A COMPARATIVE STUDY OF THE LANGUAGE, MATHEMATICS AND SCIENCE LITERACY KNOWLEDGE AND SKILLS OF GRADE 9 LEARNERS IN SECONDARY SCHOOLS IN PORT ELIZABETH

KEITH VICTOR ARNOLDS

2012
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By

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Submitted in fulfilment of the requirements for the degree of Doctor Educationis to be awarded at the Nelson Mandela Metropolitan University.

December 2012

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ACKNOWLEDGEMENTS

I would like to take this opportunity to express my most sincere appreciation and gratitude to all those who made this study possible, specifically to:

- Almighty God for providing me with the courage and strength to complete this journey.
- My promoter, Dr Christina Jordaan, for her patience and willingness to support, motivate and give expert guidance. I couldn’t have done this without you.
- The school principals and participants in this study, for making it possible for me to conduct this study.
- My parents, Victor and Thelma, for always believing in me and laying the foundation from which I could soar.
- My sons, Kevin and Keegan, I hope this will serve as inspiration for you to surpass the expectations I have for you and the goals you set for yourself.
- Mr Anthony Sparg for the professional editing service.
Language declaration

I, Anthony Sparg, language practitioner, undertook language editing of the PhD thesis titled “A comparative study of the language, mathematical and science literacy knowledge and skills of Grade 9 learners in secondary schools in Port Elizabeth” for Mr Keith Arnolds.

Anthony Sparg

20 December 2012
ABSTRACT OF THE STUDY

In South Africa, on-going concerns surrounding the development of learners' literacy, mathematics and science skills are evident and drive various research studies in this field. International studies and assessments, such as the Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS) show major differences in the proficiency levels of learners in South Africa in comparison with their international counterparts.

To date, however, the more comprehensive international standardised assessment called the Programme for International Student Assessment (PISA), has not been administered in South Africa.

The main aim of this research study was to investigate and scientifically explore the real situation in terms of language, mathematics and science literacy knowledge and skills of Grade 9 learners in South Africa and to draw a comparison between Grade 9 learners from secondary schools in the Port Elizabeth district in South Africa and their international counterparts, using the PISA standardised international assessment. In addition, the aim of the study was to determine the actual language, mathematics and science literacy skills and knowledge acquired by participants in this study.

Quantitative data collection was done by administering a modified version of the Program for International Student Assessment (PISA) to learners from eight schools in Port Elizabeth, supplemented with questionnaires completed by participating learners and school principals. Findings revealed that the South African learners sampled, ranked in the bottom percentile of participating countries in reading, mathematics and science. The study also exposed the glaring inequalities still prevalent in South African education today, 17 years into democracy. The implications point to a serious investigation into the societal and political factors responsible for the discrepancies in the South African educational system at present.
Key terms

Comparative education, exploratory-descriptive, Grade 9, international standardized assessment, knowledge and skills, mathematics, Port Elizabeth, Program for International Student Assessment (PISA), quantitative research, reading, science,
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CHAPTER 1
ORIENTATION TO THE STUDY

1.1 CHAPTER OVERVIEW

- Introduction
  - Background to and motivation for the study
  - The history of Port Elizabeth
  - The research problem

- Ethical considerations
  - Research methodology
  - Research aim and objectives

- Significance of the study
  - Clarification of concepts
  - Organisation of the study

- Research questions
1.2 INTRODUCTION

In the last two decades, teachers in South Africa have faced considerable changes to the education system, as well as major changes to the curriculum. These changes were imposed by government, by means of new policies, such as Curriculum 2005, and Curriculum Assessment Policy Statements (CAPS). The national Department of Education has successfully produced many policy (and curricular) documents, but has been less successful in implementing these documents in schools. To add to the difficulties of implementation, there are still marked discrepancies between schools in South Africa. Even after almost 19 years of democratic government, schools that were previously designated for white learners only are still very different from schools that were disadvantaged under the apartheid regime.

Johnson, Monk & Hodges (2000) are of the opinion that South Africa effectively still has separate education systems operating within the country, in light of the stark differences which persist in teacher education and education provision.

Fleisch (2007) reflects on this in his description of South Africa as consisting of two nations. Howie (2001) expresses the same sentiments in her analysis of the country as being both a developed country and a developing country with regard to its education system.

In South Africa, ongoing concerns surrounding the development of learners’ literacy and mathematical and scientific skills drive the literacy teaching and learning research landscape. Concerns regarding literacy skills among learners have been raised at different levels by various authors. For instance, Bloch (1999) and Lessing & De Witt (2005) raise concerns associated with learners’ development of basic literacy skills at Foundation Phase, while Matjila & Pretorius (2004) and Pretorius & Ribbens (2005) raise concerns about learners’ acquisition of more advanced literacy skills in high school. Concerns about the development of the advanced literacy and language skills needed for tertiary level education are expressed by Pretorius (2002). All of these levels of literacy skills acquisition have been reflected on in local research by Howie (2001).
1.3 BACKGROUND TO AND MOTIVATION FOR THE STUDY

The researcher was fortunate to work in Saudi Arabia for 11 years, from 2001 to May 2012. During this period, he worked with teachers and learners from all over the world gaining first hand insight into their literacy skills and knowledge. He has two sons who attended school in Saudi Arabia, and this gave him the opportunity to make comparisons between his sons and learners from other countries. It became clear that, although the researcher’s own sons fared better in languages, they were outperformed in mathematics and science. It should be noted that these are only informal observations, and that no formal assessments were conducted to reach these conclusions.

Smit (2002:17) remarks that 27 April 1994 marked a turning point in South Africa’s history, with the birth of the first democratic state. This transformation hailed a shift in political discourse, from a context of resistance and domination to reconciliation and democracy. The enactment of the South African Schools Act in October 1996 sowed the seeds for transformation in the country’s education system. For the first time in the history of South Africa, the country had one unitary education system and schooling that was compulsory for all children between the ages of 6 and 15 and open to all children, regardless of race. These reforms initiated a process of desegregated schooling.

Curriculum change in post-apartheid South Africa started immediately after the elections in 1994, when the National Education and Training Forum began a process of curriculum revision and subject rationalisation. The purpose of this process was mainly to lay the foundation for a single national core syllabus. Besides rationalising and consolidating existing syllabi, curriculum developers in the National Education and Training Forum removed overtly racist and insensitive language from syllabi. For the first time, curriculum decisions were made in a participatory and representative manner. However, the National Education and Training Forum process was not a curriculum development process, nor was it intended to be one (Arnolds 2006:22).
As previously mentioned, many new education policies were adopted after the first democratic election of 1994. Kraak & Young (2000:2) list a number of education initiatives introduced by the ANC government immediately after 1994, which are mentioned below:

- integrated education and training;
- a unified national Department of Education;
- a single Further Education and Training (FET) band incorporating both senior secondary schooling and technical colleges;
- a single nationally coordinated system of Higher Education and Training (HET); and
- a single National Qualifications Framework (NQF) regulated by a single qualifications authority, known as the South African Qualifications Authority (SAQA).

Kraak & Young (2000:2) mention that it is widely recognised that the major priority of the second ANC-led government, which was elected in April 1999, was the implementation of policies.

Some of these policies include initiatives such as

- the National Strategy for Higher Education;
- a review of Curriculum 2005;
- a review of the National Qualifications Framework;
- the National Skills Development Strategy;
- the Human Resources Development Strategy; and
- a new programme for work-based training (known as learnerships).

It can be argued that the above-mentioned initiatives were designed with noble intentions, such as the overall improvement of education in South Africa. However, recent reports, which will be highlighted in this study, indicate that the desired effects of these initiatives were not achieved, and that investigation is required.
Since the transition to democracy in 1994, education in South Africa has been riddled with reports of learners performing extremely poorly in literacy and numeracy tests. Reddy et al. (2006) conducted the Trends in International Mathematics and Science Study (TIMSS) in 2003 for the Human Sciences Research Council (HSRC). According to the findings of this study, South Africa had the lowest performance of school learners in mathematics and science of the 50 participating countries. While the international average score for mathematics was 467, learners from South Africa scored 264. Similarly, the international average score for science was 474, with learners from South Africa scoring only 244.

The same sentiments were recently expressed by the Congress of South African Trade Unions (COSATU) general secretary, Zwelinzima Vavi. He said that the country was unable to compete with many African states on basic survival skills, and that Zimbabweans that have moved to South Africa simply outperform their South African counterparts on many fronts. According to Vavi (News24 2009), this reflects the superior education that Zimbabweans receive in comparison with South Africans.

Jansen (2008:2) weighs in on the issue of underperforming learners by stating:

Those who write the final examination at the end of 12 years often do not pass or pass well enough to enter university. Research indicates a massive failure to achieve among young learners in literacy and numeracy in the early grades. The link between access and success is therefore very weak in South Africa’s schools, compared to less well-funded school systems in the southern African region.

To illustrate the point of underperforming learners, Caiphus Khosana reported in a newspaper article published in The Star on 27 August 2009:

Four out of five Grade 6 pupils cannot read or write at the required level. Tests conducted in 2001 and in 2004, as well as yearly assessments of pupils in Grade 6, have produced shocking results for the Department of Basic Education. Annual national assessments conducted in all primary schools show that only one in five
Grade 6 pupils achieve the average score of 50 percent and above in numeracy and literacy tests. Similar assessments show that only two in every five Grade 3 pupils meet the required levels when tested. There’s a real reason to be concerned about Grade 6. Something is not going right and needs to be addressed. Grade 3 and 6 pupils in the Eastern Cape, Limpopo and North West were the worst performers in language, mathematics and natural sciences.

Mbanjwa & Kassiem (The Star 2007: 2) report that the South Africa’s former Minister of Education, Naledi Pandor, claims that “the Education Department’s decision not to take part in an international mathematics examination was purely educational and had nothing to do with trying to avoid being embarrassed”. While Pandor did not deny that learners in South Africa were behind learners in other countries in mathematics, she said that there were interventions that the department was implementing to rectify this. Pandor has since been replaced as national Minister of Basic Education by Angie Motshekga, who immediately after her appointment established a ministerial committee to review the implementation of the National Curriculum Statement. A discussion of the finding of the ministerial committee will be given in Chapter 2 of this study.

The McKinsey report, released in 2010, reveals that in the Western Cape, from which the sample for South Africa was taken, both educators and the public were shocked that the pass rate for literacy tests was only 36 percent in Grade 3 and just 29 percent in Grade 6. Not only were these results surprisingly poor, but the results got progressively worse as learners got older. These findings indicate that there still does not seem to be any improvement in the general literacy and skills of learners in South Africa. The 2012 Annual National Assessment (ANA) results showed that Grade 9 learners scored an abysmal 12.7 national average in mathematics as reported by Mbabela (2012). The ANA results however were not segregated into gender, race, school type etc. and can thus not pinpoint exactly where the flaws in the South African education system lie. This study will attempt among others to provide some insight into the segregated nature of the results as it will analyse results in terms of race, gender, school types, etc.
Various international studies and assessments, such as the Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS) (see Chapter 2), have shown major differences in the proficiency levels of learners in South Africa with regard to mathematics and science literacy. To date, no detailed analysis of this phenomenon, using an international standardised test, has been conducted in South Africa.

An in-depth analysis of a sample of secondary schools from Port Elizabeth district will therefore contribute significantly to the body of knowledge in this field, and may provide results that can inform future curriculum development and implementation. This study will report statistical findings gathered from the administration of an international standardised assessment called the Programme for International Student Assessment (PISA). Schleicher & Tamassia (2003:3), who were tasked with preparing the report for PISA 2003, formulated the following ideas regarding PISA:

PISA assesses to what extent learners near the end of compulsory education have acquired some of the knowledge and skills that are essential for full participation in society. In all the three-year cycles, the domains of reading, mathematical and scientific literacy are covered not merely in terms of mastery of the school curriculum, but in terms of important knowledge and skills needed in adult life. It was developed by the Organisation for Economic Co-operation and Development [OECD] to measure how well students at age 15, and therefore at the end of compulsory schooling, are prepared to meet the challenges of today’s society. These skills reflect the ability of learners to continue learning throughout their lives by applying what they learned in school to non-school environments, evaluating their choices and making decisions.

Looking at assessment results in isolation would do a disservice to participants and may lead to unfair generalisations when interpreting results. For this reason, PISA included several items in the student and school questionnaires, such as learners' attitudes towards school in general, home and school resources, the influence of parents, and the living
conditions of learners, among other things. In the PISA 2000 report, Schleicher et al. (2001:99-114) present the following findings with regard to learners’ interests and engagement in learning, as well as their ability to organise the learning process:

- Motivation and engagement are central to lifelong learning, and learning autonomy can be nurtured at school;
- Subject interest can affect learning engagement;
- A positive attitude to reading leads to higher performance;
- Only a minority of students see mathematics as important for their future;
- The fact that interest can vary across different subjects indicates that it may be related to the way learning takes places;
- Many learners read only when they have to and consider reading to be a waste of time;
- In most of the countries surveyed, keen readers outperformed learners that reported low levels of engagement;
- A substantial minority of learners do not spend time reading for enjoyment;
- Education systems should strive to create a learning environment that encourages reading beyond just at school;
- In many countries, large numbers of learners have negative attitudes towards school and on average perform poorer than learners with more positive attitudes;
- Negative attitudes to school do not necessarily cause low achievement, but they are undesirable and can hinder future learning;
- The use of strategies to manage personal learning is positively linked to performance;
- Learners need to both memorise new information and understand how it relates to their prior knowledge; and
- Schools should help learners to develop strategies for managing their own learning.

Schleicher et al. (2001:139-143) looked at the relationship between learners’ background and their performance and concluded that:

- Parental occupation is a measure of socio-economic status and influenced learners’ aspirations and attitudes;
• Learners whose parents have higher-status jobs on average showed higher performance in literacy;
• Differences in performance hindered economic and social mobility from one generation to the next; and
• Generally, learners from wealthier families tend to perform better than their less wealthy counterparts.

The researchers that administered PISA asked learners about possessions in their homes related to classical culture, such as literature and art. The findings were as follows:
• Within the countries surveyed, the quarter of the learners that had the most cultural possessions in their homes had very high scores; and
• Learners that participated in cultural activities more frequently had higher literacy scores (Schleicher et al. 2001:144-146).

Next, the researchers that administered PISA asked learners to indicate how frequently they interacted or communicated with their parents in discussing political and social issues, books, films, television programmes, how often they listened to music together, how often they discussed how well the learner was doing at school, how often they ate the main meal together, and how often they spent time just talking. The findings were once again reported by Schleicher et al. (2001:139-143):
• Results were better for those communicating more on cultural matters.

Finally, learners were asked about parental education and family structure. The findings are as follows:
• A high parental level of education can contribute to a supportive home environment;
• The mother’s level of secondary education was positively associated with learner performance, with particularly low performance having been recorded among learners whose mothers had not completed senior secondary education;
• The mother’s level of tertiary education is less consistently associated with learner performance, where even learners with less educated mothers do well, which
indicates that other educational and societal factors can compensate for deficiencies in parental education;

- Single parents found it harder than couples to give learners sufficient support;
- Learners from a single-parent family performed less well than other learners, and where single-parent families are more common, the difference in performance is the greatest; and
- Learners that do not speak the test language at home performed considerably poorer than learners that do speak the test language at home (Schleicher et al. 2001:149-155).

South Africa is not part of the OECD, and, to the researcher’s knowledge, PISA has never been administered in South Africa to provide empirical research results. This was verified by conducting a search on the Nexus website. PISA will be used as an assessment for the purposes of this study, so the above-mentioned items will all be part of the questionnaire that will be administered to learners participating in the study. The results will then be compared against previous international results. More information about PISA will be given in Chapter 2.

The objective of PISA is to measure the “yield” of education systems, or what skills and competencies learners have acquired and can apply from the subjects of English, mathematics, and science to real-world contexts by age 15. The concept of literacy emphasises a mastery of processes, an understanding of concepts, and an application of knowledge and functioning in various situations within the three domains of reading, mathematics and science literacy assessed by PISA. By focusing on literacy, PISA draws not only from school curricula, but also from learning that may occur outside of school. It is unlikely to expect of 15-year-olds to have learned everything they will need to know as adults, but they should have a concrete knowledge and skills base in areas such as reading, mathematics, and science, a point stressed by Schleicher et al. (2001:19).
The fact that PISA has not yet been administered in South Africa to provide empirical research results leaves a gap for assumptions to be made concerning how learners in South Africa compare with their peers in the rest of the world in terms of acquired knowledge and skills. As PISA stresses a more holistic approach, by focusing on learner attitudes, home environment, and school resources, it will provide more reliable and relevant findings than a standardised assessment, such as TIMMS and PIRLS, whose sole focus is academic ability. A detailed description of TIMMS and PIRLS will be provided in Chapter 2. Although the PISA assessment utilised in this study includes a background questionnaire on learner attitudes, home environment, and school resources, the findings will not be part of the study, but will be dealt with as a separate academic article, as it will offer a different perspective on disadvantaged learners in South Africa.

The motivation for this study is to focus on the “educational yield” of PISA, mentioned in the previous paragraph, and to what extent participants have acquired literacy and mathematical and scientific knowledge and skills as compared with their peers in other countries. The study will add new knowledge to the field of education, as it will be the first study that will produce empirical findings that gauge how SA learners compare academically against their international counterparts in an international PISA assessment. The findings will also provide an understanding of external factors that are disadvantaging learners in South Africa, such as learner attitudes, the home environment and school resources. In addition, the findings will also aim to draw a comparison between learners from diverse educational environments after being exposed to the same curriculum for at least 9 years from Grade 1 to 9.

1.4 THE HISTORY OF PORT ELIZABETH

In order to place the study in context and refer to possible environmental factors, such as the effect of different suburbs on school and individual results, a brief history of the city where the study will be conducted is provided, as well as an explanation of the demographics of the participants and a brief overview of post-colonial segregation between
1910 and 1950 and the implementation of apartheid from 1950 until South Africa’s transition to democracy in 1994.

Frescura (1990:1) provides the following background information about the establishment of Port Elizabeth:

The British put up the first immigrant structure in Port Elizabeth in August 1799 to guard the landing place and water supplies at Algoa Bay. It is also likely that the British planned to establish a military presence in the region to discourage potential Dutch uprisings in the district of Graaff-Reinet, and to protect Cape Town, and hence the India sea route, from possible French attack.

Mackie (2009:10) explains that the area is steeped in history that stretches back to the San and the Khoi, the Portuguese explorers of 1488, and the 1820 Settlers who landed in Algoa Bay almost two centuries ago. Frescura (1990) adds that the township of Port Elizabeth was laid out in 1815, but was not developed until 1820, when some 5,000 British settlers arrived in Algoa Bay. Thus, in the beginning, Port Elizabeth served mainly as a service centre for the agricultural hinterland of present day Eastern Cape. Its basic function was to handle, and later process, goods and materials passing through its harbour. In the early years of the twentieth century, numerous manufacturing industries began to be established locally, most notable being a number of motor vehicle assembly plants, which created extensive employment opportunities. Mackie (2009:16) mentions that since the establishment of a British garrison in Port Elizabeth in 1799, and its subsequent transformation into a modern port city, it has been dubbed “The Windy City” and “The Detroit of South Africa (for its expansive motor industry). This, as well as increasing rural poverty in the region, attracted many workers to the town, to the point that until the 1960s it was South Africa’s third largest urban centre.
1.4.1 A demographic background of the participants

This section provides a brief demographic background of the four population groups in South Africa that were classified by the apartheid government, namely blacks, Coloureds, whites, and Indians, to lend credence to the environmental impact it may have on the performance of learners in the sample. The focus will be on how these population groups came to settle in Port Elizabeth.

The early population of Port Elizabeth consisted mainly of Europeans, as well as persons of mixed race, which the apartheid government subsequently labelled as “Coloureds” and “Cape Malays” (Frescura 1990). Mackie (2009:122) asserts that the growing town of Port Elizabeth began to attract a diverse community of immigrants seeking labour and trading opportunities, including various black Africans, among them isiXhosa, isiZulu, Sesotho and Setswana speakers, Europeans, Cape Malays, Indians, and Chinese. They organised themselves according to socio-economic status, rather than along racial lines, which were to be enforced much later on under apartheid.

Initially, only a few members of the indigenous population were attracted to the town, and almost from the outset, economic status was related to skin colour. Whites held a virtual monopoly over higher-paid jobs, and consequently could afford better housing in areas which were usually physically removed from other groups. Consequently, segregation was an integral part of early Port Elizabeth, with the industrial areas of South End and North End being predominantly Coloured areas, while the central and western suburbs were mainly white suburbs. However, while white attitudes to Coloured and Malay citizens remained relatively tolerant, official policies towards indigenous residents were markedly different. Thus, as an increasing number of black workers began to enter Port Elizabeth in search of employment, a number of so-called “locations” began to be established on the outskirts of the white suburbs (Frescura 1990).

This pattern of development was first established in 1834, when the colonial government granted a piece of land to the London Missionary Society (LMS) to provide a burial ground
and residential area for “Hottentots and other Coloured people who were members of the Church” (Baines 1989). This was located at the crest of Hyman’s Kloof, better known today as Russell Road. Other workers, however, chose to erect their homes closer to their places of employment, or where a supply of potable water was available, and this led to the establishment of various other suburbs.

The major black suburbs of the time were the following:

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bethelsdorp</td>
<td>1803</td>
</tr>
<tr>
<td>Fingo and Hottentot</td>
<td>1830s</td>
</tr>
<tr>
<td>LMS Outstation</td>
<td>1834</td>
</tr>
<tr>
<td>Dassie-kraal</td>
<td>c1850</td>
</tr>
<tr>
<td>Korsten</td>
<td>1853</td>
</tr>
<tr>
<td>Stanger's Location</td>
<td>1855</td>
</tr>
<tr>
<td>Gubbs Location</td>
<td>1860</td>
</tr>
<tr>
<td>Cooper's Kloof Location</td>
<td>1877</td>
</tr>
<tr>
<td>Reservoir Location</td>
<td>1883</td>
</tr>
</tbody>
</table>

With a few exceptions, these black suburbs were informal in nature, and residents living there had to endure living conditions which contemporary observers described as being squalid and open to exploitation by capitalist landlords (Frescura 1990). Many whites considered the residents of these suburbs to be unhealthy, and petitions were repeatedly organised demanding that they be removed to the outskirts of the town. These requests were in direct opposition to the needs of the growing commercial and industrial sectors, which preferred to locate their labour sources close to the harbour and the inner-city area. These conflicting vested interests created political tension in the Port Elizabeth Council, which was only resolved in 1885, when the municipality adopted its first set of markedly segregationist regulations (Frescura 1990).

As a result of this, suburbs for the exclusive use of black residents who were not housed by employers and who could not afford to purchase property were established on the outskirts of Port Elizabeth. Most prominent among these were Racecourse (1896), Walmer (1896), and New Brighton (1902).

In 1901 an outbreak of bubonic plague struck the town. This was the direct result of Argentinean fodder and horses being imported into South Africa by the British military during the Anglo-Boer War conflict. These cargoes also carried plague-infected rats, and
although many members of the white and Coloured communities were also affected, the black population was the most affected.

In 1902 most of Port Elizabeth's old locations were demolished (with the exception of Walmer), their residents' personal belongings were arbitrarily destroyed, and restrictions were imposed on inter-town travel. Although these curbs might initially have been necessary, they were only loosely applied to whites, and continued to be applied to black residents well after they were eased elsewhere, this in spite of repeated complaints by the community's leaders (Frescura 1990).

Because New Brighton was located relatively far from the city centre, many families preferred to settle in Korsten, which at the time was beyond the Port Elizabeth municipal boundary, but was still substantially closer to town. Korsten also had a substantially more relaxed attitude towards the brewing of illegal liquor, an activity which many families turned to as a strategy to balance their monthly household budgets.

During the colonial period, therefore, the system of locations created a pattern of residential segregation based on perceived racial and economic differences. However, such divisions proved to be only partial, and it was only the implementation of the apartheid Group Areas Act legislation after 1950 which brought about a structural separation of Port Elizabeth's residential areas.

1.4.2 Post-colonial segregation: 1910-1950

According to South African History Online (see http://www.sahistory.org.za/special-features/homelands) the population of New Brighton had grown from 3,650 in 1911 to 35,000 in 1950. Almost all of it was black. This polarisation was reinforced by the Native Urban Areas Act of 1923, which required municipalities to establish separate locations for their black citizens, and made black residents in "white" areas subject to a permit system, which apartheid legislation subsequently extended into the now-infamous *dompas*. The Native Land and Trust Act of 1936 also precluded blacks from purchasing land outside
designated areas. Existing suburbs, as well as new housing projects for whites, began to include racially restrictive clauses in their title deeds. In this way, most of Port Elizabeth's western suburbs were reserved for exclusive white residence.

1.4.3 The implementation of apartheid from 1950 to 1994

Mackie (2009:128) relates that the Native Reserve Location Act of 1902 and the Native Urban Areas Act, Act No. 21 of 1923, were designed to keep the “non-white” population physically, culturally and psychologically separate from and invisible to white residents. When the former National Party came into power in 1948, the city of Port Elizabeth underwent a number of extensive changes in its land use patterns, through the implementation of racially motivated segregationist legislation. This included the separation of citizens into so-called “white”, “Bantu”, “Coloured” and “Asian” suburbs. Apartheid legislation lay down that such areas should be set apart by buffer strips of at least 100 metres wide (Frescura 1990). These buffer strips often coincided with existing physical barriers. As a result, industrial areas such as Struandale, natural features such as the Swartkops River and its escarpment, and pieces of empty land such as Parsonsvei, were used to define the parameters of the city’s suburbs. According to Nel (1988:87), the Port Elizabeth Municipality tried to protect the interests of the Coloureds, Indians, Chinese, and Malays in Port Elizabeth by creating “free trading” areas, which was in conflict with one of the most important stipulations of the Group Areas Act, namely separate urban areas for each race group.

Frescura (1990) asserts that the apartheid government did not view black workers as a permanent component of urban life, but held that at some stage they would return of their own initiative and free will to some rural “homeland”. This is an attitude which had important political repercussions in later years. Not only did it relate directly to the quality of “Bantu” education, which, in turn, sparked off the Soweto student uprising of 1976, but it also created living conditions which would take many years, and a substantial proportion of the national budget, to improve. Because of this, black access to land tenure, quality housing, infrastructure, social amenities, and economic opportunities was severely curtailed.
Seymour (1990:76) mentions the indifference shown towards participatory politics by Port Elizabeth Indians residing in Malabar. Although partly affected by the Group Areas Act, Indians in Port Elizabeth were more concerned with religion and economic and social activities than politics in the 1970s to 1990s as the Group Areas Act didn’t affect them to the extent that it did the blacks.

Black suburbs were developed on the remote outskirts of the city, making daily travel to the workplace expensive. Furthermore, little retail and business development was permitted in the townships (as they began to be called), forcing residents to conduct the bulk of their shopping in the central city area. The apartheid city thus did not merely seek to beggar its black citizens, it also entrenched in its fabric the “company store” relationship existing between its black suburbs and the white-controlled central business district (CBD).

Matters did not change substantially after 1981, when the government acknowledged the permanent status of urban black communities and put in place the Ibhayi Town Council, which would administer Port Elizabeth’s black suburbs as a separate municipality. At this stage, the zoning of all industrial, retail and business development within the boundaries of a neighbouring white Port Elizabeth ensured that the two municipalities did not share equally in the city’s tax base. This is one of the ways in which Port Elizabeth’s black citizens continued to subsidise the white community’s expensive segregated lifestyle.

