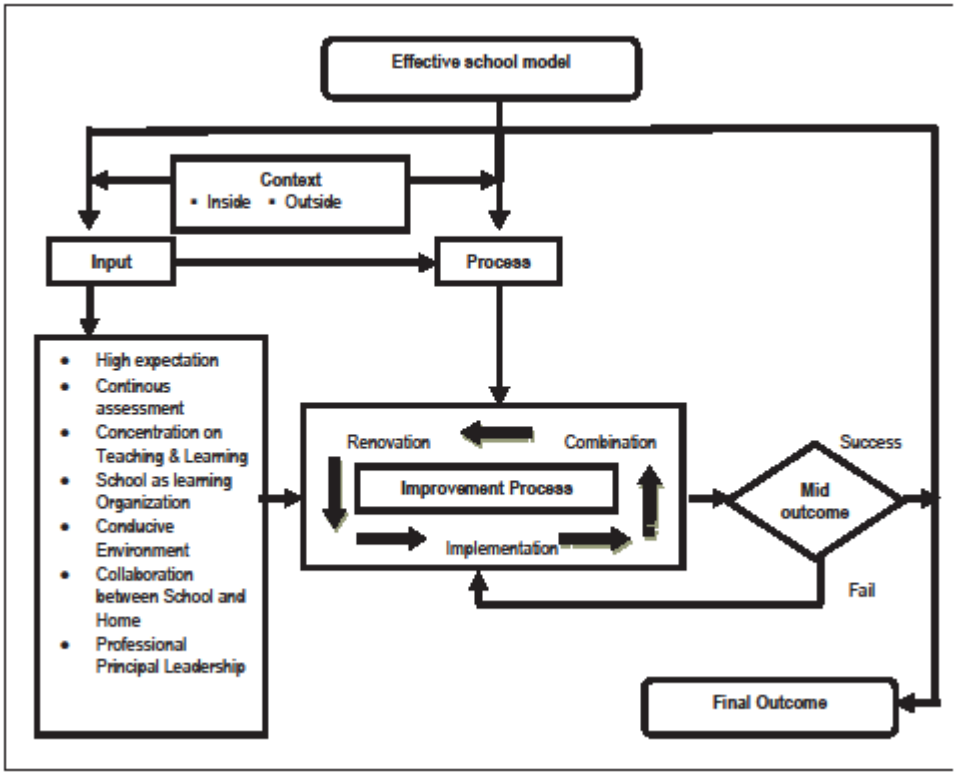

Figure 1. Effective school model of school effectiveness and improvement approach (Adopted from Ghani et al.2011).

ETHICAL CONSIDERATIONS

The researcher obtained official permission to conduct the study and asked the participants to get written consent forms before undertaking a research. The participants ethically remained anonymous for all questionnaires . All information was completely kept confidential.

METHODS

Within a quantitative research method, a survey design was used. Surveys aim to collect information as accurately as possible, and employ in such a way in repeating at another time or area, and comparable results(Lodico, Spaulding & Voegtle 2010). This study compared teachers' and students' perceptions of the factors contributing to physical sciences with each other.

a) Data Collection

Teachers' and students' perceptions of the factors contributing to poor performance in physical sciences were collected by means of a closed questionnaire. The questions about how to improve science performances were open-ended question. The questionnaire was pilot-studied to identify any ambiguity or unclear issue. Then, some questions in the questionnaire

were edited for clarity. Three questions adopted from Karigu (2015) were related to poor background in mathematics, lack of textbooks and teachers' poor teaching methods contributing to poor performance in physical sciences. The justification was to establish whether the students from different economic status and context would respond the same in three questions. The questionnaires of the teachers and students were somewhat different because some of the items were relevant to such factors as issues about job satisfaction, a lack of support from advisors and challenging content in CAPS for physical sciences. But, the closed questionnaires of the teachers and students generally covered factors about students, classrooms and schools.

A group of experts and peers in science education checked and validated the questionnaire .

b) Data Analysis

The data were quantitatively analyzed through such descriptive statistics as percentages and frequencies. Inferential statistics enabled to generalize the results from the sample data. , Since the questionnaire was the only instrument used to complement the captured data via the literature review, this study recruited this technique to gain insights of their perceptions. In analyzing the question about how to improve the poor results, the teachers' and students' responses to the questionnaires were ezposed inference analysis.

c) The Population of the Study

The population of this study was all Grade 11 students and teachers from schools in the Motheo District.

d) The Sample of he Study

The sample of this study comprised of 79 Grade 11 students attending Saturday classes at a university of technology in South Africa. The aim of this intervention was to assist them in obtaining better results to continue Science, Engineering- and Technology-driven courses at higher education institutions. Enrolment in the study, which takes place annually in January, purposes to enable students to better prepare, and improve their marks for admission to Science, Engineering- and Technology-related courses in higher education institutions The convenient sampling technique was used to select seventy nine grade 11 students and seven teachers. That is, 46 (58.2%) female and 33 (41.8%) male students participated in the study. 74 (93.7%) of the students were from co-education secondary schools, while 5 (6.3%) of them were from female secondary schools.

