

**EXAMINING FACTORS THAT IMPEDE AND ENHANCE COGNITIVE
LEARNING OF GRADE 10 LEARNERS IN PHYSICAL SCIENCE**

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Abstract

Over the years studies have discovered that the achievement of learner's performance has been below the expected level. Studies have examined the multiple of factors that determining academic performance, pointing to cognitive ability as the strongest cause among many factors. This study examines some of the factors that impede and enhance cognitive learning of Grade 10 learners in Physical science. The study adopted qualitative approach using semi-structured interview to elicit information from learners and educators on various factors that affect and promote their performance in physical science as a subject. 4 educators, 4 Head of Department and 10 learners were purposively selected for this study. The findings revealed that learners have interest and shows positive attitude for Physical science but most of learners indicated they understanding when English is used as a medium of instruction in teaching Physical science but some prefer other languages to be used for their understanding. The study also reveals that learners had a high rate of their teachers motivating them enough to like physical science, by using different method for them to understand the subject. The study however concluded by giving general recommendations for improving learners' participation and attitudes towards learning Physical science.

Key Terms: Academic achievement, Physical sciences, Learner Performance, Educator.

Introduction

A large percentage of South African schools are failing as institutions of learning and teaching (Johnson, 2009:461-462). From 2005 to 2007, the number of learners who passed Physical Sciences at the higher grade level has steadily decreased and this has affected their entry into science-based programmes at universities (Kriek & 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 27 122. Evidently, 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 55% to 37% (Department of Basic Education (2011). According to the Department of Basic Education (2011:7), any district that achieved a pass rate below 50% was underperforming. It is worth noting that the achievement of Physical Sciences learners gives an indication of the effectiveness and efficiency of Physical Sciences teaching and learning. This is substantiated in

the Report on the 2011 National Senior Certificate Examination, National Diagnostic Report on learner performance in Physical Sciences.

Table 1.1: Overall achievement in Physical Sciences from 2008-2015 (National Matric Results (Grade 12)).

YEAR	Number that wrote	30% and above (n)	30% and above (%)	40% and above (n)	40% and above (%)
2008	217 300	119 206	54.9	62 530	28.8
2009	220 882	81 356	36.8	45 452	20.6
2010	205 364	98 260	47.8	60 917	29.7
2011	180 585	96 441	53.4	61 109	33.8
2012	178 887	109 700	61.3	69 927	39.1
2013	184 383	124 206	67.4	74841	48.4
2014	169 997	103 348	61.5	64578	34.3
2015	193 189	113 121	58.6	62 456	32,6

(Report of Department of Basic Education 2015:60).

In 2009, all the 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 mathematics and science students.

A number of possible factors contribute to the poor performance of learners in Physical Sciences. Based on personal experience over the last six years, learning Physical Sciences is more challenging for African learners who are English second language speakers 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 as subject have extensive quantitative components. Cognitive requirement for physical sciences involve scientific as well as analytical thinking. Hence learners require mathematical and problem solving skills. Physical science 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% and 61.1% in 2009. In 2010, 61.1% of grade 12 learners passed the Senior Certificate examination; in 2011, the pass rate increased to 68.1% (Daily News 2012:2). The pass percentage in Physical Sciences in 2011 was 51.9% and in 2012 it was 53.3% (Department of Education 2012b). However, the extent which such factors affect learning has not been clearly established. In addition, such factors were established a decade ago. Basically, this means that current relevance in the South African high schools needs to be established. The researcher argues that besides the known factors, there could be some more factors that have gone unnoticed and will keep on affecting learners' educational effectiveness, if this research is not conducted. Hence this research contributes to academic knowledge that could be used to drive policy implementation within the South African high school context.