The process of apartheid expropriation, relocation and residential control had the effect of increasing New Brighton’s population from 35,000 persons in 1951 to 97,000 in 1960. As a result, KwaZakhele was established in 1956, and following the demolition of Salisbury Park, Fairview, and South End in the late 1960s, Zwide was established in 1968, and Motherwell in 1982 (Frescura 1990).

It also needs to be borne in mind that although the National Party government single-mindedly pursued a policy of racial segregation in the case of white areas, it tended to ignore racial mixing, and even intermarriage, in other communities. Thus, even though new segregated suburbs, such as Gelvandale, Bethelsdorp, and Bloemendal, were established
for exclusive Coloured occupation, with Malabar being set aside for Indians, some areas, such as Korsten, which historically had enjoyed a mixed population, retained much of their integrated character well into the 1980s. Other communities, however, such as Fairview and South End, saw their homes literally bulldozed to the ground and their land given over for exclusive white settlement (Frescura 1990).

Sparks (2003) alludes to the prominent role played by black South Africans from Port Elizabeth in the struggle against white oppression and the eventual dismantling of apartheid. Even though the Group Areas Act was repealed in 1991, the legacy of apartheid has been permanently imprinted on the city of Port Elizabeth. It appears that this trend is likely to continue for many years to come, and will probably never be completely eradicated from the fabric of the city. Frescura (1990) concludes that current experience has indicated that, despite the removal of Group Areas Act limitations, most middle- and upper-income black families are trapped in their old suburbs, through an inability to dispose of their properties without suffering massive financial losses. The plight of lower-income black families is even worse.

The foregoing brief explanation of the history and establishment of the city of Port Elizabeth, and, more specifically, the historically black and Coloured areas in Port Elizabeth, provides a sketch of the site of this research.

1.5 RESEARCH PROBLEM

After 13 years of implementing a new curriculum in South Africa’s schools, learners in South Africa do not compare adequately in international standardised assessments. In order to determine the “educational yield” promoted by PISA, specifically the actual language, mathematical and scientific knowledge and skills attained by Grade 9 learners in South Africa, this quantitative study was undertaken. PISA is seen to be more holistic in its approach to testing, compared to other standardised assessments, such as TIMMS and PIRLS, which are also administered in South Africa, as it incorporates the effect of learner attitudes and home and school background (see section 1.3 above).
With the world becoming more and more of a “global village”, and with the rapid increase in unemployment in South Africa, it becomes imperative for learners in South Africa to have comparable literacy, mathematical and scientific knowledge and skills.

The main research problem is the fact that the language, mathematical and scientific knowledge and skills attained by Grade 9 learners in South Africa do not compare favourably with the same expertise of learners in other countries, and there is a gap in existing research in this field, as the PISA assessment has not yet been administered in schools in South Africa.

1.6 RESEARCH QUESTIONS

The main research question of this study is the following:

How do the reading, mathematics and science knowledge and skills of Grade 9 learners from different types of schools in South Africa compare with that of learners of the same level in other countries?

The following sub-questions emerged from the main research question:

• What reading, mathematics and science knowledge and skills have participants in the study acquired?
• How do the results of South African learners compare with their international peers?
• How do the results of formerly advantaged learners compare with the results of learners in previously disadvantaged schools in South Africa?
• How do the results of learners in public schools compare with the results of learners in independent schools in South Africa?
• Is there a difference between the results of boys and the results of girls?
• Does the mother-tongue language of participants influence results? How does it influence results?
• How do the results of different race groups within the same school compare with one another?
• What effect does the availability or non-availability of school resources have on results?

1.7 RESEARCH AIM AND OBJECTIVES

The main aim of this research study is to investigate and scientifically explore the real situation in terms of language, mathematics and science literacy knowledge and skills of Grade 9 learners in South Africa and to draw a comparison between Grade 9 learners from secondary schools in the Port Elizabeth district in South Africa and their international counterparts, using the PISA standardised international assessment. The study will also focus on the educational and environmental issues that might have affected participants’ performance.

The objectives of this study are:

• To determine the actual language, mathematics and science literacy skills and knowledge acquired by participants in this study.
• To explore and compare the results of South African learners with their international peers.
• To explore and describe the differences in the results of learners from previously advantaged schools and those of learners from previously disadvantaged schools in South Africa.
• To explore and compare how the results of learners in public schools compare with the results of learners in independent schools in South Africa.
• To investigate whether there is a significant difference between the performance of boys and the performance of girls.
• To explore and describe how the mother-tongue language of participants influences results.
• To investigate whether there is a difference in the results of different race groups within the same school.
• To explore and describe how availability or non-availability of school resources contributed to differences in results.
1.8  DELIMITATION OF THE STUDY AND ITS LIMITATIONS

In this section, a delimitation of the study will be given, and the limitations of the study will be explained.

1.8.1  Delimitation of the study

Delimitations are boundaries that are set by the researcher in order to control the range of a study. They are created before any investigation is carried out, in order to reduce the amount of time spent in certain areas that may be seen to be unnecessary, and perhaps even irrelevant, to the overall study.

There are several delimitations to this research as regards the research design and the measures employed in this study. In terms of the research design, one of the main delimitations is the absence of qualitative data. Elmes, Kantowitz & Roediger (2003) describe qualitative research as follows: “Qualitative research is based on the participants’ subjective view of a changing reality, and seeks to understand the individual’s world.” A disadvantage of using only quantitative data stems from the fact that the individual’s story gets lost among the forced-choice questions (Elmes et.al. 2003). In the case of this study, incorporation of both quantitative and qualitative data through a process of triangulation would have supplemented the data and added more perceptions of the sample under investigation.

Although issues of context, related research, and the sole use of quantitative research methodology delimit this research, the findings are nevertheless significant, as they contribute to the theory and the findings in an under-theorised and under-researched field in South Africa. The findings will also be in line with and add to research done internationally.
1.8.2 Limitation of the study

Limitations refer to challenges faced by the researcher that are beyond his or her control. From the expansive field of quantitative research, an exploratory-descriptive design was adopted. As it is often considered as the first stage in a sequence of studies (Neuman 1997), this approach seldom yields unambiguous answers. Another limitation was the fact that there is little or no control for extraneous variables in this kind of research. Factors that could not be accounted for include parental influence, the learner’s home environment, attitudes and beliefs towards the skills assessed in the study, and the influence of the formative school years.

Yet another limitation of the study is the sampling method used, namely convenience non-probability sampling. Due to the fact that this particular sampling method was used, the findings are not representative of all secondary school learners in the Nelson Mandela Metropole and cannot safely be generalised to the entire population of secondary school learners in South Africa Nevertheless, the results can be generalised to all the learners in the eight schools that were part of the assessment study.

In addition, the sample size hindered the utilisation of additional parametric procedures, which could have been used to identify the relationship among variables of the sample which would have been valuable in exploring the importance of the biographical information in relation to the outcomes of the measures employed.

A very serious concern to the researcher was the truthfulness of the responses of some of the principals, as is discussed in section 4.9.7. The actual situation observed by the researcher in the sites surveyed belied the perceptions created by most school principals that there is no link between teacher attitude and teacher commitment to the school and the results obtained by the school.

The final limitation was the fact that the medium of assessment language was English only and did not cater for non-native users of the language.
1.9 METHODOLOGY

The research methods used in this study consist of a review of literature related to the study and an empirical investigation.

The empirical study will be based on quantitative research. Quantitative research uses measurement and statistical principles and models that are familiar to many natural and physical scientists (Mason & Bramble 1997:38). The study will gather statistical data and will report in a comparative way.

The study falls within the parameters of an exploratory-descriptive approach. Exploratory-descriptive research involves the provision of an accurate and detailed description of, and systematic examination and organisation of, carefully observed information about specific phenomena or constructs (Christensen 1997; Cozby 1993; Dane 1990). Descriptive research attempts to provide a complete and accurate description of a situation by summarising and communicating what is found in quantitative data. Harris (1998:48) states that “descriptive studies frequently utilise large samples, natural settings, and behaviours or scores that are of general interest”. The study deals with a large sample of data that highlight a serious concern in education in South Africa today. The descriptive research approach is an approach that is appropriate in any context where “specific knowledge is required for a specific problem in a specific situation” (Cohen and Manion 1994:194). Denscombe (2002:27) states that the aim of descriptive research is “to arrive at recommendations for good practice that will tackle a problem or enhance the performance of an organization and individuals through changes to the rules and procedures within which they operate”.

The researcher used a questionnaire to conduct the survey. According to Gall, Gall & Borg (2003:223), the purpose of a survey is to use questionnaires or interviews to collect data from a sample that has been selected to represent a population to which the findings of the data analysis can be generalised. Gall et al. (2003) define questionnaires as documents that ask the same questions of all individuals in a sample.
The study will also utilise a standardised test. A standardised test is “a test that has procedures to ensure consistency in administration and scoring across all testing situations” (Gall et al. 2003:190). The researcher will make use of non-probability convenience sampling for the purposes of the study. McMillan & Schumacher (2003:168-169) define non-probability convenience sampling as a sampling method where a group of subjects is selected on the basis of being accessible or expedient, and where the researcher selects particular elements from the population that will be representative of the population or that will provide insight into the topic of interest. Grade 9 learners from eight secondary schools in Port Elizabeth, South Africa will be sampled to complete the questionnaire and standardised test.

Participants in the sample group will not be required to provide their names, so that the principle of anonymity is complied with. Cohen, Manion and Morrison (2000:61) insist that information provided by participants should in no way reveal their identity. Where such a situation prevails, a participant’s identity is guaranteed, no matter how personal or sensitive the information is. The results of this study will be reported by using numbers, and data will be analysed in a group context, rather than on an individual basis.

Test validity is the extent to which inferences and uses made on the basis of scores from an instrument are reasonable and appropriate (McMillan & Schumacher 2003:178). To ensure test validity, the researcher will make use of a standardised test that has been used by the same age group of learners in approximately 50 countries across the world since 2000. A modified version of the test will be administered, and the same method of analysis will be used as was used in the original studies.

Test reliability will be ensured by making sure that results are free from error. The researcher will personally administer the test to all participating schools, will personally code the completed questionnaires and tests, and will do the analysis himself. This will eliminate the possibility of teacher interference or any other outside influences that may affect the findings.
The analysis of the data will be presented in the form of a comparison, using information from the questionnaires completed by participating learners and schools, as well as scores from the standardised tests. The information collected from the questionnaires will help the researcher to explore connections between how students perform in PISA and factors such as the effects of apartheid, gender, and learners’ socio-economic background, as well as the availability or non-availability of school resources and the particular policies that are in place at the schools.

1.10 ETHICAL CONSIDERATIONS

The term “ethics” refers to a system of morals or rules of behaviour (Struwig & Stead 2001:66). Ethics provide researchers with a code of moral guidelines on how to conduct research in a morally acceptable way. Researchers have an obligation to respect the rights and dignity of participants in a study and to guarantee that they are not harmed. This necessitates that researchers abide by certain ethical principles and codes of conduct in order to perform research in a morally acceptable way (Oliver 2003).

Participation by the schools in the study was voluntary, and participants were assured of their right to withdraw from the research process at any time. All aspects of the process were conducted with due respect for the rights and dignity of the participants. Participating schools and learners were assured of the confidentiality of their participation and their anonymity was maintained. To this end, no names or identifying characteristics were mentioned in the final report.

The ethical considerations involved in this study are discussed in detail in Chapter 3.

1.11 SIGNIFICANCE OF THE STUDY

This study will provide insight into the level of language, mathematics and science literacy skills and knowledge, as well as the work-readiness of Grade 9 learners in Port Elizabeth. As mentioned in sections 1.3 and 1.5, this study will constitute the first research where the
actual acquired knowledge and skills of learners in South Africa will be compared with their international peers. This study will focus on the “educational yield” that can be realised from a comparison of learners in South Africa with their international counterparts in terms of the actual situation on the ground. The focus will be on the knowledge and skills that learners in South Africa have acquired over their nine years of exposure to an outcomes-based education (OBE) curriculum, and the effects of the home environment, learner attitudes, and the availability or non-availability of school resources on learner results will be highlighted.

Although the results may not be generalisable to learners in all schools in South Africa, the findings may prove valuable in decisions on which particular curriculum or methodology will be employed in South Africa’s education system.

Although research on related aspects has been conducted, an investigation of the language, mathematics and science literacy knowledge and skills of learners in South Africa based on PISA has never been conducted before. The aspect being researched in this study is unique and will thus create new knowledge in the field of education, which can have an impact on curriculum planning and implementation in South Africa.

In conclusion, the focus of the study is what recommendations can be made, based on the findings of the research project, to improve the overall academic knowledge and skills of learners in South Africa. These recommendations will be directed at learners, parents, educators, school principals, and the provincial and national education authorities. The researcher hopes that these recommendations will lead to further studies, which will address the shortcomings highlighted in this study, as well as serving as a barometer for all stakeholders in education as to the actual state of literacy levels in South African education.

1.12 CLARIFICATION OF CONCEPTS

Below follows a clarification of the terms and concepts used in this study:
TIMMS - The acronym for Trends in International Mathematics and Science Study.
TIMMS is a large-scale comparative study of mathematics and science achievement conducted in a five-year cycle. It has been carried out since 1995 by the International Association for the Evaluation of Educational Achievement (IEA).

PIRLS - The acronym for Progress in International Reading Literacy Study.
PIRLS is part of a five-year cycle of assessments that measure trends in children’s reading literacy achievement and policy and practices related to literacy that are conducted by the IEA.

PISA - The acronym for Programme for International Assessment.
PISA is the assessment utilised as the research instrument in this study and aims to measure to what extent learners approaching the end of compulsory education have acquired knowledge and skills. PISA is conducted every three years by the Organisation for Economic Cooperation and Development (OECD).

Outcomes-based education (OBE) is the common curriculum that all the participants in the sample have been exposed to from Grade 1 to 9. The study will gauge the knowledge and skills that learners in South Africa have acquired over the first 9 grades of their education.

DET - Department of Education and Training (for blacks)
HoA - House of Assembly (for whites)
HoD - House of Delegates (for Indians)
HoR - House of Representatives (for Coloureds)

The DET, HoA, HoD and HoR were the national education departments during the apartheid era and were replaced by the Department of Education (DoE).
DoE - South Africa’s National Department of Education formed after the end of apartheid. It was replaced in May 2009 by the Department of Basic Education and the Department of Higher Education and Training.

1.13 ORGANISATION OF THE STUDY

The study is arranged into separate chapters for the sake of logical exposition and presentation of data.

Chapter 1 serves as orientation to the study and provides an exposition of the background to the study, which includes a brief background to the education situation in South Africa and the actual state of learners’ knowledge and skills in the classroom. A history of the research site and the demographic background of participants are followed by a discussion of the statement of the research problem, the motivation for the study, the significance of the study, and the aim and objectives of the study.

Chapter 2 provides a literature review of related background information on the history of education in South Africa, as well as literature and research findings on PISA and the implementation of this assessment tool in international countries. This is followed by a discussion of current issues in education in South Africa. International standardised assessments and the performance of learners from South Africa in these assessments will be highlighted.

Chapter 3 explains the empirical investigation designed to address the research problem. The aim and objectives of the study are explained, as well as the specific research design. The selection of participants and the sampling procedure are also discussed, and the measures used in the study are described. Finally, this chapter explains the procedure employed in the study, the ethical considerations involved, and the methods used to analyse the data.
Chapter 4 provides an analysis of the data collected during the empirical research. It discusses the findings and analyses the data collected from the assessment and questionnaires administered to participating learners and school principals selected for the sample. Comparisons are drawn between Grade 9 learners in South Africa and their international peers, as well as between learners from different schools in Port Elizabeth. Environmental factors that may have impacted on the study are discussed.

Chapter 5 summarises the findings of the study and makes recommendations informed by the findings. This chapter also reflects on the aim and the objectives of the study and considers the value of the research, the limitations of the research, and relevant recommendations.
CHAPTER 2
LITERATURE REVIEW

2.1 CHAPTER OVERVIEW

- Background
  - International Standardised Assessments
    - TIMSS
    - PIRLS
    - PISA

- The history of education in South Africa

- Current issues in education in South Africa
  - Graduate employment
  - Racial integration
  - Independent schooling

- Other issues influencing participants
  - Issues within/external to the classroom
  - Knowledge versus outcomes

- Changes in higher education

- Outcomes-based education
2.2 INTRODUCTION

The aim of this chapter is to provide an extensive literature review on the research topic. The chapter will review literature related to the theoretical underpinnings that have guided the thinking and methodology of this research. It will also consider factors which have emerged from the literature that plays a key role in the implementation and monitoring of national assessments in schools in South Africa.

This literature review will begin with a short background of standardised assessment systems and practices involving learners from South Africa over the past 15 years. This will be followed by a brief history of education in South Africa and its effects on learners in South Africa, focusing mainly on their attained language, mathematics and science literacy knowledge and skills as compared to the knowledge and skills of their international peers. This will be followed by a general overview of related international standardised assessments. A detailed explanation of the Programme for International Student Assessment (PISA) will then follow to ensure a full understanding of the assessment test used and analysed in this study. Finally, current education issues pertaining to this study will be explored.

2.3 BACKGROUND

Learners from South Africa fared worst out of 38 and 45 countries, respectively, in the 1999 and 2003 Trends in International Mathematics and Science Study (TIMSS). This study ranks countries on the performance of their learners, who are chosen from selected grades to write tests in mathematics and science. South Africa’s dismal performance prompted former Minister of Education Naledi Pandor in 2008 to withdraw the country’s participation in the international mathematics and science study for a few years.

In a major show of intervention, Preva Govender (2010) reports in the Sunday Times of 4 April that three million learners in public schools will have to write national tests in key subjects annually in a bid to improve appalling literacy and numeracy skills. According to
this article, the Minister of Basic Education, Angie Motshekga, would like at least 60% of all Grade 3, 6 and 9 pupils to pass literacy and numeracy tests within the next five years, as evaluations conducted among learners in Grade 3 indicated that only 36% passed literacy and only 35% passed numeracy. Grade 6 learners fared even worse, with only 38% passing literacy and only 27% passing numeracy.

Fleisch (2007:2), Professor of Education Policy at the University of the Witwatersrand, voiced his support for this endeavour and said that the national tests could be used to provide targeted interventions to underperforming schools. He said," These tests could provide very important information about potential weak areas, not just in individual learners and schools, but across the system.”

Fleisch (2007:2), however, warned that if the tests were not well designed, the trustworthiness of the testing process could be undermined. He explained the importance of this by saying that"[t]eachers have to trust that the tests accurately reflect the achievement levels of their learners”. Ezra Ramasehla (2010:2), president of the National Professional Teachers’ Organisation of South Africa (Naptosa), agreed that literacy and numeracy at schools needed urgent attention. “If we don’t [give urgent attention to literacy and numeracy at schools], we will be running into problems, because that is where we have noticed that the system has failed,” said Ramasehla.

The same newspaper article in the Sunday Times, dated 4 April 2010 quoted Motshekga as confirming that her department would ensure that teachers spent enough time on teaching reading. She stated that her department was working with non-governmental organisations such as Read and Molteno to help re-skill teachers in methods of teaching reading and writing. Umalusi, a statutory body which sets and monitors standards for general and further education, welcomed this move, and the chairperson of the body, Professor John Volmink (2010:2), said that the country faced huge challenges in terms of literacy and numeracy. He said," Those tests will have to be used as barometers, or what I call dashboard indicators, to see what kind of progress we are making."
This is indeed a positive step towards redressing the poor performance of learners in South Africa in standardised assessments and will hopefully go a long way towards providing valuable data for our education system and future research. Howie (2004:149) reports that “South Africa has only recently introduced National Systemic Assessments at Grades 3, 6 and 9 into policy and conducted its first national assessment (Grade 3)”. According to Howie (2004:149), before 2004 “South Africa had no systemic monitoring of the education system’s quality, apart from the results of matriculation examinations”.

The issue of language, mathematics and science knowledge and skills of learners in South Africa is not new and has a long history. Various debates about this issue have taken place at various levels. One of these has been the issue of mother-tongue instruction.

The Association for the Development of Education in Africa (ADEA) (2005) states that linguists and educators assert that mother-tongue instruction is far more effective than instruction through the medium of a second or a third language, which appears to be the norm in South Africa. In this regard, Somhlahlo (2009:1) says that “in South Africa African people seem to have lost pride in their languages and mostly use English as means of communication and studying”. The author adds that the use of African languages by Africans themselves has declined since 1994, and that English has become the dominant language.

Second-language education models in Africa fail because language education models in Africa often are based on second-language programmes in Europe. According to the Human Sciences Research Council (HSRC 2005:6), “[t]hese programmes are designed to teach students a second language with the focus on conversational skills, writing tasks and some literature, but not to prepare them to learn mathematics, science, geography or history”. Furthermore, students are not adequately prepared for education through the medium of the second language because the programme designers of these language courses have not kept up to date with contemporary research into the relationship between the cognitive development of children and language learning, and how children use
language to learn all areas of the curriculum (HSRC 2005). Second-language speakers of a language will then most likely be at a disadvantage academically.

So, in essence, when obtaining knowledge through a language other than your home language, the information is first translated into your home language and then processed to be understood to its full extent. This, however, is only possible when the home language is firmly embedded, with a clear knowledge and understanding of its ground rules and concepts. If one is not completely familiar with the ground rules and concepts of one's home language, one will not be able to relate new and foreign concepts to existing knowledge so as to simplify the concepts, but will leave them as unprocessed. In order to have a strongly embedded concept of your home language one needs to be familiarised with all its aspects at school level.

Schuring (1997:17) asserts that increasing numbers of speakers of indigenous African languages see English as “the language of prestige and something to be aspired to”. (Coutts 1992:42) explains that after schools in South Africa were opened to all races in 1990, formerly whites-only English-medium schools were inundated with applications from non-English-speaking children because of “the powerful appeal of these schools in terms of what they could offer formerly disempowered speakers of African languages”. Currently, there are numerous learners who have left their traditional areas where they grew up to pursue a “better education”, and their performance may be affected by the influence of their mother-tongue.

One of the aims of this study is to explain the effect of the mother-tongue on the results of learners in South Africa with regard to language, mathematics and science literacy knowledge and skills through the administration and analysis of the PISA assessment test to a representative sample of learners in South Africa.

Although limited in number, comparative assessments will be dealt with in detail in this study. These include the previously mentioned Trends in International Mathematics and Science Study (TIMSS), conducted by the Human Sciences Research Council (HSRC) in
2003, and the Progress in International Reading Literacy Study (PIRLS), conducted in 2006. Learners from South Africa have participated in both studies, but have never participated in the Programme for International Student Assessment (PISA), which will be used for the purposes of this study. A detailed explanation of PISA will be given.

Although research on related aspects has been conducted, an investigation of the language, mathematics and science knowledge and skills of learners from South Africa using PISA has never been conducted before. Related research includes a study by Didloft (2008) on the reading abilities of Grade 9 learners, a study by Sepeng (2010) on Grade 9 second-language learners in township schools, and a study by Mullajee (2008) on Grade 9 learners’ performance in science in common assessment tasks. Although related, these studies address other aspects of language, mathematics and science knowledge and skills. The aspect being researched for this study is unique and will thus add to new knowledge in the field of education and can have an impact on curriculum planning and implementation in South Africa.

### 2.4 INTERNATIONAL STANDARDISED ASSESSMENTS

The Trends in International Mathematics and Science Study (TIMSS), the Progress in International Reading Literacy Study (PIRLS), and the Programme for International Student Assessment (PISA) international standardised assessments will now be discussed in detail.

#### 2.4.1 The trends in international mathematics and science study (TIMSS)

The Trends in International Mathematics and Science Study (TIMSS) is a large-scale comparative study of mathematics and science achievement which is conducted in a five-year cycle. It has been carried out since 1995 by the International Association for the Evaluation of Educational Achievement (IEA), which is an international organisation of national research institutions and governmental research agencies.
TIMMS is conducted in many different countries worldwide at the end of the Grade 4 and Grade 8 year and is used to track changes in achievement over time. TIMSS is closely linked to the curricula of the participating countries, providing an indication of the degree to which learners have mastered mathematics and science concepts that they have been taught at school.

In 2003, some 46 countries participated in TIMSS, at either the fourth- or eighth-grade level, or both. South Africa participated in the 2003 Grade 8 study. TIMSS primarily measures learner ability in mathematics and science, as well as learner beliefs and attitudes towards these subjects. The TIMSS study also investigates curricular intentions and classroom environments. Reddy et al. (2006: x-xi) provide the following information about TIMSS:

- TIMSS uses the curriculum, broadly defined, as the organising principle in how education opportunities are provided to learners. The curriculum model has three aspects: the *intended* curriculum, the *implemented* curriculum, and the *attained* curriculum.
- TIMSS then developed items for the mathematics and science achievements tests. To accommodate for the large number of items required in the limited testing time available, TIMSS used a matrix-sampling technique. This technique involved dividing the item pool among a set of 12 learner booklets.
- TIMSS collected information from curriculum specialists, learners in participating schools, learners’ mathematics and science teachers, and their school principals.
- TIMSS is a population survey, and the sample of learners is representative of the population from which it is drawn – in South Africa this population is Grade 8 learners. For South Africa, the School Register of Needs (SRN) database was used to select the sample of schools. The sample was explicitly stratified by two dimensions:
  - province; and
  - the language of teaching and learning (English and Afrikaans were the languages chosen by schools).
The TIMSS sampling design used a three-stage stratified cluster design, which involved:

- selecting a sample of schools from all eligible schools;
- randomly selecting a mathematics and a science class from each sampled school; and
- sampling learners from within a sampled class in cases where the number of learners in a class was greater than 40.

TIMSS assesses in the area of mathematics and science and was framed by two organising dimensions, namely a content domain, and a cognitive domain (Reddy et al. 2006). Content domain is the specific mathematics and science subject matter covered by the assessment, and cognitive domain is the set of behaviours expected of learners as they engage with mathematics and science (Reddy et al. 2006).

The content domains that framed the mathematics curriculum were number, algebra, measurement, geometry, and data. The cognitive domains for mathematics were the following: knowing facts and procedures, using concepts, solving routine problems, and reasoning. The content domains that framed the science curriculum were life science, chemistry, physics, earth science, and environmental science. The cognitive domains for science were factual knowledge, conceptual understanding, and reasoning and analysis.

When South Africa participated in the Trends in International Mathematics and Science Study (TIMSS) in 1995, it was the first opportunity for the country to gain a national overview of its learners’ language, mathematical and science performance, as well as to obtain a comparison with other countries. South Africa also participated in the repeat of TIMSS in 1999 (TIMSS-99), and in both studies the performance was extremely poor compared with that of other countries.

These two studies, both conducted under the auspices of the IEA (International Association for the Evaluation of Educational Achievement), provided an opportunity for South Africa to obtain a national assessment of its learners’ performance in mathematics and science. Furthermore, given the fact that the majority of learners in South Africa are not educated in
their home language, but in another language, learners from South Africa also completed a language proficiency test in English in TIMSS-99, which enabled researchers to explore the relationship between English-language proficiency and mathematics and science achievement. As background questionnaires are also administered to the learners, teachers, and school principals in IEA studies, it is possible to explore the relationship of contextual factors on the school, the classroom, the learner, and mathematics achievement (Howie 2004:149).

The results and findings of the various different TIMSS studies that have been conducted were captured in reports, and they reveal the following:

2.4.1.1 TIMSS 1995 report

The mathematics Grade 7 and 8 results from TIMSS 1995 show that learners from South Africa came last out of the 41 participating countries (see Appendix A). Similarly, the science Grade 7 and 8 results from TIMSS 1995 ranked learners from South Africa at the bottom of the 41 participating countries (see Appendix B).

2.4.1.2 TIMSS 1999 report

In 1998, TIMSS was repeated (and is designated as TIMSS-Repeat, or TIMSS-R), with tests and questionnaires administered in 38 countries. More than 8,000 Grade 8 learners were assessed in 200 schools in South Africa, and more than 350 teachers and 190 principals from these schools participated.