32 (40.5%) of them were from secondary schools in rural areas, whilst 47 (59.5%) of them were from secondary schools in urban areas. 4 (57.1%) male and 3 (42.9%) female teachers took part in this study. 5 (71.4%) of the teachers were from co-education secondary schools, whereas 2 (28.6%) of them were from female secondary schools.. The focus on this skewed sample of the teachers and students was that this research only included volunteer participants involved a school –university intervention. Namely, this sample was more motivated and possessed higher science achievement than the average teachers and students in the same district.

FINDINGS

In this section, the findings gathered from the questionnaires and interviews conducted to reveal students' nature of science understandings were presented. In this

regard, four expected elements- being tentative, experiential, inferential, and imaginary and creativity, which the 5th-8th grade students have about the nature of science constituted their profiles. Additionally, to enhance the discussion that will be done about the students' nature of science understandings, the answers given to the questionnaire and the semi-structured interview were extensively explained by using direct quotations from the students' own statements.

Table 3 compares the students' and teachers' perceptions of the factors contributing to poor performance in Physical Sciences. The top numbers are for learners and the bottom are for teachers.

Table 3. Frequencies and percentages of students' and teachers' erceptions of the factors contributing to poor performance in Physical Sciences

Factor		Great extent		Lesser extent		Least extent	
		f	%	f	%	f	%
Lack of textbooks	Students	18	22.8-	22	27.8	39	49.4
	Teachers	-	-	3	42.9	3	42.9
Quality of Physical Sciences textbook	Students	16	20.3	33	41.8	30	38
	Teachers	1	14.2	1	14.2	4	**57.1**
The ratio of learner-teacher	Students	18	22.8	26	32.9	29	36.7
	Teachers	2	28.6	4	**57.1**	1	14.2
Students' negative attitudes towards Physical Sciences	Students	27	34.2	30	38	20	25.3
	Teachers	2	28.6	2	28.6	3	42.9
Teachers' poor teaching methods	Students	20	25.3	26	32.9	31	39.2
	Teachers	2	28.6	2	28.6	3	42.9
Lack of practical laboratory lessons	Students	40	**50.6**	14	17.7	23	29.1
	Teachers	3	42.9	3	42.9	1	14.2
Students' poor mathematical background	Students	19	24.1	35	44.3	24	30.4
	Teachers	4	**57.1**	1	14.2	2	28.6
Family socio economic status	Students	11	13.9	25	31.6	38	48.1
	Teachers	-	-	6	**85.7**	1	14.2
Non-completion of the syllabus	Students	26	32.9	24	30.4	26	32.9
	Teachers	3	42.9	2	28.6	2	28.6
English as an instructional language	Students	17	21.5	18	22.8	40	**50.6**
	Teachers	4	**57.1**	1	14.2	2	28.6
Lack of teacher's professional development	Students	17	21.5	28	35.4	30	38
	Teachers	2	28.6	2	28.6	3	42.9

40 (50.6%) of the students and three (42.9%) of the teachers perceived the lack of practical laboratory lessons as being a great contributor towards the poor performance in Physical Sciences. Four (57.1%) of the teachers and nineteen (24.1%) of the students regarded poor mathematical background as being a great contributor to the poor performance in Physical Sciences.

Four (57.1%) of the teachers regarded English as an instruction language as being a great contributor towards poor performance, while 40 (50.6%) of the students viewed English as an instruction language as a factor making the smallest contribution to poor performance in Physical Sciences. There is a disjuncture between teachers' and students' views of English as an instructional language. Perhaps this may result from the fact that most of the participants were students studying in urban areas, and some of whom attended former Model C schools. Four (57.1%) of the teachers and 30 (38%) of the students considered that the quality of the Physical Sciences textbook was not a great contributor to poor performance in the subject. This means that teachers' inabilities to assess the educational quality of a textbook.

Table 4 indicates the teachers' perceptions of poor performance that was apart from the students' questionnaires.

Table 4. Frequencies and percentages of the factors contributing to poor performance in Physical Sciences

Factors	Great extent		Lesser extent		Least extent	
	f	%	f	%	f	%
Challenging content in CAPS for Physical Sciences	5	**71.4**	2	28.6	-	-
Lack of advisor support	-	-	3	42.9	3	42.9
Job satisfaction	1	14.2	3	42.9	3	42.9

As seen from Table 4, the teachers saw the 'challenging content in the CAPS document for Physical Sciences' as being a great contributor to poor performance in Physical Sciences. Five (71.4%) of the teachers identified the 'challenging content in the CAPS document for Physical Sciences' as being a great contributor to poor performance in the subject. Perhaps this may come from a lack of in-service education on new topics contained in the CAPS document.

Table 5 illuminates the students' responses about how to improve their poor performances in Physical Sciences.

Table 5. Frequencies and percentages of the students' responses about how to improve their poor performances in Physical Sciences

Ways to improve poor performance	f	%
More extra classes in Physical Sciences	40	50.6
More practical lessons in Physical Sciences classrooms	52	65.8
Motivating students to have positive attitudes towards Physical Sciences	20	25.3
Use different teaching strategies in teaching Physical Sciences	15	19
Fully-equipped science laboratories	45	57
Relating physical science concepts to everyday life-experiences	12	20.3
Peer learning	24	30.3
Having more classroom activities than homeworks	14	17.7

As observed in Table 5, 52 (65.8%) of the students referred to more practical lessons in Physical Sciences classrooms. That is, most of the teachers maybe only doing experiments that are examinable.