A cognitive learning ability can be described as a mental capacity; competency or skill needed to carry out, or perform, a cognitive task(s) (Colman, 2009; Galotti, 2008). For example, working memory is a cognitive ability or capacity to actively retain information temporarily, while at the same time manipulating that information or accessing other information (Dehn, 2008; Izawa & Ohta, 2005). While there are numerous cognitive learning abilities, often they are positively correlated with each other. This positive correlation across abilities has, in turn, led to the acceptance of a general cognitive ability (Dickens, 2008). General cognitive learning ability commonly refers to one's overall cognitive ability and is often used synonymously with intelligence and measured with intelligence tests (Dickens, 2008). In this study, much will be examined on cognitive learning abilities that relates with performance.

PURPOSE OF THE STUDY

This study examines some of the factors that impede and enhance cognitive learning of Grade 10 learners in Physical science

RESEARCH QUESTIONS

1. What are the factors that impede cognitive learning?
2. What are the factors that can enhance the learner's cognitive learning for performance?

LITERATURE REVIEW

Cognitive learning ability is one of the major factors that contribute to performance of learners. But then the word academic performances have to be clearly defined. Academic performance is referred to as academic achievement, has been defined as "the specified level of attainment of proficiency in academic work designated by test scores" (Shamashuddin, Reddy, & Rao, 2008, p. 75). A review of the literature concerning academic performance reveals that predicting and understanding individual differences in academic performance have long been a central issue for, educators, policy makers, researcher's parents and students alike. Many factors have since been associated with academic performance and the list of factors has become large and diverse. The numerous factors, however, typically fall into two general categories namely; intellectual factors

and non-intellectual factors (Crede´ &Kuncel, 2008). Intellectual factors include intelligence, tests of general cognitive ability and tests of specific cognitive abilities (Crede´ &Kuncel, 2008;).Robertson (2012)referred to non-intellectual factors include, among others; personality factors, demographics, socio-economic factors, psychosocial factors, historical and familial factors, environmental factors, cultural factors, behavioural, attitude and motivational factors as well as the mental and physical health of individuals (McKenzie & Schweitzer, 2001).

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 leads to 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). As a physical sciences teacher at a public school in the UMgungumdlovu District in KwaZulu-Natal, a discouraged grade 9 pupil described physical sciences as “a hard subject”. Okoye (2002:562) notes that learners who come from a higher socio-economic status family are more motivated to study and show a positive attitude towards their studies.

Learning to use language effectively enables learners to acquire knowledge, to express their identity, feelings and ideas, to interact with others, and to manage their world. It also provides learners with a rich, powerful and deeply rooted set of images and ideas that can be used to make their world other than it is; better and clearer than it is. It is through language that cultural diversity and social relations are expressed and constructed, and it is through language that such constructions can be altered, broadened and refined. The implication of the above is that acquiring language skills gives learners an opportunity to learn how to learn.

Positive relationships with teachers support learners’ adjustment to school, contribute to their social skills, promote academic performance, and promote learners’ resiliency in academic performance (Battistich, Schaps& Wilson, 2004:243-262; Hamre &Pianta, 2001:949-967). The role of the teacher learner relationship is especially influential during adolescence.

Motivation to learn science is an internal state that arouses, directs and sustain science learning behaviour (Schunk 2008). Learners’ motivation is an essential element that is necessary for enhancing their cognitive learning for quality education and includes intrinsic and extrinsic. Intrinsic motivation includes involvement, curiosity challenge and social interaction (Cadzen, 2009). 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 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. Mokoena (2014) purport that “critical thinking implies a process where information is sifted. it involves an intellectually disciplined process of active and skilled conceptualization, application analysis, synthesis and evaluation of information that is collected by means of investigating, observation, experience, reflection, reasoning or communication and the use of the results to make progress in the field in which one works”. The motivation educators also could affect the teaching of physical science. Teachers have been known to have important influence on learners’ academic achievement and they play a crucial role in educational attainment. According to Akiri (2013) speaking that the educator is ultimately responsible for translating educational policies and principles into actions which is based on practice during interaction with the students. The educator, as an agent of change, should recognize that his/her major purpose is to helping learners gain the knowledge, skills, feelings and values that learner need to function effectively in the society. In other words, both teaching and learning depend on the role of the teacher and thereby influence the learners’ performance (Adu & Olatundun 2007).