According to Howie (1999), learners from South Africa performed poorly in mathematics compared to learners from other participating countries (see Appendix C). The average score of 275 points out of 800 points is well below the international average of 487 points. The result is significantly below the average scores of all other participating countries, including the two other African countries of Morocco and Tunisia, as well as those of other developing or newly developed countries, such as Malaysia, the Philippines, Indonesia, and
Chile. As was the case in 1995, learners from the Asian countries of Singapore (at the top, with 604 scale points), Korea, Chinese Taipei, Hong Kong, and Japan demonstrated the best achievement in mathematics.

Howie (1999) points out that only the most proficient learners in South Africa (and the same holds for Chile, Morocco, and the Philippines) attained the level of the average learners from Singapore (see Appendix C). Learners from South Africa that scored around the country’s average score performed worse than the least proficient learners from almost all the other countries, with the exception of Morocco, the Philippines, Chile, and Indonesia.

The province with the highest average scale score for mathematics was the Western Cape, with 381 scale points (see Table 2.1 below), but this was still significantly below the international mean score of 487. The Northern Cape and Gauteng achieved the second highest score, with 318. The Northern Province (now known as Limpopo) performed worse than all the other provinces, with a score of 226. An important finding is that there was no statistically significant difference between the scores of the girls and the scores of the boys. However, only in the Western Cape did the girls score better than the boys in mathematics. The largest differences between boys and girls were found in the Free State (34 points) and Mpumalanga (38 points), where the boys performed, on average, 4-5% higher on the achievement test than did the girls.
### Table 2.1: Average scale score for mathematics by province

<table>
<thead>
<tr>
<th>Province</th>
<th>Number of learners</th>
<th>Mean scale score out of 800 points</th>
<th>Minimum score</th>
<th>Maximum score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Cape</td>
<td>932</td>
<td>256</td>
<td>15</td>
<td>594</td>
</tr>
<tr>
<td>Free State</td>
<td>901</td>
<td>276</td>
<td>5</td>
<td>574</td>
</tr>
<tr>
<td>Gauteng</td>
<td>605</td>
<td>318</td>
<td>51</td>
<td>647</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>1228</td>
<td>292</td>
<td>5</td>
<td>612</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>963</td>
<td>253</td>
<td>5</td>
<td>601</td>
</tr>
<tr>
<td>North West</td>
<td>690</td>
<td>267</td>
<td>18</td>
<td>594</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>728</td>
<td>318</td>
<td>52</td>
<td>608</td>
</tr>
<tr>
<td>Northern Province</td>
<td>1166</td>
<td>226</td>
<td>6.5</td>
<td>458</td>
</tr>
<tr>
<td>Western Cape</td>
<td>933</td>
<td>381</td>
<td>78</td>
<td>699</td>
</tr>
<tr>
<td><strong>South Africa</strong></td>
<td><strong>8146</strong></td>
<td><strong>275</strong></td>
<td><strong>5</strong></td>
<td><strong>699</strong></td>
</tr>
</tbody>
</table>

Howie (1999:155)

### 2.4.1.3 TIMSS 2003 report

The TIMMS 2003 study was conducted by the Research Programme: Assessment Technology and Education Evaluation. This programme was established in 2001 to provide relevant information and support to all role players for improving South Africa’s education system. Fifty countries, including South Africa, participated in this study (Kanjee 2004).

Six African countries (Egypt, Tunisia, Morocco, Botswana, Ghana, and South Africa) participated in TIMSS 2003. In South Africa, the HSRC conducted these studies and tested
about 9,000 Grade 8 learners in 245 schools from all nine provinces of South Africa. An analysis of the results revealed that South Africa had the lowest scores in science and mathematics of all participating countries.

There was no significant difference between the mathematics and science scores obtained in the 1999 study and those obtained in the 2003 study as far as learners from South Africa were concerned. Dr Vijay Reddy of the Human Sciences Research Council (HSRC), who coordinated the study in South Africa, said at a media conference in Pretoria that South Africa’s scores reflected the largest distribution of scores in mathematics and science of all the countries that participated in the study. This means that there were some very low scores and a few very high scores among the scores obtained by learners from this country. An analysis of the findings shows that the large distribution of results is a reflection of the continuing inequalities in education in South African society (see Appendices C-F).

On the results of the 2003 South African National Study conducted in mathematics and science, Reddy et al. (2006) observed that there is a difference in performance among provinces, with the Western Cape, Northern Cape, and Gauteng being the three highest performers. The three lowest performers were KwaZulu-Natal, Eastern Cape, and Limpopo. The top provinces achieved almost double the scores of the lowest-performing provinces. The Northern Cape showed the greatest improvement in scores from those achieved in TIMSS-99. Other provinces that showed slight improvements were Mpumalanga and Limpopo.

Table 2.2 below illustrates the performance of South Africa’s nine provinces in TIMSS 2003 in mathematics and science. Although the Western Cape achieved the best results in both mathematics and science, none of the provinces even approximated the international averages. The Eastern Cape, the province where this research study will be conducted, ranked second last of South Africa’s nine provinces, and, even worse, scored way below the dismal average for South Africa. These statistics should sound alarm bells for the authorities that an urgent investigation is needed into the underlying causes of the poor performance of learners in this country.
Howie (2004:150) observes with regard to the influence of the mother tongue on the performance of certain countries in TIMSS that the majority of the learners from South Africa, Indonesia, Morocco, Philippines, and Singapore did not speak the test language at home. However, achievement scores varied significantly, and a link between mother-tongue influence and achievement could not be established. South Africa proved to be the exception. This issue needs to be investigated, as it appears from the data that the learners from other developing countries do not seem to be as disadvantaged by writing mathematics or science tests in their second or third language. However, it is not clear from the data why this should be so. Important lessons for South Africa may lie in the findings of such an investigation. South Africa did not participate in TIMSS 2007, so no results from that study are available to be included in this research report.
2.4.2 Progress in international reading literacy study (PIRLS)

PIRLS is part of a five-year cycle of assessments that measure trends in children’s reading literacy achievement, and policy and practices related to literacy. Countries that participate can obtain data about changes in children’s reading achievement. They can also obtain valuable information about changes in reading instruction, and how these changes relate to learners’ performance in reading (Mullins, et al. 2006).

In summary, PIRLS provides trends and international comparisons on:

- The reading achievement of learners in Grade 4;
- Learners’ competencies in relation to goals and standards for reading education;
- The impact of the home environment, and how parents can foster reading literacy;
- The organisation, time, and materials needed for reading instruction in schools; and
- Curriculum and classroom approaches to reading instruction.

The educational areas addressed by the PIRLS 2006 contextual questionnaires broadly include the curriculum, learner characteristics and experiences, the connection between home and school, the school environment, teacher characteristics, classroom resources, and instructional practices (Van Staden & Howie 2008).

A total of 40 countries and 45 education systems participated in PIRLS 2006. The IEA released the PIRLS 2006 international reading literacy achievement results on 28 November 2007 at Boston College in the United States. The results provided the overall reading averages achieved by each participating country. Through the use of Item Response Theory (IRT) scaling, the PIRLS 2006 average is set at a fixed 500 points, with a standard deviation of 100 points. Participants’ achievement is therefore placed relative to the international mean of 500. Appendix F provides the distribution of reading achievement as taken from the PIRLS 2006 International Report (Mullis et al. 2008).
South Africa participated in PIRLS for the first time in 2006. The results and findings of the administration of PIRLS (2006) in South Africa are explained in the following section.

2.4.2.1 South Africa’s overall performance in PIRLS 2006 as compared with the performance elsewhere

At the time of the PIRLS 2006 data collection, Pretorius & Ribbens (2005:139) pointed out that “neither in the past nor in the present have there been national assessment procedures for monitoring reading nor determining whether learners are reading at their appropriate motivational levels”. On this basis, the authors stated that it had been difficult to officially determine to what extent learners in South Africa have reading problems, and whether the education system is delivering on its mandate to produce literate learners.

Van Staden & Howie (2008:4) make the following observations concerning South Africa’s participation in PIRLS 2006:

Internationally, PIRLS 2006 required the assessment of learners who have had four years of schooling and for most countries this requirement translated to Grade 4 learners. The South African PIRLS 2006 study assessed this first population of Grade 4 learners, who participated in the pilot international PIRLS 2006 study, but also included a second population of Grade 5 learners as a national option included in the study.

Appendix I of this study indicates that South Africa achieved the lowest score of the 45 participating education systems. Appendix I also indicates that the international report only provides results for South Africa’s Grade 5 population. With an average age of 11.9 years, the South African learner population was the oldest across all participating countries. Grade 4 learners achieved on average 253 points (SE [standard error]=4.6), while Grade 5 learners achieved on average 302 (SE=5.6). Average achievement for both these grades is well below the fixed international average of 500 points. Closest to South Africa in reading achievement was Morocco, the only other African country that participated in PIRLS 2006, with a Grade 4 average of 323 points (SE=5.9).
Van Staden & Howie (2008:5) point out the following regarding the overall achievement for Grade 4 learners nationally by language:

The PIRLS 2006 reading assessment was administered to a sample of 16 073 Grade 4 learners in all 11 official languages in South Africa. It has to be kept in mind that the results for each language are in terms of the language of the test, not home language. This means that children were tested in the language they have been receiving instruction in for the first three years of formal schooling, a language that may well be different to the language spoken at home. Average achievement scores that are provided here per language are therefore for learners who completed the assessment in the language of the test (i.e. the language that should coincide with the language in which the learner has been receiving instruction for the first three years of schooling), and may therefore be different from the learner’s home language.

Figure 2.1 below indicates that mother-tongue Afrikaans-speaking learners who underwent the PIRLS 2006 assessment achieved the highest average score, of 351.70 (12.04), followed closely by English-speaking learners (346.82, SE=17.46). African-language-speaking learners achieved well below 300 points, with Setswana-speaking learners achieving the highest scores, while isiNdebele- and isiXhosa-speaking learners achieved the lowest average scores, at 176.80 (9.02) and 189.97 (6.50), respectively. The achievement scores of all the learners from South Africa that wrote the test were well below the international average of 500 points.
2.4.3 Programme for international student assessment (PISA)

Since the PISA will be used as the assessment instrument for this study, a comprehensive explanation of this assessment programme report is needed. This will be discussed below.

2.4.3.1 Brief background and aims of PISA

PISA aims to measure to what extent learners approaching the end of compulsory education have acquired some of the language, mathematics and science literacy knowledge and skills that are essential for full participation in national and international society. The primary objective is to monitor the outcomes of education systems in terms of learner achievement to provide empirically grounded information which will inform education and curriculum policy decisions.

According to Salz & Figueroa (2009:12), PISA surveys are carried out every three years in countries affiliated to the Organisation for Economic Co-operation and Development.
OECD), which together make up close to 90% of the world economy. The first PISA survey was carried out in 2000 in 43 countries, the second survey was conducted in 2003 in 41 countries, and the most recent survey was carried out in 2006, 2009 and 2012 in 57 countries. The next assessments will take place in 2015. PISA is steered by representatives from participating countries through the PISA Governing Board. The Directorate for Education at the Organisation for Economic Co-operation and Development (OECD) manages PISA and draws on the knowledge of a rich network of international experts (Salz & Figueroa 2009:12).

2.4.3.2 The PISA surveys

PISA tests 15-year-old learners in language, mathematics, and science and also measures a wider range of factors, including learners’ interests, attitudes, and motivation. The assessment focuses on young people’s ability to use their knowledge and skills to meet real-life challenges, rather than merely focusing on the extent to which they have mastered a specific school curriculum. This approach is called “literacy”. In order to test learners’ literacy in reading, mathematics, and science, experts from different countries designed assessment frameworks, and questions that represent these frameworks. These questions were then carefully piloted in all participating countries before a final test was constructed which is appropriate and valid across all these countries. Once the final booklets with standardised questions had been created, they were given to learners at a number of randomly selected schools in each participating country.

Tests are typically administered to between 4,500 and 40,000 learners in each country. The questions in the booklet are grouped into units. A unit consists of stimulus material such as texts, tables, and/or graphs, followed by questions on various aspects of the text, table, or graph. The questions are structured in different formats: some are multiple-choice questions, some require a short answer, and some require a longer constructed response. Learners have a time limit of two hours in which to answer these questions. In addition, learners are given a separate questionnaire containing questions about their “families and
different aspects of their learning, including their attitudes, aspirations and learning strategies” (Salz & Figueroa 2009:13).

2.4.3.3 The PISA results

Once the questionnaires are completed and collected, administrators analyse and score the questionnaires. PISA tests were scored using a detailed scoring guide of either no credit, partial credit, or full credit for each answer. The results obtained in this way were analysed to provide many interesting insights into the abilities of the participants. In addition to the performance of learners in different countries, results were also analysed with regard to other factors, such as gender, socio-economic background, and differences between schools. Through the implementation of this procedure, PISA had produced an unprecedented comparative knowledge base of school systems and their outcomes. These outcomes were monitored over time.

One of the key features of PISA is its policy orientation, with design and reporting methods determined by the need of governments to formulate policy. It is not possible to link the different information collected from learners and school principals as the direct cause of PISA results, but it is possible to compare the degree of association of various factors in different countries with educational outcomes. Many participating countries also produce national reports, and in some cases regional reports (Salz & Figueroa 2009:13).

2.4.3.4 Reading sample tasks

Salz & Figueroa (2009:16) maintain that the assessment of reading in PISA is not aimed at testing whether 15-year-old learners can read, in a technical sense, since the minority of young adults in modern societies have no skills in reading. The PISA designation of reading literacy goes further than the perception of decoding information and literal conception, towards more functional tasks. Reading literacy in PISA is defined as understanding, using, and reflecting on written content, in order to accomplish one’s objective, to build up one’s
knowledge and potential, and to participate in society. In the first PISA study, conducted in 2000, reading was the focal point of the assessment, and the greater part of the testing time was dedicated to reading tasks. In the 2003 and 2006 surveys, reading was still assessed, but less extensively. Thus, the most comprehensive analysis was conducted in 2000. Reading was once again the focus of the test in PISA 2009. Learners’ performance in reading is evaluated in relation to different text formats, reading progression, and circumstances. The principal feature in text formats is distinguishing between continuous texts and non-continuous texts. The former refers to prose organised in sentences and paragraphs, and “includes descriptions, narrations and argumentations, amongst others, while non-continuous texts include lists, maps, graphs and diagrams” (Salz & Figueroa 2009:16).

Salz & Figueroa (2009:18) explain as follows the three types of reading processes, according to PISA:

PISA assesses learners by expecting them to demonstrate their proficiency in (a) retrieving information, (b) interpreting texts and forming a broad general understanding of the text and (c) reflecting and evaluating its contents, form and features. The third element of assessment is the context or situation of the text. Four situations are distinguished: personal use, public use, occupational use and educational use. For example, a novel, personal letter or biography is written for people’s personal use, official documents or announcements for public use, a manual or report for occupational use, and a textbook or worksheet for educational use. Each question used in a PISA survey falls into one category of each of the three aspects.

2.4.3.5 Mathematics sample tasks

Similar to the reading assessment in PISA, Salz & Figueroa (2009:98-99) state that the mathematics questions in PISA attempt to assess the competence of learners to draw upon their mathematical competencies to “meet the challenges of their current and future daily
lives” (Salz & Figueroa 2009:99). Citizens have to use mathematics on a daily basis, such as when “consulting media, presenting information on a wide range of subjects in the form of tables, charts and graphs, when reading timetables, when carrying out money transactions and when determining the best buy at the market” (Salz & Figueroa, 2009:99). To capture this extensive notion, PISA utilises the concept of mathematical literacy, which is concerned with learners’ ability to “analyse, reason and communicate effectively as they pose, solve and interpret mathematical problems in a variety of situations, including quantitative, spatial, probabilistic or other mathematical concepts”.

Mathematics was the focus of the PISA 2003 survey, meaning that more time was dedicated to mathematics testing, which allowed a more detailed analysis of the results. The 2006 mathematics results were compared with the 2003 yard stick. This will also be the case with results from future surveys. In 2000 and 2006, mathematics was also assessed, but less comprehensively than in 2003. Key assessment characteristics were established for the 2000 survey and underwent minor modifications for the following surveys.

Salz & Figueroa (2009:98) explain that the PISA mathematical tasks are defined in relation to three dimensions: the content, the mathematical processes, and the situations. The dimensions are as follows:

- The first dimension, namely the content of mathematics, is defined primarily in terms of “overarching ideas”, and only secondarily in relation to curricular strands, such as numbers, algebra, and geometry, which are commonly used in curricula.
- The second dimension is the process of mathematics as defined by general mathematical competencies.
- The third competency cluster –reflection – consists of mathematical thinking, generalization and insight, and requires students to engage in analysis, to identify the mathematical elements in a situation and to pose their own problems.
In general, these processes are in ascending order of difficulty, but it does not follow that one must be mastered in order to progress to the other: it is possible, for example, to engage in mathematical thinking without being good at computations.

The third dimension is the *situation* in which mathematics is used. PISA identifies four situations: personal, educational or occupational, public (related to the local community or society), and scientific. Each question used in a PISA survey falls into one category of each of the three dimensions. To report the results of PISA 2000, a single mathematics scale was used. The average score on this scale is 500, with two-thirds of learners scoring between 400 and 600. In 2003, when mathematics was the major domain, separate scales for each of the four content areas were created in addition to the overall mathematics scale. As was the case in 2000, the average on each scale was 500, with two-thirds of learners scoring between 400 and 600. In the 2006 survey, a single mathematics scale was used to gauge performance. The results were compared to the benchmark of 500 score points, established by PISA 2003. The same scale described above will be used for the purposes of this study.

It is the policy of PISA that learners should be allowed to use calculators and other tools, as they are normally used in schools. However, the test questions are chosen so that the use of calculators is not likely to enhance a learner’s performance in the assessment.

### 2.4.3.6 Science sample tasks

As with the mathematics and reading assessments, Salz & Figueroa (2009:188-189) give a detailed background on the science sample tasks by stating that “[s]cience questions in PISA aim at evaluating how well learners apply scientific ways of thinking to situations they could encounter in their everyday lives”. This enables PISA to assess scientific knowledge that is relevant to the science curricula of participating countries, without being inhibited by the common denominator of national curricula. To capture this idea, PISA uses the concept of scientific literacy, which is “the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions”.
about the natural world and the changes made to it through human activity” (Salz & Figueroa, 2009:188-189).

To evaluate learners in science, three interconnected dimensions were distinguished, namely scientific concepts, scientific processes, and scientific situations. Scientific concepts were drawn from physics, chemistry, and biology. More specifically, PISA used themes such as “forces and movement” or “the earth and its place in the universe” (Salz & Figueroa, 2009:102). The selection of topics is based on their relevance to everyday situations, their enduring relevance, as well as the possibility to combine the topic with scientific processes (thus, more than just the ability to recall a name or a definition is required). The knowledge thus refers to the scientific concepts which learners need to grasp.

Learners and people in general, have to use and apply their scientific knowledge and understanding via scientific processes. In PISA, the focus lies on processes which citizens will need, such as distinguishing between questions which science can and cannot answer, deciding when scientific evidence is and is not valid, and weighing evidence for and against a particular course of action that affects life at the personal, social or global level. In PISA 2000, a distinction was made between the following five scientific processes: recognising scientifically investigable questions, identifying evidence needed in a scientific investigation, drawing or evaluating conclusions, communicating valid conclusions, and demonstrating understanding of scientific concepts (Salz & Figueroa, 2009).

In PISA 2003, the five processes were reduced to three processes. These three processes were describing, explaining and predicting scientific phenomena, understanding scientific investigation, and interpreting scientific evidence and conclusions (Salz & Figueroa, 2009).

The third of the three interrelated dimensions is scientific situations (sometimes referred to as areas of application or as contexts). The specific situation can be science in life and health, science in the earth and the environment, or science in technology.
The PISA 2006 assessment assessed learners’ science knowledge and skills more comprehensively. As a result of this some changes were made to the assessment. A major difference between the definition of scientific literacy used in PISA 2000 and PISA 2003 and the PISA 2006 definition is the distinction between knowledge of science and knowledge about science in the 2006 assessment. The former means an understanding of scientific concepts and theories, whereas the latter refers to an understanding of the nature, power, and limitations of science as a human activity.

In addition, the 2006 definition draws attention to the relationship between science and technology. PISA 2006 defines scientific literacy in terms of an individual’s:

- Scientific knowledge, and use of that knowledge to identify questions, to acquire new knowledge, to explain phenomena, and to draw evidence-based conclusions about science-related issues;
- Understanding of the characteristic features of science as a form of human knowledge and enquiry;
- Awareness of how science and technology shape our material, intellectual and cultural environments; and
- Willingness to engage with science-related issues and with the ideas of science as a reflective citizen (Salz & Figueroa 2009).

Instead of the three interconnected dimensions which were distinguished in PISA 2000 and 2003 (concepts, processes, and situations), PISA 2006 differentiates between four interrelated aspects, namely knowledge, competencies, contexts, and attitudes. The first three aspects bear some resemblance to the earlier dimensions, but have been altered in fundamental ways. The attitudinal aspect is a new addition.

Knowledge is subdivided into knowledge of science and knowledge about science. Knowledge of science includes four subcategories, namely physical systems, living systems, earth and space systems, and technology systems, and knowledge about science encompasses two subcategories, namely scientific enquiry, and scientific explanations.
The context can be personal, social, or global, as well as historical in some cases. Each question used in the PISA 2006 survey falls into one category of each of the three aspects. The fourth dimension is learner attitudes. The questions in this dimension are different from the questions in the other dimensions, as they have no right or wrong answer. They relate to the same scientific issue as the other questions in the unit, but they ask about learners’ attitudes towards the issue. The attitude dimension is divided into the following four subcategories: (a) interest in science, (b) support for scientific enquiry, (c) self-belief as science learners, and (d) responsibility towards resources and the environment.

To report the results of PISA 2000 and PISA 2003, a single science scale was used. The average score on this scale is 500, with two-thirds of learners scoring between 400 and 600. In 2006, when science was assessed more comprehensively, separate scales for each of the competencies and knowledge domains were created, in addition to an overall science scale. As with the science scales used in PISA 2000 and 2003, each of these scales has a mean score of 500 points, with two-thirds of learners scoring between 400 and 600.

The sections above provided a detailed explanation of the various international assessments being used in education in South Africa, specifically TIMMS and PIRLS. More importantly, a thorough explanation was given of PISA, the standardised assessment used in this study. The detailed explanation given above of the PISA test is warranted in order to address the aim and objectives of this research study, since PISA will be used for data gathering and analysis of the research data.

2.4.4 CRITICAL ANALYSIS OF INTERNATIONAL STANDARDISED ASSESSMENTS

This section will present a critical review of the various standardised assessments described above.
2.4.4.1 TIMSS

International comparative studies such as the TIMSS study have shown that despite the criticisms of national educational policy in the UK about achievement pressure for schools and teachers, a significant gain in learner achievement in mathematics was observed during the last five years (Mullis et al, 2004).

Despite the undisputed value of the reports that have already been released, the total cost of TIMSS will be hard to justify if no more valuable test results come out of the study than those past results and others already scheduled for release. Furthermore, while the reports that are part of the primary work of TIMSS were all reviewed, they are nevertheless official reports that have not received the kind of open peer review to which independent scholarship is generally subject. Therefore, each of the scholarly communities with an interest in TIMSS should explore the hypotheses suggested by TIMSS, the data that have been collected, and the methodological issues that the study has raised.

TIMSS has shown that 8th graders in the United States spend more hours in mathematics classes than do learners in Germany and Japan (Grouws, 1998). Grouws (1998) pointed out that this information, while presumably accurate, is not sufficient reason to conclude that the number of hours spent in class contributed to differences in achievement. It may be, he explained, that in one or more of the countries there is extreme variance from school to school in the hours spent in class. Such a finding could open up a new avenue for investigation, and would also militate against policy recommendations based on the mean alone. Murnane (1998) made a similar point when he stressed the importance of comparing the degree of variation in student achievement within nations and tying this variation to measures of socio-economic inequality. Similarly, King (1998:3) advocated such comparisons of within-country variation because of what they can reveal about “the importance each country accords equality across groups or its success in achieving this equality”. By going deeper than the achievement rankings in this way, researchers can make much more useful connections between TIMSS and the kinds of policy questions that are of most interest.
Metz (1998:7) remarked on the value of analysing the data in different ways from how it has been done in the past, and “comparing within countries, subgroups of schools, classes, students, subsets of the domain, performance on particular item types etc”. Other areas of interest would include variations in opportunities to learn science at the three grade levels, particular characteristics (such as structure, format, and content) of the mathematics and science items that were scaled together, and the relationship of the items to school curricula, as perceived by teachers (Metz, 1998).

However one approaches the various tests, and taking into consideration the criticisms made regarding them, it needs to be acknowledged that these tests have an undeniable value and point to deep systemic problems. It should be acknowledged that South Africa's education system is not working for the majority of the country's children (Soudien, 2007).

2.4.4.2 PIRLS

Due to the very diverse education systems in use in different countries in the world, it could be seen as unfair to draw comparisons between countries participating in standardised assessments. According to Wang, Wang & Osterlind (2011:29), in Hong Kong the PIRLS study was conducted in Chinese, which is the mother tongue of the majority of people and which is used in daily life. The “reading”, therefore, refers to Chinese reading. For the British sample, however, the “reading” refers to English reading. Due to differences in the language acquisition of Chinese and English, it could be the case that the development of reading self-concept differs as well. Wang's observation certainly highlights a need for additional investigation. Constructs related to reading may be different because of the different amount of effort required for language acquisition with regard to the two languages, different components of these languages, etc. Although translating instruments into different languages is common in cross-cultural studies (Tirri & Campbell, 2010), this may affect the external validity of the study.

From a South African perspective, the language of learning and teaching in the case of more than 80% of Grade 4 learners is a second language, mainly English, a language
which is spoken by less than 10% of the population (Howie 2003). As Heugh (2006:9) affirms, most learners who have to make the transition to “reading to learn” in Grade 4 “simply fall into the gap between learning in the mother tongue and learning through a second language of education, English”. Heugh (2006) argues that this early exit from a first language to a second-language medium of instruction at this point is actually a weak bilingual model, as an additive approach should involve at least six to eight years of first-language instruction, together with good provision of the second language, followed by dual-medium instruction in the latter years. This factor, however, cannot be offered as a reason for the inadequate performance of learners from South Africa in PIRLS.

The methodology used by PIRLS in constructing the attainment macro-indicators from which the league tables are published is based on the assumption that there exists for each individual tested a skill level, for instance in mathematics, which can be reduced to a single value on the corresponding scale (for instance in mathematics), and on which test performance depends. This scale is supposed to be the same in every country, which makes it possible to measure it in the same way everywhere. However, not everyone believes that this is the case, because of the influence of linguistic and cultural factors on the test. Even if the belief in a common international dimension is accepted, other problems remain. For instance, the fact that a given test may be well suited “to distinguishing levels of ability between individuals within a particular country, while it may prove to be useless to do this in another, thereby blurring the central issue of inequality within countries, for which policy stakes may be high in a particular country” (Bonnet 2002:389).

The other main characteristic of the methodology commonly used for international surveys should also be questioned, namely that the data needed to produce the league tables are gathered from a single, agreed-upon set of test instruments, which have been translated into all the languages concerned. This is basically how TIMSS, PIRLS, IALS, and PISA, to quote but some of the most recent studies, were conceived. International criticism is increasingly being voiced regarding this approach for devising international tests (Carey 2000; Murat & Rocher 2000; Blum & Gue’ Rin-Pace 2001). There is also increasing
concern about the predominant use in some surveys of translations of mainly English-language material.