45 (57%) of them cited to fully-equipped science laboratories. 40 (50.6%) of them depicted a need for more extra lessons in Physical Sciences, while 20 (25.3%) of them mentioned about a need for more motivation resulting in positive attitudes towards the subject. 15 (19%) of them suggested the use of different teaching strategies in teaching Physical Sciences. 12 (20.3%) of them reported to relate physical sciences concepts to their everyday life experiences. 24 (30.3%) of them stated that peer learning would improve poor performance in Physical Sciences, whereas 14 (17.7%) of them implied more classroom activities than homeworks.

Table 6 shows the teachers' responses regarding how to improve poor performance in Physical Sciences.

Table 6. Frequencies and percentages of the teachers' responses regarding how to improve poor performance in Physical Sciences

Ways to improve performance	f	%
More attention to science and mathematics concepts' basic principles	2	28.6
Avoiding code-switching resulting in more misconceptions	2	28.6
A need for more guidance and support to improve teachers' content knowledge and pedagogical content knowledge	4	57.1
A need of reasonable teacher-learner ratio for optimum interaction and attention	3	42.9
Training teachers about Natural Sciences at the GET band	4	57.1
Teacher consultation to realize problematic sections in Physical Sciences	2	28.6
Hands-on practical investigations in Physical Sciences classrooms.	2	28.6
A need for researching and reading a great deal of the topic teachers teach	1	14.2

As seen from Table 6, 2 (28.6%) of them cited to more attention to science and mathematics concepts' basic principles. 2 (28.6%) of them referred to avoid code-switching resulting in more misconceptions. 4 (57.1%) of them stated that teachers needed more guidance and support to improve their content knowledge and pedagogical content knowledge. 3 (42.9%) of them addressed a need of reasonable teacher-learner ratio for optimum interaction and attention. 4 (57.1%) of them implied training teachers about Natural Sciences at GET band. This may stem from the fact that most teachers only teach the topic they feel themselves comfortable to teach, e.g., a life science teacher will not do justice to the physical sciences a part of the 'natural sciences' syllabus.

2 (28.6%) of them pointed to teacher consultation to realize problematic sections in Physical Sciences. 2 (28.6%) of them dealt with hands-on practical investigations in the Physical Sciences classrooms. One (14.2%) student addressed a need for researching and reading a great deal of the topic teachers teach.

DISCUSSION

This study compared the teachers' and students' perceptions of the factors contributing poor performance in Physical Sciences. The results indicated that their perceptions of the factors were different. The teachers regarded 'challenging content in the CAPS document for Physical Sciences, English as an instructional language (Howie, 2003; Department of Education, 2000), and student's poor mathematical background' as great contributors to poor performance in physical sciences (Karigi et al., 2015). On the contrary to Karigi et al. (2015), this study did not find the 'lack of textbooks and poor teaching methods' as a great

contributor to poor performance in physical sciences. The students considered the 'lack of practical laboratory lessons' as a great contributor for poor performance in Physical Sciences (Mji & Makgato, 2006). Abraham and Rambuda (2000), Mosoeunyane, Torres and Zeilder (2002) (cited by Makgato,2007)saw the instructional language as a barrier for students' performances in Mathematics and Physical Sciences. This study also found that English, as an instructional language, was a great contributor to poor performance in physical sciences. Tsanwani (2014) found teachers' and students' perceptions of the factors (student's and teacher's commitment and motivation, attitudes and self-conception, students' career prospects, students' perceptions of peers and teachers, and teachers' perceptions of students) facilitating students' performances in Mathematics. This study did not find students' negative attitudes towards physical sciences as a great contributor to poor performance in physical sciences. Students suggested more practical lessons in physical sciences and fully-equipped science laboratories, whereas teachers recommended to more guidance and support for teachers to improve their content knowledge and pedagogical content knowledge and training teachers about natural sciences at the GET band.

CONCLUSION and RECOMMENDATIONS

The teachers' and students' perceptions of the factors contributing to poor performance were varied from one another. The teachers' and students' perceptions of the factors contributing to students' poor performances in Physical Sciences were worrisome. They needed to be taken into cognizance by teachers and learners in order to improve their performances. Teachers and students should implement the suggested ways reported in the current study. Group or pair projects should be assigned to students to collaborate them outside of the classroom borders to enhance peer interaction. The school laboratories should be fully equipped. Teachers should try to conduct as many experiments as possible. Role models may also be invited to the school to motivate students. Workshops should regularly be conducted to help teachers challenge the content of the CAPS curriculum. To improve their content knowledge and pedagogical content knowledge teachers need more guidance and support. The department of basic education should employ teaching assistants to help students to do their homeworks. Teachers should didactically use contextualization to teach science. Hence, this will promote conceptual change and improve student's poor performance in physical sciences.

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