METHODOLOGY

Research Approach

The study adopted qualitative research approach of an in-depth interview to investigate factors that impede and enhance cognitive learning and performance of Grade 10 learners. This approach allows the researchers to access multiple perspectives and dimensions and also improves the sources of data but also leads to better understanding of the specific research problem.

Sample/ sampling selection

Participants for this study were purposively selected from four secondary schools. The sample of four teachers, four HoD’s and 154 learners were purposely selected to provide information through quantitative and an interview on learners’ perception on physical science.

Data Analysis

In this study, the researcher used transcribing, coding and categorising and themes to analysed data collected from the learners, the head of departments from four schools selected. This was done to give meaning to the information collected and to make it easily accessible to the readers.

FINDINGS AND ANALYSIS

Theme 1: Factors that impede cognitive learning

Learners Attitude towards physical science

Majority of the respondents reported that they have interest and positive attitude for Physical science. One respondent reveals that physical science is too tough and the reason was not specified by the learner. The respondents had these to say:

Lr1D: Well , my attitude is fair, because as usual people , they take physical science as a hard , you know , subject but I intend to change that by proving that it is an easier thing. You just need to study hard.

Lr4B: My attitude I can say it's fair, because sometimes I pass it and sometimes I fail it.

Lr3B: My Physical science seem too tough, aaaah, although some reasons may be valid but it seems too tough for me.

Non parental involvement

The data gathered from the respondents showed the evidence of weak parent involvement seen in the learners' responses "Do you get assistance from your parents /guardian to do your homework? If no, then why? /How do you rate your parents'/guardians' assistance or supervision at home?" Most of the learners responded that they were not assisted. The following were also mentioned: 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:

Lr2C: My parent did physical sciences, so I mean they can help me but then they do show support in the sense of it because most times they are not always around because of work.

Lr2 D: Not at all because of their busy schedules

A Learner also mentioned that the only time the parent gets involved was when their report card arrived and it shows bad results. Learners from School D were in a similar situation with no help from parents. Obviously, most parents lacked knowledge about Physical Sciences and could not assist their children. A learner responded by saying:

Lr4 D: Not all the time but they get involved especially when I get my report and it shows bad results

Those learners 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

Language Problem

When learners are required to learn content in a second language, they are faced with the problem of content literacy (Van der Poll & 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 & 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. From the findings of the present study it was discovered that most of respondents indicated the level of understanding when English is used as a medium of instruction in teaching Physical science is good. From the interview half of the learners responded to this question saying that they prefer both languages to be used by the teacher to teach them. The reason for both languages is for their understanding. These are some statements made by the respondents

Teachers-learners' relationship

All the respondents agreed that their teachers are approachable especially for personal explanation on a particular topic. This is a major determinant of teacher-learner relationship. This implies also that they were free to relate their problem to them especially when it comes to the subject. They also confirmed that their educators always give them attention whenever they ask for assistance. From the interview the learners said that their teachers are approachable. One out of the respondent said

Lr2C: "sometimes he does sometimes he does not"

Learner Lr3C respond saying "He responds "meaning the teacher is approachable but "not in a way we expect". This simply means that a large number of the teacher create an atmosphere that makes it easy for the learner to learn.

Summary of findings and discussion on the factors that impede cognitive learning for performance

Some factors that are linked with the impediment of cognitive learning in the area of performance were highlighted according to the overview of the information from the participant. Looking at the response of the respondents many concur apart from some few, their interest and positive attitude they have towards physical science. As it is known that interest is a form of attitude portrayed in any subject especially when it comes to a subject like physical science. Interest especially in learning according to Woolfolk (2007:206) is a process through which experience causes permanent changes in knowledge or behaviour. Interest breeds learning and the discovery learning calls for active participation of the learner with interest (Zenda, 2016), Zenda (2016) cited Kramer that the learner is viewed as an active explorer and is capable of discovering new information independently (Kramer, 2002:6-7). Positive Attitude could help learners to discover scientific concepts and principles for themselves rather than through other social groups, such as educators (Department of Basic Education, 2011:9). Dhurumraj (2013)

referred to the department of education saying that physical sciences encourages a responsible and ethical attitude towards learning, constructing and applying science, and it allows for reflection and debates on theories and scientific models (Department of Education 2003). Therefore, the researcher is of the view that negative attitude hampers the cognitive learning of the learners for their performance.