2.4.4.3 PISA

Placing assessment items in context has both costs and benefits. Champagne (2009:12) asserts that “reading text and analysing diagrams takes testing time”, which may not necessarily contribute to better test results. Some of the questions raised by Champagne (2009:12) are the following: “Do test-takers try harder in tests with items that are in contexts that they find interesting? Is the test measuring more about individuals' understanding of context than their science knowledge and abilities?”

The PISA viewpoint on scientific literacy highlights the significance of science in life situations and applies the prominence of science in the blueprint of the assessment. An analysis of the science units utilised in PISA provides some information about the implications of the design decision on the information that the assessment provides about 15-year-olds' science literacy. For individuals to use science principles and practices in life situations, they must first understand the principles and be able to apply the practices. Champagne (2009:13) contends that “while testing for understanding of principles necessitates putting items in context, the objective is to keep the testing time and additional knowledge and abilities (reading, for instance) required to understand the situation at a minimum, so that the cognitive demand is on the science principles and abilities”, and not on understanding the situation in question.

Instances of situations in the PISA test items on which an individual may spend testing time unnecessarily are Science Unit 2: Ozone, for example, where half a page is dedicated to background information on the subject matter.

Blank & Smithson (2009:22) stress that it would be useful to have “some type of clear, global statements about the international assessments”, particularly PISA”. For example,
PISA is not intended to measure knowledge of the mathematics taught at school, but rather mathematical literacy.

Another consideration relates to the extent to which an assessment measures test-taking skills. Seasoned test takers might choose not to read introductory text in units but go straight to the questions. This is an example of strategic test-taking knowledge in action. These individuals have analysed the situation and have devised a more efficient plan to complete the task that does not involve following a set procedure of reading the item from top to bottom as it appears on the page of the test booklet.

A careful look at the released questions suggests that the language used in the assessment framework describing the components of scientific literacy being assessed is more complex than the knowledge and abilities being measured. For instance, of the 51 questions in the released units, 30 are categorised as measuring the competency of explaining phenomena scientifically. In the absence of any explanation of what this competency involves, one might assume that questions measuring this competency would involve the test taker writing explanations or evaluating the quality of explanations. However, further explanation of this competency suggests abilities that are less challenging, namely the following: applying knowledge of science in a given situation; describing or interpreting phenomena scientifically and predicting change; and identifying appropriate descriptions, explanations, and predictions. Of the 30 questions categorised as explaining phenomena scientifically, only one question required writing an explanation; the other 29 involved applying knowledge of science in a given situation.

Potential applications of PISA scores to policy or education practice should give consideration to matters such as testing time devoted to the components of knowledge and abilities contained in the PISA definition of scientific literacy, particularly the implications of including knowledge about science, technology, and attitudes as part of the assessment of science literacy. Furthermore, attention needs to be given to how well items match descriptions of the skills and abilities the assessment claims to measure. Ultimately, while the value of science literacy to the individual and to society, and the contribution of the
various components of science literacy to the areas of application identified in the PISA framework, will influence the choice, assessment is a resource-intensive process, and some choices regarding the allocation of resources are part of the decision-making process.

A major concern of standardised assessments such as PISA is not necessarily what gets “pushed” in science assessments, but that the format used is relevant and important, that it gets closer to the idea of measuring how to think and apply than strictly measuring knowledge. The mathematics component of PISA, for example, has very little algebra or advanced algebra (considering that the target is 15-year-olds), but the level of reasoning and numerical literacy required is what gives the test validity and/or its difficulty. However, educators do want to better address the PISA-type issues: inquiry, scientific habits of mind, etc. This concern is raised by Blank & Smithson (2009) and Champagne (2009).

Another problem is treating these literacy/process skills as separate isolated units rather than integrating them across all content areas in science. For example, teaching reasoning and analysis is not something that teachers always know how to do. A further problem is that there is an external push for content-driven standards and assessment.

Hopmann (2007:109) contends, surprisingly, and in spite of its public impact, that PISA has not “led to thorough methodological debates within the comparative research community, at least not internationally”. Bonnet (2002), Romainville (2002), Nash (2003), Prais (2003), and Goldstein (2004), for instance, have raised criticisms with regard to the design of the test and analytical shortcomings.

There has also been some fundamental and highly contested criticism of the methodological soundness of PISA’s research as a whole, as explained by Jahnke & Meyerhöfer (2006), and particularly by Wuttke (2006). However, none of this criticism has led to an international debate outside the PISA community itself on the validity claims of PISA. It seems to the researcher as if the overwhelming success of the approach has led to any attempt to discuss PISA’s design, data collection and analysis being seen as petty-
minded and irreverent. The strategy of PISA itself in not granting access to the full database, including all the questionnaires, contributes to this problem.

Some criticisms that appear to be relevant and important are the following, as extracted from Jahnke & Meyerhöfer (2006):

– Antoine Bodin (IREM de Besançon – Université de Franche-Comté) shows from a French perspective how much the PISA assessment is embedded in a certain understanding of (school) knowledge, which doesn’t fit all educational systems.
– Wolfram Meyerhöfer (Universität Potsdam) continues this argument with an in-depth analysis of what PISA really asks for in its questionnaires, showing how little this is in touch with a comprehensive concept of current didactics.
– Jens Dolin (Syddansk Universitet) adds similar arguments from a Danish perspective, underlining how much PISA’s conceptualisation of knowledge is at risk to misrepresent what is taught and learned in schools.
– Markus Puchhammer (Technikum Wien) shows, using the published example questions, how translation problems may to a certain degree affect results, thus making comparisons sometimes inaccurate.
– S J Prais (National Institute of Economic and Social Research, London) uses the example of England to demonstrate serious flaws in the response rates and sampling, which necessarily lead to biased results.
– Bernadette Hörmann (Universität Wien) points to the systematic marginalisation of special-needs learners by PISA, and to how little have been done to deal with the role of such learners within the PISA approach, at least in Austria.
– Peter Allerup (Århus Universitet) discusses a similar issue by showing in the case of Denmark to what degree PISA’s much-acclaimed analysis of the impact of gender, migration, and similar factors relied upon only a few highly problematic items.
– Svein Sjøberg (Universitetet i Oslo) underlines how much both PISA’s design, on the one hand, and learner response behaviour, on the other hand, are culturally embedded, which may lead to a partial or complete mismatch.
– **Gjert Langfeldt** (Agder Universitet) questions the validity and reliability claims made by PISA, pointing to constructional constraints, methodological mishaps, and the cultural bias embedded in the PISA design.

– **Joachim Wuttke** gives a comprehensive overview of recently voiced criticism of PISA’s research conduct, and the resulting bias and uncertainties, which puts its league tables and comparisons in question.

– **Rolf Olsen** (Universitetet i Oslo) outlines ways in which PISA can overcome some of its shortcomings, by broadening its approach and adding new research.

– **Michael Ulijens** (Åbo Akademi) explains the Finnish PISA success by the fact that what PISA asks for had already gained a foothold in Finnish schooling before PISA came around.

– **Thomas Jahnke** (Universität Potsdam) elaborates from a German perspective how PISA fails to really assess what is or should be taught in schools, and how reliance on PISA can lead to an impoverished view of the curriculum.

– **Dominik Bozkurt, Gertrude Brinek and Martin Retzl** (Universität Wien) use the case of Austria to show how the public and political response to PISA unfolds, irrespective of what PISA can really cover or prove.

– Finally, **Stefan T. Hopmann** (Universität Wien) puts both the PISA project and the PISA discourse in a comparative perspective, showing how much the design, the use of, and the response to PISA is determined by the needs and traditions of those involved.

All in all, the contributions give a very varied picture of the PISA effort. No step in the research process of PISA seems to be without substantial problems, and several steps do not meet rigorous scholarly standards. Some scholars seem to believe that these are obstacles which can be solved within the PISA framework (for example, Allerup 2006, Dolin 2006, Olsen 2006, and Sjøberg 2006), while others tend to a conclusion that the PISA project is beyond repair (for example, Langfeldt 2006, Meyerhöfer 2006, and Wuttke 2006) or so embedded in a specific political purpose that it should rather be considered as a type of research-based policy making, not as a scholarly undertaking (for example, Hopmann, Jahnke, Ulijens, Bozkurt, Brinek & Retzl 2006).
Almost all of the issues discussed above raise serious doubts concerning the theoretical and methodological standards applied within PISA, and particularly to its most prominent by-products, namely its national league tables, or analyses of school systems. Without access to the full set of original data, it is difficult to come to a final conclusion. However, the following points seem to be evident, beyond any reasonable doubt:

– PISA is by design culturally biased and methodologically constrained to a degree, which prohibits accurate representations of what actually is achieved in and by schools. Nor is there any evidence that what PISA covers is a valid conceptualisation of what every learner should know.

– The product of most public value, namely the national league tables, is based on so many weak links that they should be abandoned straightaway. If only a few of the methodological issues raised in this volume are on target, the league tables depend on assumptions about their validity and reliability which are unattainable, according to Steiner-Khamsi (2003).

– The widely discussed by-products of PISA, such as the analyses of “good schools”, “good instruction”, or of differences between school systems, and on issues such as gender, migration, or social background, go far beyond what a cautious approach to these data allows for. They are more often than not speculative, and would at least need a wider framing informed by additional research, looking at the aspects which PISA cannot cover or gets wrong in its design.

– Any policy making based on these data (whether about school structures, standards, or the curriculum) cannot be justified. The use and misuse of PISA data in such contexts – done with or without PISA researchers’ consent or cooperation – belongs solely to the sphere of policy making. Of course, PISA researchers have the same right as every citizen to pronounce their political convictions in public. However, they cannot do so claiming research as an unquestionable basis for their arguments.

This does not mean that there are no valuable lessons to be drawn from PISA. At least it is a very innovative comparative study on the uneven distribution of a peculiar kind of knowledge and abilities among young people in different countries. However, the use of PISA as research on schooling by the OECD, its members, and some of the research
groups connected to the effort goes far beyond what is scientific evidence or simply well-conducted research.

Despite the serious criticisms levelled against PISA, as explained above, PISA is still the leading international standardised assessment used today, and the benefits generated from its findings have proved invaluable to participating countries in terms of gauging international benchmarks. It is still the only internationally recognised assessment that assesses reading, mathematical literacy, and science literacy, and is used by more than 60 countries worldwide. The methodology promoted by PISA is, notwithstanding the criticism levelled against it, the most accurate barometer for assessing the acquired mathematical and scientific knowledge and skills of 15-year-olds worldwide. Therefore, the use of PISA as the assessment instrument for this study is justified.

The research conducted in this study, however, needs to be placed in context to ensure a full understanding and relevance of the data results and findings. The research data and findings will only have relevance if explained against a national perspective of the history of education in South Africa. An overview of this history is provided in the following section.

2.5 THE HISTORY OF EDUCATION IN SOUTH AFRICA

An introduction to the history of education in South Africa will now be given. A brief overview of curriculum reform in South Africa is included in this section to contextualise this study and to provide the background against which this research will be conducted.

This section will focus on the discrepancies created by the different education departments before 1994, observed by Fiske & Ladd (2004:10):

Reform of the state education system exemplifies this broader transformation process under way in South Africa in the post-1994 period. The new government inherited a system designed to further the goals of apartheid, one that lavished human and financial resources on schools serving white learners while
systematically starving those with African, Coloured and Indian learners. Before the fall of apartheid, there were between 15 and 18 different education departments operating in South Africa, namely the Department of Education and Training (DET) for blacks, the House of Representatives (HoR) for Coloureds, the House of Delegates (HoD) for Indians and the House of Assembly (HoA) for whites.

After the emergence of the new political dispensation in 1994, the new education authorities had to address the legacies of the past. According to Pretorius (2007:31), “a sophisticated education system for whites was in place, but millions of adult South Africans (mainly black persons) were functionally illiterate”. Furthermore, millions of children in South Africa “endured school conditions resembling those of the most impoverished states of Africa” (Pretorius 2007:31).

De Wet & Wolhuter (2009:1) make the following comments about the phenomenon of medium of instruction in black schools after the Soweto uprising of 1976:

In the era prior to 1994, black and white learners not only attended separate schools but the segregated schools had different policies regarding medium of instruction. Resistance to the language policy regarding black education culminated in the 1976 uprisings. This led to the scrapping of both Afrikaans and black home languages as language of instruction in black schools. After the uprisings, black schools followed a policy of decreasing bilingualism. After 1994, in the spirit of democracy, official and educational status was granted to eleven languages. Deep-seated distrust, and fear that home-language education would lead to impoverishment, social and political isolation, and disempowerment, caused the majority of South African learners to prefer English rather than their home language as language of instruction.

Although English is regarded as the language of commerce, technology, education, and training, it is the home language of only 8.2% of South Africans. The Bill of Rights, as contained in South Africa’s Constitution (RSA 1996a: Section 30) guarantees equal status for all 11 of the country’s official languages, namely Afrikaans, English, isiNdebele,
isiXhosa, isiZulu, Sepedi, Sesotho, Setswana, siSwati, Tshivenda, and Xitsonga. isiZulu is the home language of 23.8% of South Africans, followed by isiXhosa, at 17.6% of the population, Afrikaans, at 13.3%, Sepedi, at 9.4%, and both English and Setswana with 8.2% (Pretorius 2007).

The Bantu Education Act, Act No. 47 of 1953, brought about two totally separate education systems, one for white learners, and one for black learners (De Wet & Wolhuter 2009). Truter (2004:164) points out that this resulted in “a dichotomy of two separate cultures that functioned separately from kindergarten up to university level”. This was also the case with the language policy, because there was a separate language policy for white learners and black learners.

The Bantu Education Act, Act No. 47 of 1953, determined that the use of the home language as medium of instruction was compulsory up to and including Standard 6. Both Afrikaans and English were compulsory school subjects from the first year of school. From Standard 7 onwards, English and Afrikaans were used as medium of instruction on a 50/50 basis. Furthermore, the policy placed a ceiling on opportunities for development, because it was expected of black people to acquire academic skills in two “foreign” languages (Chick 1992:275).

Regardless of the educational advantage of home-language instruction, there was much resistance to the implementation of this policy, as explained by Chick (1992:275):

In the minds of the black community, such advantage was overshadowed by the realization that educational motives were secondary to political ones. Consistent with apartheid ideology, mother-tongue instruction prepared the different language groups for separate existence […] the policy served to divide and rule black people.

The ANC came to political power in 1994 and made a concerted effort to transform the educational landscape. Education not only had to be transformed, it “had also to play a key
role in the transformation of the South African community” (Duvenhage 2006). The 1995 White Paper for Education and Training (DoE 1995:4) stated this vision as follows:

It should be a goal of education and training policy to enable a democratic, free, equal, just and peaceful society to take root and prosper in our land, on the basis that all South Africans without exception share the same inalienable rights, equal citizenship, and common national destiny, and that all forms of bias (especially racial, ethnic and gender) are dehumanizing.

A few years later, the Department of Education (DoE 2001:2) repeated this idea by emphasising that education is imperative “to overcome the devastation of apartheid, and provide a system of education that builds democracy, human dignity, equality and social justice”. For this to materialise, education had to undergo a transformation. Duvenhage (2006:133) clarifies the main thrusts of education transformation as follows:

- The creation of a single, non-racial education dispensation wherein there is space for all participants;
- The entire overhaul and democratisation of education management;
- The upgrading and improvement of the education infrastructure; and
- The transformation of curricula in order to eradicate the legacy of apartheid in the system.

Duvenhage (2006) concedes that the ANC government tried very hard to realise the transformation objective. There were many achievements, although some plans failed, and others had to be redesigned. Duvenhage (2006:135) lists, among other things, the following transformation successes:

- increased access to schools;
- a considerable improvement in the qualifications of educators;
- an improvement in the ratio of educators to learners; and
- an increase in the per capita spending per learner.
Some of the failures were highlighted at a two-day summit in 2006, during which members of the Eastern Cape Department of Education reflected upon transformation in education and highlighted the following failures:

- a shortfall in learners’ skills development, in particular literacy and numerical skills;
- an unequal distribution of resources and infrastructure; and
- a poor work ethic among educators.

At this summit, the Chairperson of the Education Portfolio Committee, Mahlubandile Qwase, lamented the lack of support for African languages and culture in former Model C schools according to Sityata-Soga (2006). With reference to this, Van Wyk (2006:24) reported that “schools in South Africa do not function satisfactorily”. According to the Executive Director of the Institute for Justice and Reconciliation (IJR), Charles Villa-Vicencio (in Van Wyk 2006:24), “the blame must be laid at the door of principals who do not manage their schools effectively, as well as poor discipline amongst learners”. Jansen (in The Star 2005) was quoted as saying that governing bodies of former Model C schools thwarted the transformation process. He said that “far too many all-white schools […] have used language policy or enrolment policy or teacher appointment processes to retain the dominant culture and clientele of the school”.

The following section will deal with the new curriculum implemented in South African schools based on outcomes-based education.

### 2.6 OUTCOMES-BASED EDUCATION (OBE)

In this section some components of outcomes-based education (OBE) as the foundation of the current South African curriculum are addressed. The new curriculum for the state education system known as Curriculum 2005 [C2005] and was introduced in 1997. The new curriculum needed to reflect the emphasis in the new constitution on equity and human rights and, in sharp contrast to its predecessor, had to foster universal access and common expectations for all learners. It needed to stand as a “statement of what all citizens of the
new South Africa should know and be able to do as workers, citizens, and fulfilled individuals” (Fiske & Ladd 2004:154).

Fiske & Ladd (2004:154-155) explain that the new curriculum would meet the following three requirements related to content and pedagogy:

1. First, instruction had to reflect the social values that define the new South Africa, namely values that Nelson Mandela summarised in his inaugural address as “peace, prosperity, non-sexism, non-racialism, and democracy”.

2. Second, the content of the new curriculum had to be non-authoritarian. Whether delivered in white schools or black schools, apartheid-era instruction had been doctrinaire, and apartheid content was defined at the centre. The post-1994 climate would not tolerate the mere substitution of one orthodoxy for another. Local schools and communities had to be able to participate in shaping curriculum content.

3. Third, the new curriculum needed to be delivered in a democratic fashion. Instruction in the apartheid era had been universally teacher-centred and emphasised rote learning rather than critical thinking and open-ended problem solving. Instead, the new curriculum would focus on the child, promote active learning, and give each learner some responsibility for the shaping of his or her own education.

OBE has its roots in the behaviourist psychology of B.F. Skinner, the pedagogical principles of Paolo Freire, the mastery learning techniques of Benjamin Bloom, and the curriculum objectives of Ralph Tyler. According to Fiske & Ladd (2004:157), it is also “consistent with progressive learner-centered educational principles nurtured by English private schools”. Its adoption in South Africa in the mid-1990s can be explained in part by the fact that at the time OBE was enjoying considerable popularity in other English-speaking countries, most notably Australia and New Zealand. The Department of Education was particularly influenced by William Spady, an American proponent of the method who visited South Africa as a consultant.
The implementation of Curriculum 2005 was not without problems, and it soon became apparent that it warranted investigation. Arnolds (2006:36) explains in this regard:

Introduced into schools in 1998, Curriculum 2005 was reviewed in 2000 to assess its structure and design, accompanying teacher development processes, learning materials developed to support the curriculum, provincial support to teachers in schools and implementation time-frames. The Ministerial Review Committee presented its report on 31 May 2000. The Review Committee recommended that strengthening the curriculum required streamlining its design features and simplifying its language through the production of an amended National Curriculum Statement. In addition, it recommended improving teacher orientation and training, learning support materials and provincial support. It also recommended relaxation of time-frames for implementation.

In June 2000, the Council of Education Ministers accepted the curriculum recommendations of the Review Committee, and in July 2000 Cabinet resolved that:

The development of a National Curriculum Statement, which must deal in clear and simple language with the curriculum requirements at various levels and phases, must begin immediately. Such a statement must also address the concerns around curriculum overload and must give a clear description of the kind of learner in terms of knowledge, skills, values and attitudes that is expected at the end of the GET band (Arnolds, 2006:36).

The institution of outcomes-based education (OBE), another centrepiece of government’s education transformation plan, bogged down in the everyday realities of South Africa’s classrooms, such as under qualified teachers, a lack of adequate resources, and the absence of a proper culture of teaching and learning in many schools (Warnich & Wolhuter 2009), to the extent that even the founder and most voluble exponent of OBE, William Spady, counselled government to abandon the OBE project, describing it as a “professional embarrassment”.

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Jansen (1999) mentions overwhelming challenges in the early implementation of OBE in South Africa’s education system, specifically ordinary teachers coming into contact with a curriculum discourse that was completely foreign to their understanding and practices. Educators also struggled with a constant shift in language, such as from “competencies” to “outcomes”, which showed that insufficient thought had gone into the transition to OBE. Jansen (1999) also criticises influences by foreign experts from Scotland, Australia, New Zealand, England, and the United States, most of who do not even offer OBE in their own countries. These issues caused educators to lose confidence in OBE from the outset, and they were reluctant to adapt to the curriculum.

Fiske & Ladd (2004) add to this and lament that while Curriculum 2005 specified teaching and learning outcomes, it provided little of the explicit content knowledge that teachers require to achieve these outcomes. In the spirit of democracy and local participation, teachers were expected to generate this content on their own, using not only standard sources such as textbooks, but information derived from local sources. Taylor & Vinjevold (1999) suggest that the lack of specified content was “a terrible mistake”, because it undermined the overall goal of promoting equity within the school system.

Fiske & Ladd (2004:162) list the following other common drawbacks of Curriculum 2005:

- the language of the new curriculum;
- teachers were not given adequate training in either the principles or the practical requirements of OBE; and
- teachers complained that record-keeping was time-consuming and reduced the amount of time they could devote to classroom instruction and curriculum planning.

Gilmour & Soudien (2009) assert that when the new National Curriculum Statement was introduced in 1998, educators with strong professional histories in middle-class schools did not agree with the “de-professionalised corps” operating in schools. An even more real danger was that the learners themselves were socially and culturally not the autonomous subjects that were envisaged in the constructivist principles of the curriculum. They were, instead, children who had been deprived of opportunities on many levels in the past,
impoverished children whose cultural and often philosophical backgrounds did not accord with what the curriculum professed. Consequently, a deep sociological disjuncture existed between what the policy sought to achieve and what learners actually had to work with.

Thus the outcomes-based education curriculum, while intended to address inequalities in education, actually led to more and new issues in South African education. As concluded by Gilmour & Soudien (2009:290), “macro structural features of race and class”, augmented by a curriculum “which is epistemologically largely inaccessible”, leads to a state that, in a “reductionist” way, deprives the majority of learners of success.

2.7 REVAMPED CURRICULUM

There has been much criticism of the OBE curriculum. It appears that the Education Department acknowledges the deficiencies of OBE and is taking concrete steps to remedy them. The Department of Basic Education (DBE) appointed a panel of experts to investigate challenges relating to OBE, which led to a streamlining of the National Curriculum Statement, and ultimately Curriculum and Assessment Policy Statements (CAPS) to be implemented in 2013. According to Liebenberg (2011), based on recommendations from all stakeholders, the DBE recommended the introduction of the CAPS as follows:

The aim of the CAPS will be to improve the quality of teaching and learning. The focus will be on the content per term and the required assessment tasks for each term. The advantage of the CAPS is that every subject in each grade will have a single, comprehensive and concise document. The DBE emphasized that the CAPS is not a new curriculum. The renewal of the national catalogue will vary. In some subjects there will be more curriculum changes than in others.

Draft copies of the CAPS were made available for public comment at the end of 2010, and implementation was to be due in 2012 for Foundation Phase (Grade 1-3) and Grade 10, in 2013 for Intermediate Phase, Senior Phase, and Grade 11, and in 2014 for Grade 12.
2.8 CURRENT ISSUES IN EDUCATION IN SOUTH AFRICA

In addition to an understanding of the history of education and the implementation of OBE in schools in South Africa, a brief explanation of current issues in education in South Africa is necessary to provide the background to this study.

Soudien (2007:182) asserts that “failure to produce a high quality education system remains the country’s primary challenge”. Samoff (2008:ix) highlights the following issues in South Africa’s education system:

- Schools struggle to maintain quality;
- Equipment and fittings are lost to thieves;
- Drug dealers are operating at school gates;
- Students and teachers become dispirited and alienated;
- Many teachers and learners show up sporadically, or arrive but do little work;
- Teachers see innovations as imposed and unmanageable and regard national and provincial education departments with suspicion and distrust, or worse;
- Privilege, often still based on race, and increasingly on class;
- University students mock integration and enthusiastically support reactionary parties;
- The gains – they do exist, and they are significant – are often swamped by education’s debilitating disabilities; and
- The daily struggles of learners are more about survival than social transformation.

Furthermore, Jansen (2005) states the reasons for the bad performance of education in South Africa as being failures in the managerial matters of schooling, teachers, textbooks, and time, a view supported by Taylor & Vinjevold (1999) and Crouch & Mabogoane (2001). Gilmour & Soudien (2009:281) conclude that “silent exclusion”, which refers to the phenomenon where children enrol at school and attend classes but learn little, is a worrying feature of education access in South Africa. Shortcomings include “educational financing, administration and the delivery of services” (Hartley & Omarjee 2008:7).
These issues in education in South Africa are particularly important with regard to the expected results from the different schools and the educational environment in which these schools operate. Issues in education in South Africa include the following:

2.8.1 Graduate employment

Even after more than 18 years into the new democracy, South Africa still suffers from the long-term consequences of apartheid. Bhorat (in Chisholm 2004:31) points out that this is even more pertinent in the labour market, including among black graduates, particularly in the field of education, training, and development. He is, however, surprised by the high unemployment levels among individuals with degrees, and he highlights the following:

[F]or African participants with a degree the unemployment rate stood at 16.41 per cent in 2002 while the figures for whites were 3.15 per cent. However, despite these lower unemployment rates for degreed workers, it needs to be noted that the rate of increase in numbers of unemployed was greater for degreed workers. Hence the number of white unemployed increased by 141 per cent over the seven-year period and more than quadrupled for African graduates (Bhorat in Chisholm 2004:31).

Moleke (2005: vi) explains the importance of higher education as follows:

People with higher education enjoy a clear advantage in the labour market. Their likelihood of being unemployed is low; and when this does occur, the period of unemployment is relatively short. When they are employed, the employment is normally in better-paid jobs. Such employees also quickly gain knowledge and work experience, which further benefits them in the job market. However, differences occur by race and gender.

Moleke (2005) conducted a study of graduate employment trends in South Africa involving university graduates who qualified between 1990 and 1998. The following are some of the findings:
• While the employment of graduates increased during this period, differences occurred between race groups;
• African professionals experienced a decline in employment rate during the period, while members of all other race groups experienced an increase in employment rate between 1995 and 1999;
• The participation of females in the labour force increased by 29.8%, compared to an increase of 18.5% among males;
• The number of economically active persons as a percentage of the total population increased as follows: Africans experienced an increase of 27.2%, compared to 22.1% among Asians, 18.3% among Coloureds, and 10% among whites;
• Graduates in fields with a more professional focus, such as medical science and engineering, found employment much more sooner than those who qualified in fields of a more general nature;
• While more than half of males and females obtained immediate employment after graduating, the proportions were slightly higher for males;
• Graduates from historically white universities had better employment prospects than graduates from historically black universities;
• The first job for 66% of graduates in the survey was permanent, while 19% found temporary employment, and 15% found contract employment;
• The majority of graduates (58%) were in a professional job, while 19% were in a managerial position, and 11% were in an administrative job;
• A larger proportion of males were in managerial functions, while a larger proportion of females were in professional/technical and administrative functions;
• Whites made up the highest proportion (23.6%) of those in managerial positions, followed by Asians (19.6%), Africans (10.8%), and Coloureds (10.6%); and
• Half of all the graduates (50.9%) had their first job in the public sector, with 46.8% in the private sector, and only 2.4% in self-employment.

Moleke (2005) asserts that factors such as field of study, race, gender, and institution play a role in graduate unemployment. According to Moleke (2005:19), “Africans, females, those who studied humanities and arts and those who studied at historically disadvantaged
universities [have] the highest rate of graduate unemployment”. Moleke (2005:19) adds that there exists “a mismatch between the types of skills/qualifications held by many graduates and the demand for skills/qualifications that are in short demand”. The same sentiments are expressed by Koen (2006) and Letseka & Maile (2008).

Letseka & Maile (2008:2) argue that

Previous studies have revealed the stark realities of racial inequalities in higher education. In addition, higher education institutions produce an insufficient number of graduates with relevant qualifications for the labour market. Others point out that the labour market has discrimination problems of its own, most conspicuous in a deliberate refusal to employ graduates from historically black universities.

Labour market interventions should thus be “geared towards better-educated youth marked by their formal qualifications”, as they do not match with the labour demand needs of the economy (Bhorat 2004:56). PISA gauges the “work-readiness” of 15-year-olds and also looks at the factors that impinge on their mathematics, science and literacy skills. This, in turn, could have an effect on their eventual performance in the labour market, according to Bhorat (2004).

2.8.2 Racial integration

The focus of this section is integration of the different race groups in schools subsequent to the abolition of apartheid. Pandor (in Nkomo et al. 2004:11) mentions that although the racial and gender composition of our schools is changing, learners in South Africa are not integrating. Pandor (in Nkomo et al. 2004:11) adds that the challenge is the successful promotion of the value of dignity, equality, and advancement of human rights and freedom. She maintains that integration will only be achieved when girls are regarded as equal to boys. Post-1994 education practice has focused heavily on desegregation and expanding access. With a few exceptions, schools have remained hierarchical, authoritarian, and teacher-centred. According to Samoff (2008:x), “[c]ritical reasoning, self-reliant learning, cooperative approaches, community responsiveness, environmental awareness, self-
confident assumption of responsibility, political consciousness, engaged citizenship, and more were marginalized”.

The PISA assessments conducted as part of this study will indicate whether racial integration of learners in different schools since the abolition of apartheid has led to a standardisation of language, mathematics, science and literacy skills and knowledge among learners. These assessments will also determine the factors that have contributed to disparities, if any, in the findings, by means of a background questionnaire which will be administered.

Van der Berg (2001) conducted a national study of racial integration in schools in South Africa in 1997. Van der Berg (2001) classified schools on the basis of the predominant race of learners at the school, with a percentage of 70% being chosen as the arbitrary cut-off for learners being of one particular race. Thus, for example, “mainly African” or “mainly Coloured” schools are those with more than 70% African or Coloured learners, respectively. “Mixed schools” were those in which no race group accounted for more than 70% of the learners.

According to Van der Berg’s calculations, 96% of the African learners in South Africa were in “mainly African” schools, and only 3.2% were in “mixed schools”. Furthermore, within the “mainly African” schools, 99.6% of learners were African. In other words, most African learners are still in schools with other African learners. It was likewise found that white learners still attend mainly white schools: 77% of white learners were in “mainly white” schools, and the proportion of white learners in “mainly white” schools was, on average, 90% or more; 22% of white learners were in racially mixed schools (Van der Berg 2001).

Van der Berg (2001) summarises that as of 1997, more than three-quarters of South Africa’s white learners still had very little exposure to African or Coloured peers at school. Eighty-five percent of Coloured learners were in “mainly Coloured” schools, while more than half of Indian learners were in racially mixed schools. A few former Model C schools remain enclaves of privilege, now with more Africans among their students and many
Model C schools have “decayed, either closed or are enrolling African students but are not offering an effective education programme”, according to Samoff (2008:xiii). Soudien (2007) emphasises that the extent to which wealthy and white children perform better than poor and black children is a legacy of the country’s past. It should also be taken into cognisance that schools in South Africa have fundamentally preserved their apartheid-era racial profiles, as a result of a range of factors, such as the cost of fees, class, the medium of instruction, geographical access and cultural (dis)comfort (Gilmour & Soudien 2009).

Notwithstanding the above-mentioned factors, schools in South Africa are racially integrated, albeit only legislatively speaking, and not in reality and the PISA study will determine to what extent integration has occurred, and how learners from the different race groups compare within the same school, as well as in the sample in general. The study will also look at the environmental factors that influence the performance of the different race groups in the sample.

2.8.3 Independent schooling

Kitaev (1999:43) defines independent schools as “all formal schools that are not public, and may be founded, owned, managed and financed by actors other than the state, even in cases where the state provides most of the funding and has considerable control of these schools”. Hofmeyer & Lee (2004) lament the dearth of research conducted on independent schooling in South Africa, and they name Randall (1982) and Christie (1990) as specialists on the subject of independent schooling in South Africa. However, both of these sources date to before 1994. A definite research vacuum thus exists in the field of independent schooling in South Africa.

2.8.3.1 A historical overview

According to Randall (1982), the first independent schools in South Africa were, established in the mid-nineteenth century and were mainly traditional private schools based on English prototypes and followed what was termed a liberal education” (Randall 1982).
Du Toit (2004:2) asserts that “church schools were also among the first to emerge and consisted largely of Catholic, Anglican and Methodist schools”, a view supported by Muller (1992) and Kitaev (1999). As far as private correspondence colleges are concerned, the first such college in South Africa was Intel, which was founded in 1906. It was followed by the colleges of Lyceum and Damelin, founded in 1917 and 1955, respectively. New independent schools mushroomed after 1980 in response to conditions in black schools during apartheid.

Hofmeyer (2001) notes a considerable increase in independent schooling after 1990. This view is supported by the Independent Schools Association of South Africa (ISASA) (2001). James (1991:2) identifies two types of demands which have fuelled the growth of independent schooling in South Africa:

- “Excess” demand for more schooling (usually associated with developing countries);
- “Differentiated” demand for different and even better schooling (normally associated with developed countries).

Excess demand is probably responsible for the low-fee schools serving African middle and lower socio-economic households, while differentiated demand has characterised the traditional and religious independent schools. In his preface on independent schooling in South Africa, Du Toit (2004: v) remarks that “[t]he current landscape of independent schooling appears to have a segmented profile, characterized by two types of schools: smaller, predominantly African low-to-average-fee schools and larger white predominantly higher-fee schools”. Black learners currently constitute more than 70% of learners in independent schools. More than 50% of all independent schools have low to average fees. However, there is evidence that despite diversification and increased opportunity, historical patterns of inequity continue to prevail in this sector, as can be seen in the work by Hofmeyer & Lee (in Chisholm 2004).

Du Toit (2004:1) further contends that independent schooling in South Africa has always been “shaped by political factors, but is currently shaped by a range of social and economic
factors”. Before the enactment of the South African Schools Act of 1996, many of these independent schools were unregistered, but they were all forced to register in due course in order to continue operating.

For the purposes of this study, independent schools in the Port Elizabeth will be approached and their results will be compared with public schools for the PISA testing.

2.8.4 Other factors influencing participants

Makolo (2005) makes interesting observations which are relevant to the findings of this study, including issues external to the classroom which have a major impact on the overall performance of schools and issues within the classroom environment. The background questionnaire that participating learners had to complete as part of the assessment (see Appendix P) focuses on both internal and external issues that may have an effect on the outcome of the findings of the study, and will thus warrant investigation.

2.8.4.1 Issues external to the classroom

Makolo (2005) remarks that the three provinces with the highest annual school fees also had relatively low HIV/AIDS prevalence. The opposite is true for the three provinces with the lowest annual school fees. This doesn’t suggest a link between the cost of school fees and HIV/AIDS prevalence, but rather indicates that a serious education challenge exists, as those schools with a high prevalence of HIV/AIDS also have poor financial resources. He mentions that learners in these latter provinces are thus doubly disadvantaged.

Taylor et al. (2003:17) illustrate a “definite relationship between numeracy pass rates and learners affected by poverty”, particularly in the Western Cape, although the problem may not be just financial. Van der Berg (2005:19) points out that although the poorest learners in the Western Cape receive four times more per capita funding than their more affluent peers this factor did not relate to an improvement in test results.
2.8.4.2 Issues within the classroom environment

In his analysis of a survey conducted on class sizes between 2001 and 2003, Makolo (2005:6) reports that

- 58% of African educators taught classes of more than 46 learners;
- A substantial number of white teachers taught classes of only 21 learners;
- A significant number of Coloured teachers (29%) taught large classes;
- The majority of Asian educators (57.9%) taught classes of about 36 to 45 learners.
- Only 23.6% of Asian educators taught classes of 46 learners or more.

It appears that even 18 years into the new democracy, not much has changed in terms of educator-learner ratios by race. Howie (2008:10) relates that for the PIRLS 2006 study, the classes with “low educator-learner ratios of 1:20 achieved significantly better results than classes with between 40-60 learners”. Because of the abstract nature of mathematics and science, it would not be advantageous to teach these subjects in large classes, as it would be difficult to give every learner the required individual attention.

Gilmour & Soudien (2009:295) contend that “in weaker schools staff allocation to classes was often done on ‘political/personal’ rather than professional criteria”. This often resulted in “uneven class sizes and weaker teachers getting weaker classes”. Management thus, in effect, sort of “punishes” certain educators by allocating “academically weak” or ill-disciplined classes to them. The learners in such classes are more likely to underachieve throughout their school career, as they may be unable to escape their circumstances. This scenario holds true, as these learners find it extremely difficult to transfer to schools that offer a better quality of education.

Research conducted by Baxen & Gilmour (2000) demonstrated the difficulties that teachers were having with the curriculum in understanding both content and requirements, and if there are “pedagogical problems in delivery”, then the end product of poor performance should not be too unexpected. Gilmour & Soudien (2009) mention that low expectations from teachers of weaker and underprivileged learners compound the “silent
exclusion” of learners. This can result in some learners being “coerced” into not opting for subjects such as mathematics and physical science at secondary level, which, in turn, leaves them with limited options at tertiary level.

Taylor & Vinjevold (1999) has claimed that increasing levels of support to underperforming schools and paying more attention to in-school processes – such as providing and monitoring homework in subjects such as mathematics – and the procurement of competent teachers does make a difference. His work makes it clear that it is not teacher qualifications that matter, so much as the character or the value of the teacher. Van der Berg (2005) expresses the same sentiments.

2.8.5 Knowledge versus outcomes

Much has been said about the value of knowledge versus outcomes in education in South Africa. Kraak & Young (2000:28) relate that in the early 1990s there was the assumption that shifting from the “narrow concept of competence to the broader concept of outcomes as a basis for defining qualifications would allow space for debates about knowledge content”. The question of knowledge tended to be avoided by focusing on notions of competence, partly because it was restricted to vocational knowledge and partly because it was assumed that knowledge was always implied in competent performance in the workplace. This turned out to be not the case. As Muller (2000a) argues, outcomes are either too narrowly prescribed to take into account knowledge or they are too diffuse or too difficult to assess. In both cases, knowledge content gets lost.

The criterion of adequacy shifts the attention to education outcomes and the minimum acceptable or adequate level of education. As long as all schools are providing an acceptable or adequate education, below this standard it would not be inequitable for some schools to surpass this minimum level (Fiske & Ladd 2004:8). This scenario could lead to learners in South Africa, for example, lagging even further behind their international counterparts in the areas of mathematical, science and literacy knowledge and skills, as
has been evidenced by the performance of South African learners in comparative international assessments such as TIMSS and PIRLS (see Appendices A-I).

The challenge is to label the minimum level of adequate education. The central question is “Adequate for what?” The answer may lie in a concept explained by Rawls (2001) as the notion that every learner should attain a minimum set of education outcomes connected to his or her long-term life chances. Another answer may draw on philosopher Amy Gutmann’s concept of a democratic threshold. In Gutmann’s (1987) view, the primary role of education is to promote a democratic society characterised by deliberative and collective decision-making, and hence the threshold is the level at which a person has the ability to participate effectively in the democratic process. Fiske & Ladd (2004:9) comment on both of these concepts and conclude that

Combining these two views, we conceive of educational adequacy in the South African context as the education level needed for someone to participate fully in both the political and economic life of the country. Standards of adequacy are very different in the post-apartheid period. For one thing, all citizens are entitled to participate fully in the new democracy and are thus in need of the skills required for critical and independent thinking. Moreover, because the country’s economic vitality depends crucially on its ability to be competitive in the global knowledge-based economy, a typical worker must have a much higher level of education than in the past.

2.8.6 Changes in higher education

In their executive summary on dropout rates at South African universities, Letseka & Maile (2008) mention that South Africa’s graduation rate of 15% is one of the lowest in the world, according to the National Plan for Higher Education (NPHE), compiled by the Department of Education in 2001. This is of particular concern given the shifts that have taken place in employment distribution and the critical shortage of high-level skills in the labour market. This combination of factors is likely to act as a major impediment to achievement of government’s economic development goals. The Department of Education has also noted
wide disparities in graduation rates, with the average graduation rate for white students being more than double that of black students (Letseka & Maile 2008).

Fiske & Ladd (2004) explain that the new black-run government that came into power after the democratic elections of 1994 inherited a higher education system consisting of 36 universities and technikons, some of which were historically white and some of which were historically black. They indicate that, as with the primary and secondary levels, higher education has faced enormous problems related to the legacy of apartheid, including limited resources, financial mismanagement, poor teaching, and low achievement in institutions serving black students.

The Education White Paper of 1997 states:

In South Africa today, the challenge is to redress past inequalities and to transform the higher education system to serve a new social order, to meet pressing national needs, and to respond to new realities and opportunities.

As a starting point, the White Paper called for a single unified system of higher education, run by national government, which would be committed to serving students of all races (Fiske & Ladd 2004).

In May 2002, the Cabinet approved a revised national plan that called for the consolidation of 36 existing institutions into a structured system of 21 institutions, consisting of 11 universities, six technikons, and four “comprehensive universities” offering both university and technikon programmes. According to Jansen (2002), the mergers of universities did not succeed, as these mergers were driven by ideological motives. Samoff (in Weber 2008:xiv) contends that at the changeover to majority rule, there was wide-ranging accord that reorganising higher education required priority attention, and that leading white institutions have largely been sheltered from institutional rearrangements, while black institutions have been reorganised and merged. On the positive side, Soudien
(2007) mentions that the Higher Education Act of 1998 led to the black student enrolment at higher education institutions increasing from 191,000 in 1993 to 449,000 in 2003.

Jansen (in Chisholm 2004:293) lists the following challenges that the higher education sector in South Africa faces:

- The profile of academics at higher institutions remains constant, namely largely white and male;
- “Knowledge producers” are predominately white and male; and
- It will become increasingly difficult to recruit and retain promising black academics at higher institutions.

2.9 CONCLUSION

This chapter dealt with the context of international standardised assessments, with particular emphasis on PISA, which will be used as the research instrument in this study. The rationale for highlighting international standardised assessments, specifically PISA, was to provide an overview of the dynamics of PISA and how they will impact on this study. The other assessments, namely TIMMS and PIRLS, acted as a comparative framework to illustrate how learners from South Africa have performed in other international standardised assessments.

The chapter also provided a backdrop to education in South Africa to present a framework for the context in which the participants operate, and it explored current issues within the media regarding the social, political and economic factors of the country’s education system. Issues dealt with in this chapter included deficiencies in graduate employment, problems with racial integration in schools, and the disparities between independent schools, and the effect that these issues have on education in the country. In addition, the chapter highlighted factors internal and external to the classroom and what effect these factors may have on the mathematics, science and literacy knowledge and skills of learners in South Africa. The purpose of this chapter was to look at the actual situation in education.
in South Africa, and what impact this situation may have on the performance of learners in the sample.

The following chapter will examine the quantitative research design and methodology used in this study.
CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

3.1 CHAPTER OVERVIEW
3.2 INTRODUCTION

In Chapter 3, the empirical study designed to address the research problem will be explained. The chapter explains the research methodology and the data-gathering strategies that were employed.

The aim and objectives of the study will also be described, and an overview of the specific research design used to achieve the aim and objectives of the study will be provided. Thereafter, an explanation is given of the data-analysis techniques used. An identification of the participants and the sampling procedure, as well as the research procedure, will also be included. Finally, this chapter will provide a description of validity and reliability, as well as the ethical considerations observed in the study, a delimitation of the study, and its limitations.

3.3 RESEARCH PARADIGM

Mertens (2005) defines research as a systematic investigation where data are collected, analysed, and interpreted in some way in an effort to understand, describe, and predict a phenomenon. Research is influenced by the researcher’s mental framework, which is referred to as a paradigm. Maree (2007:47) views a paradigm as “a set of assumptions of beliefs about fundamental aspects of reality which gives rise to a particular world-view”, which represents the world-view that guides the inquiry. This implies that the research paradigm serves as the lens through which, or organising principles by which, reality is interpreted.

In this study, the researcher followed a positivist approach. A positivist approach is defined by Krauss (2005:759) as an approach where “the object of study is independent of researchers; knowledge is discovered and verified through direct observations or measurements of phenomena and facts are established by taking apart a phenomenon to examine its component parts”. This study fits the positivist paradigm, as the researcher was completely independent of the object of study in the sense that the researcher was working
outside the sphere of South African education during the research process. Furthermore, content knowledge was systematically discovered and verified by means of two questionnaires and an international standardised assessment (see Appendices O, P, and Q). Facts were then established by dissecting the different components of the findings generated by the various data-gathering instruments mentioned in the previous sentence and were examined and reported within their constituent parts.

### 3.4 RESEARCH DESIGN

A research design is a plan that indicates how the researcher intends to investigate the research problem (Denzin & Lincoln 2006; Mouton 2002). This study can be classified under the theoretical framework of comparative and international education. According to Holmes (in Noah 1984:551), the nineteenth-century pioneers of comparative education were men whose task was to develop their own national system of education. Almost without exception, they were members of a new class of officials appointed to take a special interest in education. As administrators, they wanted to know whether anything of practical value could be learned from the study of foreign systems of education. Some of these pioneers were prepared to adopt from foreign systems those features that would benefit but not harm their own education systems. Today comparative and international education can be of assistance to policy makers and administrators and can form a valuable part of the education of teachers.

Kelly, Altbach & Arnove (1982:508) assert that

> Comparative education has traditionally served educational planners, policy-makers, and others involved with the applied aspects of educational policymaking. Much of the database in this field has been developed with the interests of such groups in mind. Comparative education serves as a means to provide information on policy options in planning educational reform and a benchmark to compare the effectiveness of educational practices.
Kelly et al. (1982:508) add that

Planners and administrators who use comparative knowledge are for the most part in ministries of education, international agencies, aid organizations, and to some extent in school systems. Although relatively few of these individuals are “producers” of knowledge in the field, they are important in applying research, sponsoring studies, and determining the shape of comparative education through their funding of research.

Epstein (1994:399) contends that

[C]omparative education tends to draw its inspiration from the social sciences. In doing so it makes certain assumptions about schooling. For one thing, the field views schools as integral parts of culture, as never inert but susceptible to social change. However, the universal basic aim of the school in general remains the preparation of children for their economic future, taking cognizance of a variety of aspects involved in such a future. The predicament of schools lies in the fact that they cannot accurately anticipate the future for which they have to prepare the learners.

This study is comparative in nature, as the relation between learners in South Africa and their international peers will be explored. It also does not simply mean comparing different groups, but, as Maree (2007:73) points out, “it involves searching systematically for similarities and differences” between learners from South Africa and their international peers in terms of mathematical, scientific and literacy knowledge and skills. Furthermore, comparisons between the achievements of different racial, religious and status groups, as well as genders, participating in the study will be drawn. The performance of learners in the different educational settings will also be investigated to ascertain how effectively teaching and learning is implemented in these schools. Hopefully, the diverse character of the findings of the study will provide information for policy makers in planning education.
transformation and will serve as a yardstick to evaluate the effectiveness of current education practices in South Africa.

3.5 RESEARCH DESIGN AND METHODOLOGY

The purpose of a research design is to provide a structure for the answering of research questions (Neuman 2006). This study falls within the domain of quantitative research methodology, as it uses numerical data to describe and explore a phenomenon. In this study, a questionnaire was used to conduct a survey, and the data was converted into nominal data for analysis. Quantitative research is inclined to be deductive, as it tests theory. The results can be generalised to the learners in the grades of those specific schools, provided that appropriate sampling techniques are used.

Gall, Gall & Borg (2003:223) maintain that the purpose of a survey is to use questionnaires or interviews to collect data from a sample that has been selected to represent a population to which the findings of the data analysis can be generalised. They further contend that questionnaires are documents that ask the same questions of all individuals in the sample. The study will also employ a standardised test. A standardised test is “a test that has procedures to ensure consistency in administration and scoring across all testing situations” (Gall et al. 2003:190).

An advantage of quantitative studies is that the range of the data is able to be presented in a coherent and functional way using numbers (Blaxter, Hughes & Tight 2003; Bless & Kuthuria 1993; Struwig & Stead 2001). Quantifying abstract concepts allows one to discuss topics that might otherwise be difficult to analyse. Furthermore, data can be precisely and exactly compared when it is in numerical and statistical form (Rubin, Rubin & Piele 2005).

One of the disadvantages of the quantitative method is that detailed insight into the research problem may be compromised (Neuman 2006). However, many investigators feel
that by using quantitative research methods and statistical techniques, researchers bring greater precision and objectivity to the matter under investigation.

This study will utilise empirical statistical data, which will be precisely and accurately compared and analysed, which is a key feature of quantitative research. The questionnaire and assessment instruments utilised in the study are quite comprehensive, and it was felt that a quantitative methodology was best suited to the current study.

Within the broader sphere of quantitative research, this study adopted an exploratory-descriptive approach. Exploratory-descriptive research involves the provision of an accurate and detailed description of, as well as a systematic examination and organisation of, carefully observed information about specific phenomena or constructs (Christensen 1996; Cozby 1993; Dane 1990). Descriptive research attempts to provide a complete and accurate description of a situation by summarising and communicating what is found in quantitative data. Harris (1998:48) states that “descriptive studies frequently utilize large samples, natural settings, and behaviours or scores that are of general interest”. This study deals with a comprehensive sample of data generated from 248 learners in eight schools that highlight a serious concern in education in South Africa today. The exploratory-descriptive approach is deemed appropriate for this particular research study.

3.6 PARTICIPANTS AND SAMPLING

3.6.1 Participants

The sample for this study consisted of 248 learners who were all in Grade 9 at secondary schools in Port Elizabeth. The participants were selected from eight different secondary schools. The main criterion was that they should be in Grade 9, as the local sample would be compared with their international peers within the same age group or numbers of school years attended, (see Schleicher & Tamassia (2003) in Chapter 1).

Other considerations for the sample selection include:
• Diversity in race groups in schools: The sample includes learners from the white, black, Coloured and Indian population groups of South Africa. One of the focuses of the study is to determine whether there are still academic achievement disparities in the knowledge and skills levels of the four in the country after having been exposed to an integrated education system. Therefore, it was deemed appropriate to make the sample group as racially diverse as possible.

• Types of schools: Public schools from the four former education departments that catered for learners before 1994, that is, the HoR, the HoD, the HoA, and the DET, as well as independent schools, were represented. The motivation behind selecting schools representing all the former education departments was to assess whether the characteristics of the education system before 1994 are still affecting learners. Have learners who have been exposed to an integrated public school system acquired similar knowledge and skills, or is the scenario still reminiscent of the apartheid era, where unfair privilege was extended to, for example, the former House of Assembly (HoA) schools (Fiske & Ladd 2004).

• The mother tongue of learners: Learners whose home language is English, Afrikaans, or isiXhosa, as well as foreign learners, were incorporated in the study. Analysis of results will feature a comparison between the effects of language on academic achievement, as mentioned by ADEA (2005), Somhlahlo (2009), Schuring (1997), Coutts (1992), etc in Chapter 2. Although the medium of testing in the assessment used in this study is English, it is not necessarily the mother tongue or medium of instruction of all of the participants in the sample. The results of learners using English as a first language or medium of instruction will be compared with the achievement of learners using English as a second language, either as medium of instruction or as home language.

• Religion: A Christian school and an Islamic school were selected, while the religious persuasions of the other six schools were mainly Christian and mixed. The motivation behind selecting schools that would represent the major religions in South Africa was to determine how the quality and standard of education in religious schools in South Africa compare with each other and how they compare with the quality and standard of education in public schools. The study will compare the
achievement of learners in the two religious schools in the sample, and it will explore whether there is a difference in the acquired skills and knowledge of learners in religious schools compared to learners from public schools.

- School location: Schools from different suburbs and areas were included. For example, schools from Port Elizabeth’s historically white suburbs, the northern areas, which essentially cater for Coloured learners, the townships, which cater mainly for black students, and Malabar, where most Indian learners study, were chosen. The motivation behind selecting schools from different residential areas was to determine how the area or suburb where learners live or attend school affects their knowledge and skills and to determine whether this plays a significant role in academic achievement. Chapter 1 sketched a background to the history of Port Elizabeth and explained how the different races ended up living in their respective suburbs during the previous apartheid dispensation. Many of the learners in the sample still attend schools based on the racial segregation patterns that existed before 1994, and the study also aims to look at whether academic results are still skewed towards schools in former advantaged areas to the detriment of former disadvantaged schools.

Based on the factors discussed above, an effort was made to make the research sample as diverse and representative of the Port Elizabeth population as possible, to ensure accountable and relevant results and findings. A breakdown of the sample according to the biographical and personal details of the participants follows.

### 3.6.1.1 Ethnicity

The data shows that out of the different race groups that participated in the assessment white learners made up 17% of the sample, Coloured learners made up 27%, black learners made up 48%, Asian learners made up 7%, and other race groups made up 1%.
Two of the sample groups had only black learners, while most of the other groups contained learners that represented various race groups. The sample comprised one Korean learner.

3.6.1.2 Gender

The gender distribution of the sample, revealed that 34% of the learners were male, and 66% of the learners were female. The large difference in female-male ratio can be partly attributed to the fact that one sample group was an all-girls school.

3.6.1.3 Home Language

The data collected regarding the different home languages spoken by the participants in the sample indicate that the majority of the learners, 116 were isiXhosa-speaking, followed by English speakers, which comprised 88 of the sample. Afrikaans was spoken by 40 of the learners, while speakers of other languages made up just less than 2% of the sample at four. Some of the other home languages indicated by the learners include isiZulu, Sesotho, and Korean.

3.6.2 Sampling

The study employed a convenience, non-probability sampling technique to obtain a sample of Grade 9 learners from secondary schools in Port Elizabeth. Convenience sampling is the process where the researcher selects a sample primarily because it is accessible and reasonably reflective of the population of interest (Harris 1998; Fowler 2002). According to Leary (1991), this is the crudest form of sampling, because anyone who is convenient becomes part of the population. When using non-probability sampling, the researcher has no way of knowing the probability that a particular case will be selected for the sample (Harvey & McDonald 1993; Leary 1991).
McMillan & Schumacher (2003:168) assert that in non-probability sampling, the researcher uses subjects “who happen to be accessible or may represent certain types of characteristics”. As referred to in Chapter 1 by Salz and Figueroa, PISA is an international assessment directed at 15-year-olds, which coincides with learners in Grade 9 in South Africa. This study falls within the contention of McMillan & Schumacher (2003:168), in that the participants selected for this study match the characteristics of the PISA target groups. In order to draw a valid comparison between learners from South Africa and their international peers, non-probability sampling is thus used for the purposes of this study, as the participants will most likely be of the same age or in the same grade.