Theme 2: Factors that can enhance the learner's cognitive learning for performance

The motivation of the learners

On the aspect of motivation, the respondents identified that the teacher get them motivated them enough to like physical science. Virtually all the learners indicated that their teachers do motivate them in physical science. One of the learners at the interview said that the teacher does not really get time to motivate. This is what the respondent had to say;

Lr2B: Not really because aaaah... he, he doesn't motivate us sometimes. We don't get much time to be motivated. We just get to the subject and learn.

The teaching approach

The teaching approach comes in a form of the method's the teacher uses to teach the learners. From the findings of the study it was discovered that most of respondents indicated that their teachers use different method for them to understand the subject. A respondent said this

Lr2A agreed in using the teacher's method but use my own method. Respondent

Lr1B response to not using the teacher's method. 18% of the learners said "No" to the question. This means that their teacher does not use different method of approach to teach them. A respondent was not really specific in statement but said that the teacher does a little bit of demonstration

Lr2C said "not really but not really a lot, but he does have a little bit of demonstration here and there.

Looking at the question that related to the above question which says whether they use their teacher's method in solving physical science problems. Many respondents that they use their teacher's method. The findings from the interview shows that 7 respondents revealed that they use their teachers' method. There are some that says that though they use their teacher's method but they also use their own. A respondent said this;

Lr2A agreed in using the teacher's method but use my own method.

This was also confirmed by the educators that they do give the learners different method for their understanding. Finding from the interview of the educators shows that all four educators responded to the question to be given different method of teaching for the learners understanding. Two of the respondents indicated that the learners were taught using the group work. The two respondents made the following statement;

EdrA: Yes, for example in grade 10 as a small class, I set them in groups and provide what I gave them to put it in summary.

EdrB: mhm... Mostly group work. Using group methods, grouping them and giving them what to work as a group

A respondent clearly stated that the learners were given lecture method, group work and demonstration, because of how it helps the educator to cover a lot of lesson. The respondent made the following statement;

EdrC: The lecture method because it is a, it makes me cover a lot of things within a lesson. Another method I also use is group work as well as aah... yeah demonstration.

The heads of department confirmed from the finding that many of the learners enjoy their method of teaching. Three respondents revealed from the question that was asked whether the teachers give the learners different method of teaching for their understanding. The heads of department revealed that the teacher gives the learners different methods which include group work, lecture method and practical. These following were said;

HoD A: Yes. Group work and lecture method.

HoD B: Yes they do understand that learners have different learning styles. Those who are so, who need more of the practical side, they do so. Mhm... those who can take the abstract things, they also accommodate them in that line.

HoD C: Yes we try different approaches and eeeh try to relate things to everyday life. Eeeh so that it's not just theoretical and aaaaah, we do, we try whatever method to get them understand the work, yes.

Cognitive level of learners

The way in which learners typically receive and process information was revealed to have relation to academic performance and cognitive ability of the learner. A finding from the respondent shows how the learners were able to process information that they receive when been taught. Most of the respondents who were asked to indicate when they think about what they did yesterday are they most likely to get a picture. The overall response of the learners shows that they do get picture and a word of what they were taught a day before. Looking at the percentage responses to the question, it was clear that both respondents who tend to understand the overall structure but fuzzy about detail did respond to the question were equal.

The inclusive of practical work in physical science

Practical work is known to supports development of scientific skills, thinking skills and how scientists work. It helps, learners to be exposed to basic processes of science. From the open

ended question, the respondents stated how they wanted physical science to be handled in order to improve their performance. It was revealed that the educator should make the lessons more and more experiments. Other respondents asked for more lab and the stuff that is used or important in science. The following were the statements the respondents made:

Bring things that we don't have for e.g. lab so that we can do practical

We need lab to do our practical

I want physical science to be handled by doing everything in practical and the teacher may try to explain. We need to be involved by a teacher in order to improve and we need to participate.