McMillan & Schumacher (2003:169) divide non-probability sampling into three types, namely convenience sampling, purposeful sampling, and quota sampling. Relevant to this study is convenience non-probability sampling, described by McMillan & Schumacher (2003:169) as selecting subjects on the basis of being “accessible or expedient”. The researcher is based in the city of Port Elizabeth, which makes it logical to target samples from this city. Furthermore, participants in the sample sites are already “conveniently” arranged in the appropriate age or grade group required by the PISA study. Thus, the study uses convenience non-probability sampling, as the participants match the characteristics of the PISA groups and are accessible and convenient for the research study.

One of the limitations of convenience non-probability sampling is that there is an unequal chance of being included in the sample, and although the sample may provide the researcher with prolific data, the sample will probably not be representative of the population (Graziano & Raulin 2000; Struwig & Stead 2001). There are no attempts to control bias, which implies difficulties with regard to the generalisability of the results (Dane 1990; Sheskin 2000; Struwig & Stead 2001). Caution should thus be taken when generalising the findings. McMillan & Schumacher (2003:169) assert that the generalisability of the findings will be limited to the characteristics of the subjects, in this case Grade 9 learner in Port Elizabeth schools.

However, with the study being exploratory-descriptive research, generalisability was not a
concern, as it can be assessed through replication (Schonegevel 1997; Sullivan 2001). Non-probability convenience sampling is also less complicated than probability sampling methods, as it takes advantage of respondents who are readily available. However, the disadvantage of non-probability sampling is that it is less precise (Bailey 1987). Patton (1987) stated that despite the disadvantages of non-probability convenience sampling, it is the most commonly employed sampling strategy in the social sciences. Another major advantage of this type of sampling is that it is less expensive in terms of costs and time (Gravetter & Forzano, 2006; Cozby, 1993).

As previously mentioned, a total of eight schools were selected for the study. The researcher chose schools covering as diverse demography as possible to represent the population. A breakdown of the demography of the different schools follows. For the sake of reliability and validity, the schools will be identified as Schools A to H.

**School A**
This school is situated in the western suburbs of Port Elizabeth and used to operate under the former House of Assembly (HoA), which was in charge of Model C schools. A total of 26 learners were assessed, of which 13 were white, 11 were black, and two were Coloured. Most of the educators at the school are white. The medium of instruction is English.

**School B**
This school is also located in the western suburbs, and like School A, operated under the former HoA. The medium of instruction is Afrikaans, and 31 learners took part in the study, of which 12 were white and 19 were Coloured. Because of the medium of instruction, no black learners were assessed at this site. The majority of educators at the school are white.

**School C**
School C is also situated in the western suburbs, and caters explicitly for Christian learners. The school is independent, but follows the curriculum of the National Education Department. Twenty-three learners were assessed at this site, of which 18 were white, four were black, and one was Korean. Once again, most of the educators at the school are white. The medium of instruction at the school is English.
School D
The fourth school in the sample is located in the township and used to operate under the auspices of the former Department of Education and Training (DET) for black learners. The sample comprised 33 participants, of which all the learners were black and 32 learners used isiXhosa as their home language. The medium of instruction at the school is English, and most of the educators are black.

School E
School E is located in the area previously demarcated for the Indian segment of the population. The school formerly functioned under the House of Delegates (HoD), which catered to the education needs of Indian learners. The medium of instruction is English, and of the 36 learners sampled, 14 were black, 12 were Coloured, and nine were Indian. The majority of educators at the school are Indian.

School F
The sixth school in the sample is also an independently-operated school, which caters for Muslim learners. The school follows the national education curriculum, and the medium of instruction is English. Of the 22 participating learners, 11 were Coloured, nine were Indian, and two were black. Most of the staff at the school are Coloured or Indian.

School G
This school is situated in the northern suburbs and is a girls-only school that used to belong to the Catholic Church but fell under the former House of Representatives (HoR), which was charged with Coloured education. All the learners sampled were black and used isiXhosa as their home language, while the medium of instruction at the school is English. The staff complement is mostly Coloured, with a few black educators.

School H
The last school included in the sample also used to fall under the HoR, as it is located in the northern suburbs of Port Elizabeth. A total of 34 learners were assessed, of which 22 were Coloured, and 12 were black. The school’s medium of instruction is English, with most
of the educators being Coloured. English is the home language of 20 of the learners sampled, 10 speak isiXhosa, three speak Afrikaans, and one speaks Sesotho.

3.7 RESEARCH METHODS

Two questionnaires were used for assessment purposes in this study. The first questionnaire, which was administered to the learners, is the same instrument that was used by the OECD in previous assessments. The questionnaire consists of two parts, with the first part designed to extract biographical data and background information from participating learners (see Appendix P). The second part contains the reading, mathematics and science sample tasks (see Appendix Q).

The second questionnaire was for completion by the principal of the school or a designate, and was also taken from the PISA resources (see Appendix O). Among other things, this questionnaire asks information about:

- The characteristics of the school;
- The student body;
- The school’s resources;
- Staffing;
- The organisation of the school;
- The environment in the curriculum;
- Career guidance and preparation of the learners for further education.

This information helps to illustrate the similarities and differences between groups of schools, in order to better establish the context of learners’ test results. For example, the information provided may help to establish the impact of resource distribution on learner achievement – both within the same school and between schools.

A comprehensive questionnaire (see Appendix P) was used by the researcher to obtain essential demographic and background information from the learners. The instrument used is the same as the one used by PISA for the learners who took the assessment in the ±50
OECD countries that regularly participate in the process. The questionnaire was modified by the researcher to accommodate local conditions, for example some countries use the terms “standard” or “key level”, while South Africa uses the term “grade” to identify the different year levels. Minor terminological adaptations such as these did not compromise the validity of the questionnaire, as meaning was not affected.

The questions included were based on the literature review and included biographical information needed for the meaningful interpretation of the research findings. The questionnaire requested information pertaining to the participant’s age, gender, home language, ethnicity, members of the family and their influence on the learner’s education, the school environment, the learner’s study habits and attitude to learning, and future aspirations. Specific aptitudes to reading, mathematics, and science were also solicited. The final three parts of the questionnaire relate to the assessment in reading, mathematics, and science. A thorough breakdown of each component is given below.

As mentioned in Chapter 2, PISA aims to measure how far learners approaching the end of compulsory education have acquired some of the knowledge and skills necessary for full participation in today’s knowledge society. The PISA assessment comprises reading, mathematics, and science tasks.

**Reading tasks**

The PISA 2009 definition of reading literacy states that reading literacy is to understand, use, reflect on, and engage with written texts, in order to achieve one’s goals, to develop one’s knowledge and potential, and to participate in society. Five aspects guide the development of the reading literacy assessment tasks, namely:

- retrieving information;
- forming a broad understanding;
- developing an interpretation;
- reflecting on and evaluating the content of a text; and
- reflecting on and evaluating the form of a text.
The purpose of the PISA reading literacy assessment is to monitor and report on the reading proficiency of 15-year-olds as they approach the end of compulsory education. Each task in the assessment is designed to gather a specific piece of evidence about reading proficiency by simulating a reading activity that a reader might carry out, either inside or outside school, as an adolescent or as an adult. The PISA reading literacy tasks range from very straightforward comprehension activities to quite sophisticated activities requiring deep and multiple levels of understanding. The difficulty of any reading literacy task depends on an interaction of several variables.

The PISA reading task section used in the assessment comprised five levels of proficiency (from Level 1 to Level 5). Questions were given a mark based on the difficulty level of the question, as illustrated below in Table 3.1.

Table 3.1: Reading task levels according to PISA 2003

<table>
<thead>
<tr>
<th>Level</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Above 625</td>
</tr>
<tr>
<td>4</td>
<td>553-625</td>
</tr>
<tr>
<td>3</td>
<td>481-552</td>
</tr>
<tr>
<td>2</td>
<td>408-480</td>
</tr>
<tr>
<td>1</td>
<td>335-407</td>
</tr>
</tbody>
</table>

The PISA 2003 report provides the following narrative description of learner proficiency levels for reading below.

**Level 5**

Learners proficient at Level 5 on the reading literacy scale are capable of completing sophisticated reading tasks, such as managing information that is difficult to find in unfamiliar texts, showing detailed understanding of such texts and inferring which information in the text is relevant to the task, and being able to evaluate critically and build hypotheses, draw on specialised knowledge, and accommodate concepts that may be contrary to expectations.
Level 4
Learners proficient at Level 4 on the reading literacy scale are capable of difficult reading tasks, such as locating embedded information, dealing with ambiguities, and critically evaluating a text.

Level 3
Learners proficient at Level 3 on the reading literacy scale are capable of reading tasks of moderate complexity, such as locating multiple pieces of information, making links between different parts of a text, and relating a text to familiar everyday knowledge.

Level 2
Learners proficient at Level 2 are capable of basic reading tasks, such as locating straightforward information, making low-level inferences of various types, working out what a well-defined part of a text means, and using outside knowledge to understand a text.

Level 1
Learners proficient at this level are capable of completing only the simplest reading tasks developed for PISA, such as locating a single piece of information, identifying the main theme of a text, or making a simple connection with everyday knowledge.

Learners performing below 335 score points – that is, below Level 1 – are not likely to demonstrate success in the most basic type of reading that PISA seeks to measure. This does not mean that they have no literacy skills. Nevertheless, the pattern of their answering in the assessment is such that they would be expected to solve fewer than half of the tasks in a test made up of items drawn solely from Level 1, and therefore they would perform below Level 1. Such learners have serious difficulties in using reading literacy as an effective tool to advance and extend their knowledge and skills in other areas. Learners with literacy skills below Level 1 may therefore be at risk, not only of difficulties in their initial transition from education to work. Presumably they would therefore not be able to benefit from so-called lifelong learning.
Below follows a breakdown of the number of reading questions asked per level.

Table 3.2: The number of reading questions asked per level

<table>
<thead>
<tr>
<th>Level</th>
<th>Number of questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

The modified standardised assessment used in the study provides an adequate spread of reading questions over the different levels, as can be seen from Table 3.2 above.

**Mathematics tasks**

The PISA mathematics domain is concerned with the ability of learners to analyse, reason, and communicate ideas effectively as they pose, formulate, solve, and interpret mathematical problems in a variety of situations. The PISA mathematics assessment focuses on the capacity of 15-year-old learners (the age when many learners are completing their formal compulsory mathematics learning) to use their mathematical knowledge and understanding and to carry out the tasks (PISA 2009 report).

Similar to the reading tasks, the PISA mathematics task section used in the assessment comprised five levels of proficiency (from Level 1 to Level 5). Questions were given a mark based on the difficulty level of the question, as illustrated below in Table 3.3:
Table 3.3: Mathematics task levels according to PISA 2003

<table>
<thead>
<tr>
<th>Level</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Above 606</td>
</tr>
<tr>
<td>4</td>
<td>545-605</td>
</tr>
<tr>
<td>3</td>
<td>483-544</td>
</tr>
<tr>
<td>2</td>
<td>420-482</td>
</tr>
<tr>
<td>1</td>
<td>358-419</td>
</tr>
</tbody>
</table>

The PISA 2003 report provides the following narrative description of learner proficiency levels for mathematics below.

**Level 5**

At Level 5, learners can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare, and evaluate appropriate problem-solving strategies for dealing with complex problems related to these models.

Learners at this level can work strategically, using broad, well-developed thinking and reasoning skills, appropriately linked representations, symbolic and formal characterisations, and insight pertaining to these situations. They can reflect on their actions and can formulate and communicate their interpretations and reasoning.

**Level 4**

At Level 4, learners can work effectively with explicit models for complex concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic ones, linking them directly to aspects of real-world situations. Learners at this level can utilise well-developed skills and reason flexibly, with some insight, in these contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments, and actions.
Level 3
At Level 3, learners can execute clearly described procedures, including those that require sequential decisions. They can select and apply simple problem-solving strategies. Learners at this level can interpret and use representations based on different information sources and can reason directly from them. They can develop short communications reporting their interpretations, results, and reasoning.

Level 2
At Level 2, learners can interpret and recognise situations in contexts that require no more than direct inference. They can extract relevant information from a single source and can make use of a single representational mode. Learners at this level can employ basic algorithms, formulae, procedures, and conventions. They are capable of direct reasoning and making literal interpretations of the results.

Level 1
At Level 1, learners can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are obvious and follow immediately from the given stimuli.

Below follows a breakdown of the number of mathematics questions asked per level.

Table 3.4: The number of mathematics questions asked per level

<table>
<thead>
<tr>
<th>Level</th>
<th>Number of questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>8</td>
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<tr>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Table 3.4 above illustrates that the higher-order-level mathematics problems featured more than the problems in Levels 1 and 2.

Science tasks

Scientific literacy is defined as the capacity to use scientific knowledge, to identify questions, and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity. This definition is based on three dimensions: scientific knowledge or concepts, scientific processes, and the situations or context in which the knowledge and processes are assessed (PISA 2009 Report). The PISA science assessment encompasses a continuum of scientific knowledge and the cognitive abilities associated with scientific enquiry, it incorporates multiple dimensions, and it addresses the relationships between science and technology. It provides an assessment of learners’ scientific literacy by assessing their capacity to use scientific knowledge (Bybee 1997a; Fensham 2000; Law 2002; Mayer & Kumano 2002).

The PISA science task section used in the assessment comprised six levels of proficiency (from Level 1 to Level 6). Questions were given a mark based on the difficulty level of the question, as illustrated below in Table 3.5.

Table 3.5: Science task levels according to PISA 2003

<table>
<thead>
<tr>
<th>Level</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Above 707.9</td>
</tr>
<tr>
<td>5</td>
<td>663.4-707.8</td>
</tr>
<tr>
<td>4</td>
<td>558.8-633.3</td>
</tr>
<tr>
<td>3</td>
<td>484.2-558.7</td>
</tr>
<tr>
<td>2</td>
<td>409.5-484.1</td>
</tr>
<tr>
<td>1</td>
<td>334-409.4</td>
</tr>
</tbody>
</table>
The PISA 2003 report provides the following narrative description of learner proficiency levels for science below.

**Level 6**
At Level 6, learners can consistently identify, explain, and apply scientific knowledge and knowledge about science in a variety of complex life situations. They can link different information sources and explanations and use evidence from those sources to justify decisions. They clearly and consistently demonstrate advanced scientific thinking and reasoning, and they use their scientific understanding in support of solutions to unfamiliar scientific and technological situations. Learners at this level can use scientific knowledge and develop arguments in support of recommendations and decisions that centre on personal, social or global situations.

**Level 5**
At Level 5, learners can identify the scientific components of many complex life situations, they can apply both scientific concepts and knowledge about science to these situations, and they can compare, select, and evaluate appropriate scientific evidence for responding to life situations. Learners at this level can use well-developed inquiry abilities, they can link knowledge appropriately, and they can bring critical insights to situations. They can construct explanations based on evidence and arguments based on their own critical analysis.

**Level 4**
At Level 4, learners can work effectively with situations and issues that may involve explicit phenomena requiring them to make inferences about the role of science or technology. They can select and integrate explanations from different disciplines of science or technology, and they can link those explanations directly to aspects of life situations. Learners at this level can reflect on their actions, and they can communicate decisions using scientific knowledge and evidence.
Level 3
At Level 3, learners can identify clearly described scientific issues in a range of contexts. They can select facts and knowledge to explain phenomena, and they can apply simple models or inquiry strategies. Learners at this level can interpret and use scientific concepts from different disciplines, and they can apply them directly. They can develop short statements using facts, and they can make decisions based on scientific knowledge.

Level 2
At Level 2, learners have adequate scientific knowledge to provide possible explanations in familiar contexts or to draw conclusions based on simple investigations. They are capable of direct reasoning and making literal interpretations of the results of scientific inquiry or technological problem solving.

Level 1
At Level 1, learners have such limited scientific knowledge that it can be applied to only a few familiar situations. They can provide scientific explanations that are obvious and that follow explicitly from given evidence.

Below follows a breakdown of the number of science questions asked per level.

Table 3.6: The number of science questions asked per level

<table>
<thead>
<tr>
<th>Level</th>
<th>Number of questions</th>
</tr>
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<tbody>
<tr>
<td>6</td>
<td>3</td>
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<tr>
<td>5</td>
<td>8</td>
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<tr>
<td>4</td>
<td>6</td>
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<td>3</td>
<td>13</td>
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<tr>
<td>2</td>
<td>8</td>
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<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3.6 demonstrates that most of the science questions were pitched at Level 3,
followed by levels 5 and 2.

3.8 RESEARCH PROCEDURES

Permission was granted to the researcher by Dr Nyathi Ntsiko, District Director of the Eastern Cape Education Department (see Appendix N), to approach schools willing to participate in the study. A letter inviting principals of the targeted schools and setting out the aims and conditions of the research (see Appendix M) was then drafted and personally taken to the targeted schools by the researcher. In total, 18 schools were approached by the researcher, to ensure inclusivity and to improve the sample return size. Only 12 of the schools approached consented or returned the consent letter to participate contained in the invitation letter (see Appendix M). The researcher then selected eight schools to participate in the study based on the diversity of the background of the institutions. The assessments were conducted in 2010 and took about one month to complete.

3.8.1 Piloting and administering of the assessment

Because of practical reasons, such as schools not being able to provide computer access to their learners to take the computerised version of the PISA assessment, it was decided to make use of the pencil-and-paper version of the PISA assessment. Clements & Ellerton (1995) assert that pencil-and-paper tests are commonly used in assessments that involve large samples.

The assessment was piloted using two Grade 9 learners from a school not selected for the study. The motivation behind the pilot was twofold: to get an indication of the time required to complete the entire assessment, and also to ensure that there were no discrepancies between the questionnaire and the answer booklet. It took the first learner approximately three-and-a-half hours to complete the assessment, including two breaks of 15 minutes each. The second learner required about 4 hours and 30 minutes. The two learners pointed out several typing errors and omissions on the answer sheet. The researcher corrected the mistakes pointed out by the learners before administering the assessment to the main
sample. Since the questionnaires used in the pilot were exactly the same as the ones used for PISA, the researcher deemed that a more extensive pilot was not necessary.

The researcher conducted the assessments at the sites himself to ensure consistency. On average, the assessment took about five hours to complete and proved to be very taxing on the learners. Schools were reluctant to release an entire class for the best part of the school day, and in some cases the researcher had to make a follow-up visit to allow learners to complete the tasks.

The procedure and importance of the survey was explained to learners before the assessment was administered, and learners appeared very enthusiastic about participating. Learners were allowed to have the same regular breaks as the rest of the school population, and because individual learners worked at different paces, there was no real risk of them sharing answers. Furthermore, learners were not allowed to take the questionnaires out of the examination venue.

Blazek & Forbey (2011) are of the opinion that there has been a massive increase in the use of computerised testing in assessments in recent years, a point supported by Wang, Jiao, Young, Brooks & Olson (2008) and Lim et al. (2006). Although these authors all make mention of traditional paper-and-pencil tests, the researcher could not locate any literature on the effects of paper-and-pencil tests on respondents. From personal observation noted by the researcher during the assessments, the following factors impinged on the respondents:

- Constant sharpening of pencils led to time-wasting and disruption to other learners;
- Many learners did not have erasers, and the sharing of stationery led to disruptions and breaks in concentration;
- Learners appeared frustrated with the constant paging and transferring of answers from questionnaire to the multiple-choice answer booklet;
- There were frequent incidents of learners writing answers in the wrong spaces, which resulted in time-wasting, as incorrect answers had to be erased and rewritten;
• Even after the required method for the answering of the questions was explained to all respondents, many learners gave invalid responses, for example instead of choosing from the given choices A, B, C, or D, some wrote out the answers in words or answered using the numbers 1, 2, 3, etc. The researcher then went round and alerted individual learners, who then corrected the discrepancies. This scenario also led to time-wasting and added to the frustration of some learners with the assessment process.

The above-mentioned factors could definitely have had a negative impact on the outcome of the results for individual respondents.

At the end of each session at a site, the assessments, together with the school questionnaire, were collected by the researcher. Marking all the scripts took about three months. The data gathered from the assessments were then captured in Microsoft Excel format for ease of analysis. With the researcher being fortunate to work at a university ranked within the top 2% in the world, he approached the Statistics Department of King Fahd University of Petroleum and Minerals (KFUPM) in Saudi Arabia for assistance in analysing and correlating the data gathered from the study. Furthermore, the researcher approached Danie Venter of the Statistics Department of Nelson Mandela Metropolitan University (NMMU) to obtain input on the best procedure to conduct the collating, analysis and reporting of the data relevant to this study.

3.8.2 The data-gathering instruments

Three data-gathering instruments were used in this study.

The first instrument was a questionnaire which was administered to school principals from the sampled schools. This questionnaire was the same as the one used by PISA since its inception, except that the researcher slightly modified the terminology to reflect conditions in South Africa (see Appendix O). The questionnaire consisted of 22 questions, both open-ended and closed questions, as well as scaled and checklist items. The questions related
to information about

- The school’s resources;
- The number of teachers in the school, and their qualifications;
- Characteristics of the student body;
- The relationship the school has with its learners;
- Some of the administrative structures in the school; and
- Some of the pedagogical practices at the school.

The second instrument was a learner questionnaire also making use of open and closed form, scaled and checklist items. This questionnaire was also taken directly from the PISA resources and related to questions about (see Appendix P)

- Learners and their family;
- Learners’ experience of their school; and
- What learners plan to do in the future.

The main data-gathering instrument was the PISA sample tasks (see Appendix Q). These tasks measure learner ability in reading literacy, mathematics literacy, and science literacy. Questions range from multiple-choice questions to open-ended questions that required learners’ insight.

The statistical data generated from the questionnaires and the sample tasks were captured in a Microsoft Excel spreadsheet and were subjected to analysis of variance (ANOVA) techniques to provide descriptive statistics.

3.9 ETHICAL CONSIDERATIONS

Many researchers have stressed the importance of ethical practices when conducting research (Graziano & Raulin 2000; Craig & Baucum 2002; Oliver 2003). Researchers have an obligation to respect the rights and dignity of participants and to assure them that they will not be harmed. This requires that researchers abide by certain ethical principles and
codes of conduct in order to perform research in a morally acceptable way (Oliver 2003; Struwig & Stead 2001).

The term “ethics” refers to a system of morals or rules of behaviour (Struwig & Stead 2001:66). Ethics provide researchers with a code of moral guidelines on how to conduct research in a morally acceptable way. Strict ethical measures have to be adhered to throughout the planning and execution of qualitative research. Adherence to these measures prevents the researcher from engaging in scientific misconduct, such as plagiarising others’ work, falsely reporting results, and failing to uphold the confidentiality and privacy of research participants.

The researcher’s application for ethical approval was granted by the Research Ethics Committee of Nelson Mandela Metropolitan University, under the Ethics Clearance Reference Number H12-EDU-ITE-003 (attached as Appendix R). The researcher received written consent to conduct the research from both the Department of Education, as well as the principal of each respective school (copies of both letters are attached as Appendices M and N). Participation in the study was voluntary, and participants were orally assured of their right to withdraw from the process at any time.

Ethics and the validity of the research conducted should not be looked at as separate issues (Korchin & Cowan 1982). In fact, unethical research practice reduces the external validity of the research. Unethical research practice includes acts such as not fulfilling the research requirements of informed consent, and failure to maintain privacy and confidentiality (Russell and Roberts 2001). Salkind (2003) has outlined guidelines to ensure that researchers always act in the best interests of their participants. As mentioned in Chapter 1, participants in the sample group were not required to provide their names, so that the principle of anonymity was ensured. In this way, participants’ confidentiality was ensured, regardless of how personal or sensitive the information was that they provided. Individual learner consent was not solicited, as the teachers and principals served in loco parentis for the learners at their school and gave consent on the learners’ behalf. All of the participants used in this study were informed volunteers and were aware that their
responses would be used for this research. Participants were also assured of their right to seek full disclosure about the research topic and the results of the study.

According to McMillan & Schumacher (2003:178), test validity is “the extent to which inferences and uses made on the basis of scores from an instrument are reasonable and appropriate”. Test validity was ensured by using a standardised test that has been used by learners of the same age group from about 50 countries across the world. In addition, results will be reported by using numbers, and data will be analysed in a group context, rather than on an individual basis. A modified version of the test was administered, and the same method of analysis was used as in the original PISA studies.

Test reliability refers to “the extent to which the results [obtained from the administration of an instrument] are similar over different forms of the same instrument or occasions of data collection” (McMillan & Schumacher, 2003:178). In this study, test reliability was assured by making sure that results were free from error. The researcher administered the test personally to all participating schools, and collected the completed questionnaires and tests and did the analysis himself. This eliminated the possibility of teacher interference or any other outside influences that could have affected the outcome of the analysis of the data.

3.10 DATA ANALYSIS

This study had eight aims and objectives, and data were analysed accordingly. Descriptive statistics were used to reach the aims of the study. Descriptive statistics are used to organise, summarise, simplify, and describe data (Gravetter & Forzano, 2006; Gravetter & Wallnau 1999). Descriptive statistics summarise raw data in a more easily interpreted manner, often through the use of averages, graphs, and tables (Gravetter & Wallnau 1999; Neuman 2006; Struwig & Stead 2001).

The data analysis procedure proved to be extremely tedious, particularly the data capturing. After all the assessments were collected from the different schools, they were divided into eight groups, each group representing one of the participating schools. Each
school was then assigned a code (that is, “School A”, “School B”, etc.), with all scripts from School A beginning with “A”, followed by a number, that is, “A1”, “A2”, etc. This procedure was duplicated for each school. Data was captured first by individual schools using a Microsoft Excel spreadsheet and then into a master spreadsheet for comparison purposes. A total of 48 sets of questions were captured, although only the first 18 sets were used for the purposes of the study, as they were sufficient to address the aims of the research. The remaining sets of questions were answered by all participating learners and will be utilised by the researcher for future research and for the purpose of publishing articles.

First, the learner’s code was captured, followed by the reading, mathematics and science scores according to the level that the learner obtained. This allowed the researcher to compile averages for the three disciplines and to draw comparisons, first between the sample and the international PISA results, and then between the participating schools in the sample. In this way, the first aim of the study was achieved.

To answer how results compared, the data from the participating schools were correlated and compared. Having all the data captured on one spreadsheet allowed the researcher to achieve all the other aims involving data supplied by the learners, namely comparisons between the performance of formerly advantaged schools and formerly disadvantaged schools, public schools and independent schools, boys and girls, and different race groups within the same school, as well as the influence of the mother tongue.

The final aim was to explore and describe how factors relating to the school environment contributed to differences in the results. To achieve this aim, a separate spreadsheet was used to capture the data supplied by the principals or designates of each participating school. This data comprised 22 sets of questions with various subsections (see Appendix P).
3.11 CONCLUSION

This chapter focused on the research design and methodology employed in this study. The data-collection method was explained, and the method of data analysis was discussed. Specifically, the research design, sampling techniques, assessment measures, research procedure, and methods for data analysis were described. In addition, the ethical considerations observed in the study were explained.

A discussion of the analysis of the data and the research results will be presented in Chapter 4.
CHAPTER 4
RESEARCH DATA ANALYSIS AND RESULTS

4.1 CHAPTER OVERVIEW

Introduction

Quantitative findings

How learners from South Africa compare with their international peers

How males compare with females

How public schools compare with independent schools

How former advantaged schools compare with former disadvantaged schools

The influence of the mother tongue on performance

How different race groups within the same school compare

The effect of the school environment on performance
4.2 INTRODUCTION

This chapter will focus on the results collected from the completed survey and will match the aims of the study highlighted in the previous chapters.

The primary aim of this research study is to investigate and scientifically explore the real situation in terms of language, mathematical and science knowledge and skills of Grade 9 learners in South Africa and to draw a comparison between Grade 9 learners from secondary schools in Port Elizabeth and their international counterparts, using a standardised international assessment. The study will also focus on the educational and environmental issues that could have affected participants’ performance.

This research has the following objectives:

• To determine the actual reading, mathematical and science knowledge and skills acquired by participants in this study;
• To explore and describe differences in the results of formerly advantaged schools and formerly disadvantaged schools in South Africa;
• To explore and compare how the results of learners in public schools compare with the results of learners in independent schools in South Africa;
• To investigate whether there is a significant difference between the performance of boys and the performance of girls;
• To explore and describe how the mother-tongue language of participants influences results;
• To investigate whether there is a difference between the results of different race groups within the same school; and
• To explore and describe how the availability or non-availability of school resources contributed to differences in the results.

As stated in Chapter 3, a comprehensive questionnaire (see Appendix P) was used as the data-collection instrument to obtain data about essential demographic and background information from the learners. The questionnaire is based on the questionnaire used by
PISA for the assessment of learners in the ± 50 OECD countries that regularly participate in the PISA assessment process. The questionnaire was modified to accommodate local conditions and the context of South Africa. To ensure that these minor adaptations did not compromise the validity of the questionnaire, a small pilot study was conducted.

As mentioned in the previous chapters, the study is quantitative in nature and relies on a vast amount of statistical data. The data was captured in Microsoft Excel format and was verified by Danie Venter of the Department of Statistics at NMMU. The statistical analysis was conducted by the researcher, assisted by the Department of Statistics of King Fahd University of Petroleum and Minerals (KFUPM) in Saudi Arabia.

The following processes were performed:

- the means, simple frequencies, and percentage scores for the responses were calculated (see Tables 4.1 to 4.12).
- differences in scores between learners according to gender and type of school were inspected and compared (see Figures 4.1 to 4.6).
- A Likert-scale data were inspected to see if there were any obvious effects in terms of the school environment on the results (see Tables 4.14 to 4.16 and 4.19 to 4.23).

4.3 QUANTITATIVE RESULTS

4.3.1 A comparison of the South African learners sampled and their international peers

4.3.1.1 Reading results

Table 4.1 below represents the overall reading scores of the South African learners in this study.
Table 4.1: Overall reading scores across the levels

<table>
<thead>
<tr>
<th>School</th>
<th>Number of learners(N)</th>
<th>Below Level 1 (below335)</th>
<th>Level 1 (335 to 407)</th>
<th>Level 2 (408 to 480)</th>
<th>Level 3 (481 to 552)</th>
<th>Level 4 (553 to 625)</th>
<th>Level 5 (above 625)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>26</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>9</td>
<td>12</td>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td>B</td>
<td>31</td>
<td>1</td>
<td>14</td>
<td>10</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>1.6</td>
</tr>
<tr>
<td>C</td>
<td>23</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>3.6</td>
</tr>
<tr>
<td>D</td>
<td>33</td>
<td>29</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>E</td>
<td>36</td>
<td>26</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>F</td>
<td>22</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>6</td>
<td>1</td>
<td>3.0</td>
</tr>
<tr>
<td>G</td>
<td>43</td>
<td>30</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0.6</td>
</tr>
<tr>
<td>H</td>
<td>34</td>
<td>20</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>248</td>
<td>106</td>
<td>34</td>
<td>30</td>
<td>44</td>
<td>26</td>
<td>8</td>
<td>1.49</td>
</tr>
</tbody>
</table>

Table 4.1 above illustrates the distribution of reading scores gathered from the data of the eight schools. As shown, learners from School C performed the best, with an average of 3.6, followed closely by School A. Only three schools managed to score on average above Level 3 (equating to a score of 481 to 552). Four schools scored on average below Level 1 (equating to a score below 335). Overall, the eight schools sampled achieved an average of 1.49, which equates to a score of around 375 on the 2006 PISA Reading Scale (see Appendix J). The PISA average score for the assessment done in 2006 is 500, located in the middle of the range of Level 3.

Seventy-eight learners (31.4%) were able to score at the PISA average of 500, while eight managed to answer questions at Level 5, which equates to a PISA score of above 625. An alarming 42.7% of the sample was unable to answer the most basic reading literacy questions posed at Level 1.

Relating the reading results to the respective tasks of each level, as defined in section 3.10 (“Reading tasks”), the mean of 1.49 would signify that the 248 learners in the sample are
capable of completing only the simplest reading tasks developed for PISA, such as locating a single piece of information, identifying the main theme of a text, or making a simple connection with everyday knowledge. However, a significant number of learners (78 out of 248), were found to be proficient in reaching the PISA average of 481 points (Level 3 and above) and are capable of completing difficult reading tasks (see section 3.10 “Reading tasks”). A further eight can be matched with the best learners in the PISA world samples (Level 5), meaning that they are capable of completing sophisticated reading tasks (see section 3.10 “Reading tasks”).

It appears from the above results that the poor performance of learners can be linked to the specific school that they attend. Four of the worst-performing schools in the reading assessment were, for example, unable to produce a single learner that could answer questions at Levels 4 and 5. An interesting finding is that all the learners that could not answer reading assessment questions at Levels 4 and 5 came from four former disadvantaged schools, which indicates that the learners in these schools are not performing well in reading.

The South African sample would rank 53rd out of 57 countries that participated. This shows that literacy levels in schools in South Africa are still among the lowest in the world, as asserted by Jansen (2008:2), and as attested to by the performance of South African learners in PIRLS 2006 (see Appendix I). However, care must be taken when comparing across nations, particularly in the light of socio-economic inequality, as pointed out by Grouws (1998) and Murnane (1998) in section 2.4.4.1.
4.3.1.2 Mathematics results

Table 4.2 represents the overall mathematics scores of the South African learners in this study.

Table 4.2: Overall mathematics scores across the levels

<table>
<thead>
<tr>
<th>School</th>
<th>Number of learners (N)</th>
<th>Below Level 1 (below 358)</th>
<th>Level 1 (358 to 419)</th>
<th>Level 2 (420 to 482)</th>
<th>Level 3 (483 to 544)</th>
<th>Level 4 (545 to 605)</th>
<th>Level 5 (above 606)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>26</td>
<td>8</td>
<td>0</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>B</td>
<td>31</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1.6</td>
</tr>
<tr>
<td>C</td>
<td>23</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>0</td>
<td>2.6</td>
</tr>
<tr>
<td>D</td>
<td>33</td>
<td>4</td>
<td>1</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>E</td>
<td>36</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>F</td>
<td>22</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>G</td>
<td>43</td>
<td>0</td>
<td>6</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.9</td>
</tr>
<tr>
<td>H</td>
<td>34</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.7</td>
</tr>
<tr>
<td>Total</td>
<td>248</td>
<td>110</td>
<td>25</td>
<td>79</td>
<td>21</td>
<td>12</td>
<td>1</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Results from the mathematics data, captured in Table 4.2 above, reveal that, as with the reading results, School C outperformed the other participating schools sampled in this study, with an average level of 2.6. The only other school to reach the average proficiency of Level 2 was School A. Once again, the same four schools that scored below Level 1 in reading also scored below Level 1 in mathematics. The PISA 2006 average for mathematics was also 500 (see Appendix L). The average for the South African sample, of 1.2, equates to a score of about 370 (see Table 3.3. Mathematics task levels).

A total of 214 of the 248 South African learners, representing 86.2% of the sample, scored under the PISA average of 500 points, situated in the middle of the range of Level 3. Only 34 learners managed to score around or above the PISA average, representing 13.8% of the sample. In addition, only one student proved proficient at answering questions at Level 5, or above 606 points.

As is the case with the results for reading, the mean for mathematics, of only 1.2, indicates that the learners in the sample could only answer questions involving "familiar contexts where all relevant information is present and the questions are clearly defined" (see section
3.10 “Mathematics tasks”). Furthermore, they are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are obvious and follow immediately from the given stimuli (see section 3.10 “Mathematics tasks”). Thus, the majority of learners in the sample could not perform most of the higher-order mathematical skills expected by PISA from 15-year-olds. In defence of the results, Blank & Smithson, (2009) and Champagne (2009) in section 2.4.4.3 contend that the PISA-type mathematical skills, such as inquiry, and scientific habits of mind, are not specifically taught in schools. Thus, learners may be proficient in mathematics at school grade level, but not able to solve PISA-type mathematics problems.

Yet another possible explanation for the poor mathematics results of the South African sample could be that the PISA units are treated as separate and isolated, as opposed to integrated, as mentioned in section 2.4.4.3. This would then become problematic for learners, as many teachers do not always know how to teach reasoning and analysis (see section 2.4.4.3).

The results above would place the South African sample at joint 55th position with Colombia and Brazil out of 59 countries in the PISA 2006 (see Appendix L) and reaffirms South Africa’s TIMSS 2003 ranking as the lowest in mathematics performance (see Appendix E). Blank & Smithson I (2009) in section 2.4.4.3 stress the distinction between school mathematics and mathematical literacy, which is what is assessed in PISA, while King (1998) advocates cross-country comparisons of policy decisions (see section 2.4.4.1). The poor performance of South African learners in this study should nevertheless be of concern to the relevant education authorities. Furthermore, the poor achievement of South African learners in this study adds substance to the assertion of Soudien (2009) mentioned in section 2.4.4.1, namely that the education system is not working for the majority of South Africa’s children.
4.3.1.3 Science results

Table 4.3 represents the overall science scores of the South African learners in this study.

Table 4.3: Overall science scores across the levels

<table>
<thead>
<tr>
<th>School</th>
<th>Number of learners (N)</th>
<th>Below Level 1 (below 334)</th>
<th>Level 1 (334 to 409.5)</th>
<th>Level 2 (409.5 to 484.1)</th>
<th>Level 3 (484.1 to 558.7)</th>
<th>Level 4 (558.7 to 663.3)</th>
<th>Level 5 (663.3 to 707.9)</th>
<th>Level 6 (above 707.9)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>26</td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>5.5</td>
</tr>
<tr>
<td>B</td>
<td>31</td>
<td>11</td>
<td>11</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>C</td>
<td>23</td>
<td>8</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>2.5</td>
</tr>
<tr>
<td>D</td>
<td>33</td>
<td>20</td>
<td>13</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.5</td>
</tr>
<tr>
<td>E</td>
<td>36</td>
<td>35</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>F</td>
<td>22</td>
<td>18</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.5</td>
</tr>
<tr>
<td>G</td>
<td>43</td>
<td>38</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2.5</td>
</tr>
<tr>
<td>H</td>
<td>34</td>
<td>33</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>248</td>
<td>172</td>
<td>39</td>
<td>13</td>
<td>2</td>
<td>10</td>
<td>9</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Results from the overall science scores indicate that School A produced the best average, of 2.5, although it was not enough to pass the PISA 2006 science average of 500 (see Appendix K). A total of 224 South African learners sampled (9 out of 10) could not reach the PISA average of 500 points for the science assessment, while only around 10% were considered proficient.

PISA did not compile a country ranking scale for the 2006 science report, so it is not possible to draw an international comparison. However, according to the PISA 2006 report (see Appendix K), Kyrgyzstan ranked last in science among the participating countries, as 58.6% of their sample scored below Level 1. The findings of this study reflect that 69% of the South African sample scored below Level 1, which means that the South African sample would have fared worse than the Kyrgyzstan sample by more than 10%. Once again, this is consistent with the 2003 TIMSS science results, where South Africa ranked last out of more than 50 countries; with an average achievement score of 244 (see
The dismal mean of 0.7 achieved by the participants in this study shows that Grade 9 learners from South Africa have such limited scientific knowledge that it can only be applied to a few familiar situations. They can present scientific explanations that are obvious and follow explicitly from given evidence (see section 3.10 “Science tasks”). Science literacy appears to be a major stumbling block for most South African learners, according to the findings of this study. However, a possible reason for the poor performance can be linked to the assertion of Champagne (2009) (see section 2.4.4.3) about “individuals’ understanding of context”, as opposed to their actual science knowledge and abilities.

Frustration in not understanding the scientific context could have had a major effect on participant performance in this study. Another possible factor in the poor performance in science could be that disproportionately more questions were pitched at Level 3 or higher (see section 3.10 “Science tasks”) as compared to the reading and mathematics questions. Because they had to deal with scientific skills pitched at a high level, coupled with the aforementioned problems of context, it is not surprising that participants achieved the lowest mean in science.

### 4.4 DIFFERENCES IN RESULTS BETWEEN FORMERLY ADVANTAGED SCHOOLS AND FORMERLY DISADVANTAGED SCHOOLS

In this context, the term “formerly advantaged schools” refers to schools that fell under the administration of the previous HoA (see section 2.5) and were the main beneficiaries under the former apartheid government. Schools that functioned under the former HoR, HoD, and DET (see section 2.5) are classified as “formerly disadvantaged schools”.

This study consisted of three schools that were regarded as advantaged under the former dispensation in South Africa and four that are regarded as formerly disadvantaged. One school was not considered in this comparison, as the institution only started operating from 1996, and can thus not be classified as formerly advantaged or disadvantaged. Three
separate comparisons will be drawn to illustrate the differences between the seven schools in proficiency in the three skills assessed, namely reading, mathematics, and science.

### 4.4.1 Differences in reading results between formerly advantaged schools and formerly disadvantaged schools

Figure 4.1 below illustrates the difference in reading results between formerly advantaged schools and formerly disadvantaged schools.

![Figure 4.1: Reading scores: Formerly advantaged schools and formerly disadvantaged schools](image)

The results show that learners from the formerly advantaged schools considerably outperformed learners from the formerly disadvantaged schools. A total of 80 learners from schools that were previously regarded as advantaged completed the assessment. The PISA average of 500 points or more was achieved by 58% of learners in this group. In
terms of the proficiency levels explained in section 3.10 (“Reading tasks”), the majority of learners from formerly advantaged schools in this study are able to complete reading tasks ranging from moderate complexity (Level 3) to sophisticated (Level 5). Effectively, this achievement would have ranked the learners from this cluster within the top 60% percentile if they had participated in the international PISA assessment process. This scenario is supported by Howie (1999), who mentions that the most proficient learners in South Africa in TIMSS 1999 attained the average achieved by countries in the top percentile, such as Singapore (see Appendix C).

As far as the formerly disadvantaged group is concerned, out of a total of 146 learners, only 9.5% managed to attain the PISA reading average of 500 points, which means that these learners are capable of reading tasks of moderate complexity. Ominously, 71.9% of learners in this group scored below Level 1 and were unable to “demonstrate success on the most basic type of reading that PISA seeks to measure” (see section 3.10 “Reading tasks”). As a cluster, this group would have ranked last, on a par with learners from Azerbaijan (see Appendix J), which is a relatively new country which is still shaking off the shackles of communism. This points to a major crisis in literacy levels in South Africa, as this problem has been highlighted on several occasions, notably by Khosana (2009), Bloch et al. (1999), Matjila & Pretorius (2004), Pretorius & Ribbens (2005), and Howie (2001).
4.4.2 Differences in mathematics results between formerly advantaged schools and formerly disadvantaged schools

Figure 4.2 below illustrates the difference in mathematics results between formerly advantaged schools and formerly disadvantaged schools.

Figure 4.2: Mathematics scores: Formerly advantaged schools and formerly disadvantaged schools

Figure 4.2 shows that learners from the formerly advantaged schools performed significantly better than learners from the previously disadvantaged schools in mathematics. Out of the 80 learners from the formerly advantaged group, 36.2% scored around the PISA mathematics average of 500. This means that these learners are able to perform mathematical tasks ranging from “executing clearly described procedures, including those that require sequential decisions” to “developing and working with models for complex situations, identifying constraints, and specifying assumptions” (see section 3.10 “Mathematics tasks”).

In contrast, the disadvantaged schools produced no learner who was able to reach the average. Significantly, 69.8% of the formerly disadvantaged cluster could not solve mathematics problems at or above Level 1, which means that they were unable to even
answer questions involving “familiar contexts where all relevant information is present and the questions are clearly defined” (see section 3.10 “Mathematics tasks”). Formerly disadvantaged learners that scored below Level 1 represent 60.9% of the sample. Notably, not a single learner from the formerly disadvantaged schools could answer questions pitched at Levels 3, 4 and 5. It can thus be interpreted that the problem with mathematical literacy lies more in the previously disadvantaged schools than in the formerly advantaged schools. This is supported by the TIMSS 1999 report, which mentions that South Africa was the country with the largest distribution of scores in mathematics and science (see Appendix A).

4.4.3 Differences in science results between formerly advantaged schools and formerly disadvantaged schools

Figure 4.3 below illustrates the difference in reading results between formerly advantaged schools and formerly disadvantaged schools.

![Figure 4.3: Science scores: Formerly advantaged schools and formerly disadvantaged schools](image-url)
The data contained in Figure 4.3 illustrate that, yet again, formerly advantaged schools outstripped previously disadvantaged schools significantly in science. The 80 learners from the formerly advantaged sample averaged just under Level 2, equating to a PISA science score of approximately 470. In terms of science tasks, this means that these learners have “adequate scientific knowledge to provide possible explanations in familiar contexts or draw conclusions based on simple investigations” (see section 3.10 “Science tasks”). In comparison, the 146-strong sample from the formerly disadvantaged schools could only average a level of 0.1, with only 18 learners, or 8% of the sample, managing to attain Level 1 proficiency or better. These learners have such limited scientific knowledge that it cannot even be applied to familiar situations (see section 3.10 “Science tasks”). In the formerly advantaged sample, 28.7% of learners were able to perform tasks at Level 3 or above, which imply that these learners can perform the following science tasks (see section 3.10 “Science tasks”):

- Describe scientific issues in a range of contexts;
- Work effectively with situations and issues that may involve explicit phenomena about the role of science and technology;
- Identify the scientific components of many complex life situations; and
- Consistently identify, explain, and apply scientific knowledge in a range of complex life situations.

Once again, the findings of the study reveal the massive disparity in the quality of education between formerly advantaged schools and formerly disadvantaged schools, even after 16 years of democracy. These findings are consistent with Fleisch’s (2007) description of South Africa as consisting of two nations and Howie’s (2001) description of South Africa as being both a developed country and a developing country with regard to its education system.
4.5 RESULTS OF LEARNERS IN PUBLIC SCHOOLS COMPARED WITH LEARNERS IN INDEPENDENT SCHOOLS

The following set of results will investigate and describe how learners from public schools who participated in the study fared compared to learners from independent schools.

Public schools in South Africa are classified as schools under the administration of the national government and are partly or wholly funded by the state. Independent schools, on the other hand, are not administered by local, provincial or national government; thus, they retain the right to select their learners and are funded in whole or in part by charging for their learners' tuition, rather than relying on public (government) funding (Kitaev 1999:43). The study consisted of two independent schools, both religious in nature, and six public schools. The independent school sample consisted of 45 learners, while the public school sample consisted of 203 learners. This reflects current socio-economic realities in South Africa. Due to the generally more expensive school fees at most independent schools, most learners in South Africa attend public schools (Hofmeyer 2001:15; Du Toit 2004:1).
4.5.1 Differences in reading scores between independent schools and public schools

Figure 4.4 below shows the difference in reading scores between independent schools and public schools.

![Reading scores: Independent schools and public schools](image)

**Figure 4.4: Reading scores: Independent schools and public schools**

The results in Figure 4.4 above show that independent schools significantly outperformed public schools. A total of 36 out of the 45 learners in the independent school sample, or 80% of the sample, managed to score around or above the PISA reading average of 500. This group achieved a mean of 3.3 for reading, which equates to a PISA score of about 508, which would have ranked these learners within the top 10 of the 56 countries that took part in the PISA 2006 assessment (see Appendix J). In effect, most learners in this study that attend independent schools are capable of completing reading tasks ranging from moderate complexity (Level 3) to sophisticated (Level 5) (see section 3.10 “Reading tasks”).

In contrast, the learners from the public schools achieved a mean of only 1.0 for reading.
However, 42 learners (or 20.6% of the public school sample) were able to score around or above the PISA reading average of 500. It should be noted that the majority of these learners were from the formerly advantaged schools. Alarmingly, 52.2% of public school participants could not perform the most basic Level 1 reading literacy tasks.

The data above confirm the notion that education in independent schools is superior to education in public schools, as independent schools have historically been better resourced and cater for a select clientele. Alarm bells should be ringing for the education authorities, considering the large number of public school learners that were unable to interpret basic reading activities. Further investigation and research on the PISA average of 500 in the reading results of independent schools and public schools, needs to be done.

4.5.2 Differences in mathematics scores between independent schools and public schools

Figure 4.5 below shows the difference in mathematics scores between independent schools and public schools.

![Figure 4.5: Mathematics scores: Independent schools and public schools](image)
The data in Figure 4.5 illustrate that independent school learners again performed considerably better than public school learners. While more than 40% of independent school participants scored around and better than the PISA mathematics average of 500, only just over 5% of public school participants could achieve this feat. The 40% of independent school learners who scored around and better than the PISA mathematics average of 500 are able to perform mathematical tasks ranging from “executing clearly described procedures, including those that require sequential decisions” to “developing and working with models for complex situations, identifying constraints, and specifying assumptions” (see section 3.10 “Mathematics tasks”).

More than 45% of public school learners who completed the mathematics assessment were unable to master the most basic mathematical tasks required at Level 1, meaning that they were unable to even answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. In comparison, only 15% of independent school learners were unable to answer Level 1 proficiency questions.

If the independent schools in the sample had represented South Africa in the PISA 2006, they would have ranked alongside countries such as Italy and Israel (see Appendix K). By comparison, public schools would have been fourth from the bottom, surpassing only Azerbaijan, Qatar, and Kyrgyzstan (see Appendix K). This indicates the huge disparity that exists between education in independent schools and education in public schools. It has to be pointed out that not much “thorough methodological debate” regarding PISA has taken place within the international community (see Hopmann’s (2007) assertion in section 2.4.4.3). PISA results are difficult to compare within countries that do not form part of the PISA community, as no reference framework exists. However, this study draws a direct comparison between the results obtained from this research and previous PISA assessments conducted during the last decade. As mentioned in section 2.4.4.3, Jahnke & Meyerhöfer (2006) lament the general lack of criticism of PISA and attribute this lack of criticism to the overwhelming success of the PISA approach.
4.5.3 Differences in science scores between independent schools and public schools

Figure 4.6 below shows the difference in science scores between independent schools and public schools.

![Figure 4.6: Science scores: Independent schools and public schools](image)

The results above illustrate that there is only a marginal difference between independent schools and public schools in performance in the science assessment. The majority of independent school learners (57.7%) and public school learners (71.9%) could not perform science tasks pitched at Level 1. Only eight independent school learners managed to achieve the PISA average score for science of 500, compared to 16 public school learners. Significantly, three public school learners from one of the formerly advantaged schools were able to perform tasks at Level 6, while no learners from the independent schools were able to do so. The three learners mentioned above can thus consistently identify, explain, and apply scientific knowledge in a variety of complex life situations, the highest order of knowledge and skills listed in the PISA proficiency levels for science (see section 3.10
In contrast to the results for reading and mathematics, public schools appeared to hold their own against independent schools in the science category. This is an interesting finding and warrants further research and investigation. This also poses a dilemma for parents, as parents send their children to independent schools, having the perception that all spheres of education in such schools are of a higher level, as asserted by Coutts (1992).

### 4.6 DIFFERENCES IN THE PERFORMANCE OF BOYS AND GIRLS

The following is an extract taken from the World Development Report (2012:8) regarding gender equality and development:

> Progress in closing gender gaps in education has been steady and sustained at all levels – primary, secondary, and tertiary. In many countries, and especially for higher education, these gaps are now reversing, with boys and young men at a relative disadvantage. Two-thirds of all countries have reached gender parity in primary education enrolments, while in over one-third, girls significantly outnumber boys in secondary education. Even in regions with the largest remaining gender gaps – South Asia and sub-Saharan Africa (particularly West Africa) – there have been considerable gains. And in a striking reversal of historical patterns, more women than men now attend universities, with women’s tertiary enrolment across the globe having risen more than sevenfold since 1970(fourfold for men). Yet while boy disadvantage is slowly emerging in some places, girl disadvantage where it exists tends to emerge earlier in life and is deeper.

As mentioned in section 3.9.1, a total of 248 learners were sampled, with a gender breakdown of 163 females to 85 males. This section will focus on the performance of the participants according to gender.
4.6.1 Differences in reading performance based on gender

The following figure provides a breakdown of the performance of males and females in the reading assessment.

Figure 4.7: Reading scores: Gender

An analysis of the data captured in Figure 4.7 above reveals that females outperformed males quite considerably in reading. The PISA average for reading of 500 points, or Level 3, was achieved by about 38% of females, compared to less than 13% of males. Furthermore, more than 70% of males scored at Level 1 or below. In terms of the reading task levels explained in section 3.10 (“Reading tasks”), most males in the study are only capable of completing the simplest reading tasks developed for PISA, such as “locating a single piece of information, identifying the main theme of a text, or making a simple connection with everyday knowledge”. In contrast, just fewer than 50% of females in the sample scored at Level 1 or below.
The findings are in line with the extract from the World Development Report 2012, which states that girls now outperform boys in the sphere of education. It could also be interpreted that girls in South Africa read more than boys, and thus test better when it comes to reading. However, this assumption is inconclusive, and further study is needed to either confirm or debunk the theory. As part of the questionnaire, learners were asked detailed questions about their reading habits, how frequently they read their reading preferences, etc. However, these findings will not be discussed in this study, but will be analysed and discussed in an article to be submitted for publication in an accredited journal.

### 4.6.2 Differences in mathematics performance based on gender

The following graph provides a breakdown of the performance of males and females in the mathematics assessment.

![Bar chart showing mathematics scores by gender](image.png)

**Figure 4.8: Mathematics scores: Gender**
An analysis of the data in Figure 4.8 shows that females also outperformed males in the mathematics assessment. Almost 60% of the males in the sample could not perform the entry-level mathematics tasks at Level 1, compared to 37% of the females tested. This means that almost 58% of the males in the sample were unable even to answer questions involving “familiar contexts where all relevant information is present and the questions are clearly defined” (see section 3.10 “Mathematics tasks”). Whereas more than 15% of the females achieved the PISA mathematics average of 500 points at Level 3, only about 10% of the males achieved the same feat.

These findings are in contrast with the findings of Howie (1999) concerning the results of TIMSS Mathematics 1999 (see Appendix C), where the author states that there was no statistically significant difference in the scores of the boys and the scores of the girls.

4.6.3 Differences in science performance based on gender

The following figure provides a breakdown of the performance of males and females in the science assessment.

![Bar Chart](image)

**Figure 4.9: Science scores: Gender**
Figure 4.9 illustrates that males and females performed equally poorly in the science assessment, with the majority of members of both genders (females just over 81%, and males over 90%) unable to perform science tasks pitched higher than Level 1. Effectively, the majority of learners in the study have “such limited scientific knowledge that it can only be applied to a few familiar situations (see section3.10 “Science tasks”). However, 10% of females were able to attain the PISA average for science of 500 points at Level 3, compared to only 7% of males.

Science appears to be problematic for most learners in this study, irrespective of gender. It is quite worrying to consider that, on average, 85% of participants in the study could not solve the most basic science questions pitched at Level 1. However, this is consistent with the findings of the HSRC concerning TIMSS 1999 and 2003, where South Africa ranked last among all participating countries (see Appendices C, D, E and F).

4.7 THE INFLUENCE OF THE MOTHER TONGUE ON PERFORMANCE

The following section will describe the influence of the mother tongue on performance. As mentioned in section 3.9.1.3, the majority of the learners in the sample (46.7%) listed isiXhosa as their mother tongue. English was reported as being the mother tongue of 35.4% of the learners. Afrikaans was reported as being the mother tongue of 16.1% of the learners, and just less than 2% of the sample reported to have other languages, such as Korean, isiZulu, Sesotho, etc., as their mother tongue (see Figure 3.3).