EdrC: *The lecture method because it is a, it makes me cover a lot of things within a lesson. Another method I also use is group work as well as aaah yeah demonstration.*

Three of the four HoD's responded that practical side will enhance the studies of the learners. This is statement made.

HoD B: *The best method are those that involve eeehm...the practical side, yeah, doing thing and learners see things been done, instead of telling learners, learners see themselves. Yeah*

HoD C: *Eeeh..., it involves not too much of explaining but a lot of practice*

HoD D: *There is chalkboard method and demonstration because physical science is about demonstration and you have to do a practical work just to, to, to put more light in the subject. In other word it can be called a process skill.*

Summary of findings and discussion on factors that can enhance the learner's cognitive learning for performance

Some factors that enhance cognitive learning in the area of performance were highlighted according to the overview of the information from the respondents. On the aspect of motivation, the respondents identified that the teachers get them motivated enough to like physical science. On the other hand, there are those few who say that the teacher, does not really get time to motivate. The role of the educator is much paramount in the motivation of the learner. The educator, as an agent of change, should recognize that his/her major purpose is to motivate and help learners gain the knowledge, skills, feelings and values that learners need to function effectively in the society. In other words, both teaching and learning depend on the role of the teacher and thereby influence the learners' performance (Adu & Olatundun, 2007).

From the findings of the study it was discovered that most of respondents indicated that their teachers use different method for them to understand the subject and the approach of their teachers that are used in teaching is good. Many of the learner interviewed revealed that they use their teacher's method. There are some that says that though they use their teacher's method but

they also use their own. In this way the researcher believes that most of the learners are involve in the active learning. Teaching approach is a two-way process which is uses as active learning outcome based education (OBE) placed tremendous emphasis on making learning a two-way process. 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. 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.

Mokoena (2014) also purported that “critical thinking implies a process where information is sifted.it involves an intellectually disciplined process of active and skilled conceptualization, application analysis, synthesis and evaluation of information that is collected by means of investigating, observation, experience, reflection, reasoning or communication and the use of the results to make progress in the field in which one works”. The above indicate that physical sciences learning will require critical thinking skills as is indicated in the CAPS document that purpose of Physical sciences is to make learners aware of their environment and equip learners with investigating skills relating to physical and chemical phenomena, for example lightning and solubility.

Conclusion /Recommendations

Based on the findings of this research into examining the cognitive learning effect on grade 10 students’ performance in physical science in selected schools in uMgungundlovu education district KwaZulu Natal the researcher recommends that schools ensure that:

- Learners are appropriately assisted with regards to the selection of subjects at the FET phase.
- Parents should spend more time encouraging learners in physical science subject motivate, speaking positive word (like completing tasks or achievements) by words like “you can make it”, “you can do better”, and never use words to discourage them.
- Parent should encourage their children to read more, thus improving language. By reading learners would develop a better understanding of words and meaning. To assist learners with this aspect parents should ensure that their children have adequate reading material.
- In addition, parents should supervise their children to complete their school works and homework and have a good relationship with the educators so as to monitor how the learner is making progress.
- More activities should be provided which stimulate the cognitive development of every learner.
- Testing could include more comprehension and critique-based questions and material, depending on the level required.

- Educators could, otherwise, take steps to ensure that students have retained and comprehended the material learned, such as testing the students again at a later stage.
- 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.
- Visits to schools to assess the laboratory status of schools.
- Adequate funding for new updated text books in line with the current syllabus.
- Department of Education should revisit the physical science curriculum which expected to be done with the short term and possibly separating it into physics and chemistry in the FET phase.
- It is also recommended, that future studies investigating academic performance should describe the tests and exams used in order to obtain an average score as a measure of academic performance. For example, what kinds of tests were used as well as what the tests intended to asses.

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