4.7.1 The influence of the mother tongue on reading scores

As pointed out by Howie (2004:156) regarding the influence of the first language on performance in the TIMSS assessment, more than 70% of learners from South Africa, Indonesia, Morocco, the Philippines, and Singapore did not always speak the language of the test at home. In some cases, second-language speakers of English outperformed native speakers in reading, as was the case in Indonesia and Malaysia. This would suggest
that the differences between language groups are not dependent only on language. It should also be pointed out that science and mathematics are more “international” in terms of concepts than language is. Language is heavily based on culture, and is not “logical” to the same extent that science and mathematics are.

Table 4.4 illustrates the distribution of the different languages listed as mother tongues by the participants and a breakdown of the performance of speakers of the different languages according to the different proficiency levels.

**Table 4.4: Reading scores: Mother tongues**

<table>
<thead>
<tr>
<th>Language</th>
<th>Afrikaans (N=40)</th>
<th>English (N=88)</th>
<th>isiXhosa (N=116)</th>
<th>Other (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below Level 1</td>
<td>4</td>
<td>24</td>
<td>76</td>
<td>2</td>
</tr>
<tr>
<td>Level 1</td>
<td>15</td>
<td>9</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Level 2</td>
<td>11</td>
<td>8</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Level 3</td>
<td>8</td>
<td>22</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Level 4</td>
<td>2</td>
<td>17</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Level 5</td>
<td>0</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>1.7</strong></td>
<td><strong>2.2</strong></td>
<td><strong>1.4</strong></td>
<td><strong>1.0</strong></td>
</tr>
</tbody>
</table>

Table 4.4 above reveals that the native English speakers performed significantly better in the reading assessment than speakers of the other languages, with more than half of these learners achieving scores above the PISA reading average of 500 points, or Level 3. This implies that more than 50% of native English speakers have the ability to complete reading tasks ranging from moderate complexity (Level 3) to sophisticated (Level 5), and that they compare favourably in the PISA tables (see Appendix J). The Afrikaans-speaking learners performed second best, with 25% achieving the PISA average. They were thus outperformed by the English-speaking learners by more than double. The isiXhosa-speaking learners performed worst, as more than 65% of them were unable to perform tasks at Level 1. However, almost 20% of them were able to match the PISA average.
As mentioned above, differences between language groups are not dependent only on language. This could explain why 20 of the isiXhosa-speaking learners achieved the PISA average, in contrast to the PIRLS 2006 results, analysed by Howie (2008), where Afrikaans-speaking learners performed the best, and isiXhosa-speaking learners ranked last, together with speakers of isiNdebele. It should also be remembered that isiXhosa-speaking learners in schools in South Africa usually receive instruction in English. This development was also highlighted by Wang et al. (2011) in section 2.4.4.2, who stressed the differences in the “development of reading” and the amount of effort required in reading by non-native speakers of English. These learners should thus not be expected to perform at an equivalent level to native speakers of the language. Other exponents of the effect of the second language on achievement include Howie (2003) and Heugh (2006) in Chapter 2.4. Another effect is the use of “translations of mainly English-language material” (see Carey 2000; Murat & Rocher 2000; Blum & Gue’ Rin-Pace 2001 in section 2.4.4.2).

4.7.2 The influence of the mother tongue on mathematics scores

Table 4.5 illustrates the distribution of the different languages listed as mother tongues by the participants and a breakdown of the performance of speakers of the different languages according to the different proficiency levels.

<table>
<thead>
<tr>
<th></th>
<th>Afrikaans (N=40)</th>
<th>English (N=88)</th>
<th>isiXhosa (N=116)</th>
<th>Other (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below Level 1</td>
<td>12</td>
<td>29</td>
<td>68</td>
<td>1</td>
</tr>
<tr>
<td>Level 1</td>
<td>5</td>
<td>8</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Level 2</td>
<td>16</td>
<td>28</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>Level 3</td>
<td>6</td>
<td>11</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Level 4</td>
<td>1</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Level 5</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>1.4</strong></td>
<td><strong>1.6</strong></td>
<td><strong>0.7</strong></td>
<td><strong>1.2</strong></td>
</tr>
</tbody>
</table>
As far as the mathematics results are concerned, the English-speaking learners again came out on top, with a quarter of them able to reach the PISA average for mathematics of 500 points, or Level 3, or better. The Afrikaans-speaking sample did not lag too far behind, with 17% of them matching the PISA average. The isiXhosa-speaking learners could only produce four candidates out of 116 that were able to reach the PISA average. In addition, almost 60 of the isiXhosa-speaking learners scored below Level 1.

Relating to the notion that mathematics is more “international” in terms of concepts, as explained in section 2.4, when obtaining knowledge in a language other than your home language, the information is first translated into your home language, and is then processed to be understood fully. This, however, is only possible when the home language is firmly embedded with a clear knowledge and understanding of the ground rules and concepts of the language. If you are not completely familiar with the ground rules and concepts of your home language, you will not be able to relate new and foreign concepts to an area of understanding so as to simplify the concepts, and new concepts will thus remain foreign and strange. This could explain why most isiXhosa-speaking learners performed so poorly in mathematics and were unable to perform even the most basic mathematical tasks that involve “familiar contexts where all relevant information is present and the questions are clearly defined” (see section 3.10 “Mathematics tasks”).

Since the test medium was English, it would be expected of native English speakers to perform well, as they have an easier thought process, as asserted by Tirri & Campbell (2010) in Chapter 2.4. Bonnet (2002) in section 2.4.4.2 questions the suitability of assessments between the different PISA countries, citing the inequalities within these countries. This contention of Bonnet (2002) would definitely apply to participants in this study, as is evidenced by the background of the learners, as was explained in Chapter 2.4.4
### 4.7.3 The influence of the mother tongue on science scores

Table 4.6 illustrates the distribution of the different languages listed as mother tongues by the participants and a breakdown of the performance of speakers of the different languages according to the different proficiency levels.

<table>
<thead>
<tr>
<th>Language</th>
<th>Afrikaans (N=40)</th>
<th>English (N=88)</th>
<th>isiXhosa (N=116)</th>
<th>Other (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below Level 1</td>
<td>19</td>
<td>59</td>
<td>92</td>
<td>2</td>
</tr>
<tr>
<td>Level 1</td>
<td>11</td>
<td>7</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Level 2</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Level 3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Level 4</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Level 5</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Level 6</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td><strong>0.9</strong></td>
<td><strong>1.1</strong></td>
<td><strong>0.3</strong></td>
<td><strong>0.5</strong></td>
</tr>
</tbody>
</table>

The results show that, as is the case with the reading and mathematics assessments, the English-speaking participants again scored better than their counterparts in science. In this group, almost one-fifth of the 88 learners were able to match or surpass the PISA average for science, compared to 10% of Afrikaans speakers, and only 2% of isiXhosa-speaking learners. IsiXhosa-speaking learners again struggled, with 79% of them being unable to perform science tasks at Level 1. The English-speaking learners, too, had the dubious distinction of more than two-thirds of them scoring below Level 1 in the science assessment. On the other hand, this group produced the only three learners who managed to perform the highest-level science tasks, at Level 6.

The overall results are consistent with the findings of all previous science assessments involving learners from South Africa (see Appendices B, D and F), which shows South Africa's poor achievement in international assessments. As explained in section 4.7.1, sciences, such as mathematics, have more "international" concepts, and are different from languages, which are more cultural in nature. It appears, however, that language plays only
a small part in science ability, as the majority of learners in the study, irrespective of mother tongue, struggled with science problems at the basic Level 1. Science turned out to be the skill most learners were unable to perform.

4.8 THE PERFORMANCE OF DIFFERENT RACE GROUPS WITHIN THE SAME SCHOOL

The racial diversity of South Africa’s schools became evident in this study, with only the school in the township having no other races than blacks. Although situated in an area previously classified for Coloureds, the all-girls school in the northern areas also only had black learners. These two schools will consequently not be included in the comparison. This section will investigate and describe how different race groups within the same school compare in the context of this study. To facilitate the results and achieve this aim, the schools will be analysed individually.

4.8.1 SCHOOL A

Table 4.7: Results by race group (N=26)

Reading

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>3.00</td>
</tr>
<tr>
<td>Coloured</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2.50</td>
</tr>
<tr>
<td>White</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>8</td>
<td>1</td>
<td>3.76</td>
</tr>
</tbody>
</table>

Mathematics

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1.36</td>
</tr>
<tr>
<td>Coloured</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1.50</td>
</tr>
<tr>
<td>White</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>2.69</td>
</tr>
</tbody>
</table>
As is evident from the data in Table 4.7, there is a significant difference in the results for reading between black learners and white learners from School A, although the majority of participants from both groups scored well above the PISA average for reading. All white learners from this group scored 500 points or more in the reading assessment, while about three-quarters of black learners did the same. Of the two Coloured learners, one scored at the 500-point average, and the other scored just below.

The mathematics assessment proved difficult for all race groups at the school, although more than 50% of white learners could still attain the PISA average for mathematics, compared to just over 25% of black learners. One of the Coloured learners scored 500 points or more, while the other scored below Level 1.

The results for science reveal a huge disparity in the performance of white learners and black learners, as almost 70% of white learners could perform tasks at Level 4 (see section 3.10 “Science tasks”) or higher, compared to less than 20% of the black learners in this sample. Of the two Coloured learners, one scored at Level 6, while the other could not even answer questions pitched at Level 1.

This research site probably provides the best indicator of racial integration of all the schools in the sample in terms of ethnic distribution. Being a formerly advantaged school that catered for whites, it seems that the status quo remains, as most learners in the sample are still white. This finding is consistent with Van der Berg’s (2001) claim that 90% of white learners attend mainly white schools and continue to outperform the other race groups. It would also appear that black learners at this school have many individual learners who can hold their own against their international peers in reading and mathematics. Race does not
appear to have played a role in science performance at this research site.

4.8.2 SCHOOL B

Table 4.8: Results by race group (N=31)

<table>
<thead>
<tr>
<th>Reading</th>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coloured</td>
<td>1</td>
<td>8</td>
<td>7</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1.63</td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>0</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1.75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coloured</td>
<td>5</td>
<td>1</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1.83</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Science</th>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Level 6</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coloured</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1.42</td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.75</td>
</tr>
</tbody>
</table>

As is evident from the data in Table 4.8, the results for reading show some similarities between Coloured learners and white learners at School B. Because the medium of instruction at School B is Afrikaans, School B had only Coloured learners and white learners. This lends credence to Jansen’s assertion in The Star of 1 August 2005 that some schools have used language policy to maintain the dominant culture and clientele of the school. Both of the race groups in this sample had only three learners who could reach the PISA average for reading. In addition, the majority of learners from both race groups scored below the PISA average of 500 points.

In the mathematics assessment, 25% of the white learners scored at or above the PISA average for mathematics, compared to only 5% of the Coloured learners. In addition, more than a quarter of the Coloured learners could not perform mathematics tasks at Level 1.
The results for science paint a different picture, with more than 15% of the Coloured learners managing to attain Level 4 or above, in contrast with not a single white learner from this sample being able to manage that feat. Overall, both race groups performed considerably poorly in the science assessment, with 84% of the Coloured learners and 100% of the white learners being unable to achieve the PISA average for science.

There appears to be no significant dominance by any race group in this sample, with performance being similar across each of the three literacies. With English being offered as a second language at the school, it is not really surprising that most learners did not do well in reading. The influence of Afrikaans as the native language of the learners may have affected their comprehension of some questions, as the learners in this sample probably receive the least exposure to English during school hours of all the schools in this study.

### 4.8.3 SCHOOL C

#### Table 4.9: Results by race group (N=23)

**Reading**

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>3.25</td>
</tr>
<tr>
<td>White</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>3.8</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Mathematics**

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>White</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**Science**

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Level 6</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.75</td>
</tr>
<tr>
<td>White</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>2.0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
</tbody>
</table>
The first thing that should be remembered is that School C is both independent and Christian-based. The sample from this school consisted of white and black learners from South Africa and one Korean learner. Table 4.9 shows that white learners comprised the largest population group in this sample, and that almost 90% of them scored 500 points or more for the reading assessment. Half of the black learners achieved the PISA average for reading, with the other half failing to do so. The Korean learner achieved the PISA average of Level 3.

White learners also outperformed learners from the other race groups in mathematics, with almost three-quarters of them reaching the PISA average. Only one black learner from this sample managed to do the same, while the Korean learner scored under the PISA average.

As with the reading and mathematics assessments, white learners outscored learners from the other race groups in science. Significantly, almost 45% of white participants attained the PISA average for science, with the majority of them scoring at Level 4 or higher. Neither the black learners nor the Korean learner could reach the PISA average.

This school performed the best overall in this study. This could have something to do with the small class sizes, which is characteristic of independent schools. The sample consisted of only 23 learners, the second-smallest school sample in the study. White learners outstripped black learners significantly in all three skills. It is, however, worth mentioning that the black learners in this sample outperformed black learners from the other schools in the sample in mathematics and reading and their performance in science was surpassed only by the black learners from School A.

Overall, the white learners at this independent Christian school outperformed learners of all races at all the other schools in the sample. The same is true of the black learners at this independent Christian school.
4.8.4 SCHOOL E

Table 4.10: Results by race group (N=36)

Reading

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0.6</td>
</tr>
<tr>
<td>Coloured</td>
<td>9</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>Indian</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Mathematics

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>10</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>Coloured</td>
<td>9</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>Indian</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Science

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Level 6</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.75</td>
</tr>
<tr>
<td>Coloured</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Indian</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.10</td>
</tr>
</tbody>
</table>

According to Table 4.10, black learners performed the best in reading at School E, with more than 20% reaching the PISA average, whereas only one Coloured learner could do the same. Almost 90% of the Indian learners scored below Level 1 in reading.

The results also show that all race groups performed equally poorly at this research site in both mathematics and science, with not a single learner being able to reach the PISA average in either assessment. The science results were particularly bad, as only one Indian learner out of the entire sample managed to perform tasks at Level 1.

It appears that race has not played a major role in the performance of the learners in this school, but responsibility for the learners’ poor performance in the assessment should
rather be apportioned to the management of the school, as most learners struggled with all the assessments. It just does not seem possible that the majority of learners, irrespective of race, performed poorly in all three assessments.

This school placed within the bottom three of the eight schools sampled.

**4.8.5 SCHOOL F**

**Table 4.11: Results by race group (N=22)**

**Reading**

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td>Coloured</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td>Indian</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>3.1</td>
</tr>
</tbody>
</table>

**Mathematics**

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>Coloured</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1.3</td>
</tr>
<tr>
<td>Indian</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1.6</td>
</tr>
</tbody>
</table>

**Science**

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Level 6</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Coloured</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.2</td>
</tr>
<tr>
<td>Indian</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
</tr>
</tbody>
</table>

This school is, like School C, independent in operation but caters for Muslim learners only. With a sample of 22, it is the smallest school sample in the study. As is the case with School C, small classes are typical of independent schools. In general, all race groups performed well in reading, as can be seen from Table 4.11 above, with all three groups averaging around Level 3. Indian learners performed just slightly better than the Coloured and black learners in reading, as they produced a candidate able to score at Level 5.
Indian learners also outperformed the other two race groups in mathematics, with just under 50% of these learners scoring at the PISA average of Level 3. Only one Coloured learner at this school could do the same. No black learner was able to achieve this feat.

The scenario with regard to science was rather bleak, with no race group succeeding at achieving better than Level 2. The black learners fared the worst, with all learners in this race group failing to perform tasks at Level 1.

It can be concluded that due to the fact that mathematics and science have more “international” concepts than language, as explained in section 4.7.1 above, learners that perform satisfactorily in reading are not necessarily able to transfer that performance to mathematics and science. This is evident from the way the black and Coloured learners performed well in reading, but were unable to transfer this good performance to the other two skills of mathematics and science. Furthermore, science proved to be the major hurdle for most of the Indian learners in this sample, even though they performed well in reading and mathematics.

4.8.6 SCHOOL H

Table 4.12: Results by race group (N=34)

Reading

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coloured</td>
<td>9</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>Black</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Mathematics

<table>
<thead>
<tr>
<th>Race group</th>
<th>Below Level 1</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coloured</td>
<td>12</td>
<td>1</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.8</td>
</tr>
<tr>
<td>Black</td>
<td>9</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Table 4.12 above shows that the sample from School H had only two race groups represented. The Coloured learners in this sample performed considerably better than the black learners in reading, with almost one-fifth of the Coloured learners achieving the PISA average for reading of 500 points, in comparison with just over 5% of the black learners.

The mathematics results of the two race groups at this research site are a cause for concern, as no learner from either group was able to score at the PISA average for mathematics. Furthermore, more than half of the learners from both race groups could not perform the most basic mathematics tasks pitched at Level 1. The results for science at School H reflect an even more dismal state of affairs, with all the black learners and almost all the Coloured learners being unable to answer questions at Level 1.

Once again, it appears that the poor results at this school cannot be attributed to race, but rather to factors that are peculiar to the school. The fact that the Coloured and black learners at the school performed dismally in all three assessments must be attributed to the absence of a culture of learning and teaching at the school, or failures in the management of the school. This claim is plausible if one considers the satisfactory performance of Coloured and black learners at other schools in the study, notably Schools A, B, C and F.

### 4.9 THE EFFECT OF THE SCHOOL ENVIRONMENT ON SCHOOL PERFORMANCE

The final section in this chapter will focus on the effect that the school environment has on the overall performance of the school. In order to achieve this aim, the responses contained in the questionnaires completed by the school principals will be compared with the results obtained by the respective schools. Only the factors that appeared to be significant to the
research were considered and will thus be reported on. Of all the schools to which questionnaires were distributed, only School H did not return the questionnaire, so the results from this school will thus not be included.

The purpose of Table 4.13 below is to serve as a reference to the rest of the subsections of section 4.9, which will enable the school environment factors to be placed in context with the results obtained by the different schools in the assessments.

Table 4.13: A summary of the results of the different schools

<table>
<thead>
<tr>
<th>School</th>
<th>Reading mean</th>
<th>Mathematics mean</th>
<th>Science mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3.4</td>
<td>2.0</td>
<td>2.5</td>
</tr>
<tr>
<td>B</td>
<td>1.6</td>
<td>1.6</td>
<td>1.1</td>
</tr>
<tr>
<td>C</td>
<td>3.6</td>
<td>2.6</td>
<td>1.7</td>
</tr>
<tr>
<td>D</td>
<td>0.1</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>E</td>
<td>0.5</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>F</td>
<td>3.0</td>
<td>1.5</td>
<td>0.2</td>
</tr>
<tr>
<td>G</td>
<td>0.6</td>
<td>0.9</td>
<td>0.2</td>
</tr>
<tr>
<td>H</td>
<td>0.8</td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>1.49</td>
<td>1.2</td>
<td>0.7</td>
</tr>
</tbody>
</table>

4.9.1 The effect of school admittance criteria on learner performance

The focus of this segment is to determine whether the particular admittance policy used at the school had any effect on the results obtained by the school.
Table 4.14: School admittance criteria

<table>
<thead>
<tr>
<th>School</th>
<th>Resides in particular area</th>
<th>Learner's history of academic performance</th>
<th>Recommendation of feeder schools</th>
<th>Parents' religious endorsement</th>
<th>Learner requires special programme</th>
<th>Preference given to family members</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>F</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>G</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

The scoring was done using the Likert scale below.

**KEY:**
1 = Always
2 = Sometimes
3 = Never
4 = No answer

According to the data in Tables 4.13 and 4.14, there doesn’t appear to be any correlation between the results obtained by the schools and the various school admittance criteria. The responses of the principals of the different schools appear to be mixed, and no conclusive inferences can be made from the data, for example School A always considers residence in a particular area when admitting learners and obtained the highest mean scores in science, while School C doesn’t consider this factor at all, placing more emphasis on the religious endorsement of parents, yet obtained the highest mean scores in reading and mathematics. Religious endorsement is also positively correlated with the mean for reading of School F. The other factors do not appear to have been significantly correlated with the schools’ overall performance.
4.9.2 The school’s physical infrastructure and educational resources

Table 4.15: The school’s infrastructure and resources

<table>
<thead>
<tr>
<th>School</th>
<th>Poor condition of buildings</th>
<th>Poor heating, cooling, lighting</th>
<th>Shortage of classrooms</th>
<th>Lack of instructional material</th>
<th>Not enough computers</th>
<th>Lack of instructional material in library</th>
<th>Lack of multimedia</th>
<th>Inadequate science lab facilities</th>
<th>Inadequate fine arts facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>F</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

The scoring was done using the Likert scale below:

KEY
1 = A lot
2 = To some extent
3 = Very little
4 = Not at all

As can be deduced from Table 4.15 above, none of the schools are adversely affected by infrastructural deficiencies, such as poor condition of buildings, poor heating or cooling or lighting, or a shortage of classrooms. Two of the worst-performing schools, Schools D and E, reported being affected a lot by factors such as not having enough computers and instructional library materials, and a lack of multimedia and science laboratory and fine arts facilities. This proves to be partially true for another poor-performing school, namely School G. Lack of resources could thus have had an effect on the overall performance of these schools.
4.9.3 The availability of remedial resources

Table 4.16: Availability of remedial resources

<table>
<thead>
<tr>
<th>School</th>
<th>Extra courses for gifted learners</th>
<th>Special English tuition for low achievers</th>
<th>Special courses in study skills for low achievers</th>
<th>Special tutoring by staff members</th>
<th>Staff-assisted remedial classrooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>School B</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>School C</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>School D</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>School E</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>School F</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>School G</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

The scoring was done using the Likert scale below.

KEY:
1 = Yes
2 = No

Table 4.16 illustrates that none of the schools in the sample provides extra courses for gifted learners, and only one school provides special English tuition for low achievers. School G is the institution that provides the best remedial support to its learners. It is closely followed by School C. It is interesting to note that the two schools with the best results (namely School C and School A) and one of the schools with the worst results (namely School G) provide the best remedial support of all the schools sampled. It is therefore not conclusive whether the extra help that learners at these schools received proved to be beneficial to them in this assessment. It is nevertheless worth noting that schools have introduced remedial interventions to assist learners.
4.9.4 Teacher-learner ratio

Table 4.17: Teacher: learner ratio

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Number of teachers</th>
<th>Number of learners</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>54</td>
<td>1040</td>
<td>1:19</td>
</tr>
<tr>
<td>School B</td>
<td>32</td>
<td>741</td>
<td>1:23</td>
</tr>
<tr>
<td>School C</td>
<td>18</td>
<td>456</td>
<td>1:25</td>
</tr>
<tr>
<td>School D</td>
<td>24</td>
<td>540</td>
<td>1:22</td>
</tr>
<tr>
<td>School E</td>
<td>34</td>
<td>968</td>
<td>1:28</td>
</tr>
<tr>
<td>School F</td>
<td>19</td>
<td>184</td>
<td>1:9</td>
</tr>
<tr>
<td>School G</td>
<td>24</td>
<td>638</td>
<td>1:26</td>
</tr>
</tbody>
</table>

The teacher-learner ratios of the different schools, as displayed in Table 4.17 above, do not appear to have had any significant effect on the performance of the different schools, as shown in Table 4.13 above. All the schools sampled had surprisingly low teacher-learner ratios, which were well below the Department of Education target of 1:35. Considering this factor, the question arises as to what other factors led to the wide disparity in results between schools in this study. From personal observations made during the study, the researcher noticed that the four worst-performing schools in the sample had mostly black staff members, while three of the four best-performing schools had mostly white teachers. This may be coincidental, but this phenomenon nevertheless requires further investigation.

4.9.5 Teacher qualifications

Table 4.18: Qualified teachers, expressed as a percentage of the total number of teachers

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>English teachers</th>
<th>Mathematics teachers</th>
<th>Science teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>78%</td>
<td>83%</td>
<td>67%</td>
</tr>
<tr>
<td>School B</td>
<td>80%</td>
<td>33%</td>
<td>100%</td>
</tr>
<tr>
<td>School C</td>
<td>50%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>School D</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>School E</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>School F</td>
<td>20%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>School G</td>
<td>75%</td>
<td>67%</td>
<td>60%</td>
</tr>
</tbody>
</table>
There appears to be very little correlation between the overall performances of the different schools and the fraction of qualified teachers to the total number of teachers within the three skills assessed. The best-performing schools and the worst-performing schools seem to be on par as far as their percentage of qualified teachers for English, mathematics, and science is concerned. School D had a 100% qualified teacher corps in English, but only one qualified science teacher available to its Grade 9 learners. The school obtained the worst results in these two disciplines. School C performed best out of all the schools in reading, even though only 50% of their English teachers had a qualification in English. School C performed the best out of all the schools in mathematics, and had a 100% qualified mathematics teacher staff available to Grade 9 learners at the school. In contrast, School E had a 100% qualified teacher staff in all three subject areas, but turned out to be the second-worst-performing school in this study.

If teacher qualifications don't have any effect on the overall performance of the schools, one may have to consider other factors, such as where these qualifications were obtained, the teaching methodology employed by teachers individually or as a school, the effectiveness of the school management and education authorities, or even the quality of teacher training in South Africa.
4.9.6 Frequency of assessment

The responses to how often assessments were done per year were captured using the following scale.

Table 4.19: Frequency of assessment

<table>
<thead>
<tr>
<th>School</th>
<th>Standardised tests</th>
<th>Teacher-developed tests</th>
<th>Teachers’ judgemental rating</th>
<th>Learner portfolios</th>
<th>Learner assignments/projects/homework</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>School B</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>School C</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>School D</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>School E</td>
<td>4</td>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>School F</td>
<td>2</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>School G</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

KEY:
1 = 4 or more times a year
2 = 3 times a year
3 = Twice a year
4 = Once a year
5 = Never

The assessment practices of the schools are largely governed by the Department of Basic Education, which prescribes how learners are to be assessed. For example, the main assessment procedure for Grade 9 learners is the standardised end-of-year test designed by the national Department of Basic Education. Some of the schools experienced problems in interpreting the question on the frequency of administration of standardised tests, with some schools indicating “once a year” as a response, while others gave the response “4 or more times a year”. Overall, teacher-developed tests are conducted, on average, four or more times a year by most schools, as is the case with learner assignments and projects. Due to the descriptive nature of the assessment policies, there doesn’t appear to be any significant correlation between the frequency of various types of assessment and the
overall performance of the different schools in literacy, mathematics, and science.

4.9.7 The principal’s perception of the teachers

Table 4.20: The principal’s perception of the teachers

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Teacher morale is high</th>
<th>Teachers work with enthusiasm</th>
<th>Teachers take pride in the school</th>
<th>Teachers value academic achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>School B</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>School C</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>School D</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>School E</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>School F</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>School G</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

The scoring was done using the Likert scale below:

KEY:
1 = Strongly agree
2 = Agree
3 = Disagree
4 = Strongly disagree

Table 4.20 above reflects each school principal’s perception of the teachers at the school. In general, most school principals surveyed seem quite content with the overall attitude and commitment levels of the teachers at the schools. The majority of principals agreed that teacher morale is high, teachers work with enthusiasm, and they take pride in the school. Only one principal felt that teachers value academic achievement. Thus, there is no clear connection between teachers’ attitude and commitment to the school and the overall performance of the different schools.

These findings proved very surprising to the researcher, particularly the responses on teacher morale and enthusiasm. In some of the schools that the researcher visited, there was a teacher absenteeism rate of 10 per day. Furthermore, in informal discussions with
both teachers and principals, the researched perceived a sense of disillusionment with the teaching profession from both teachers and principals. Comments such as “I’m only doing this because there’s nothing else out there for me” and “retirement cannot come soon enough” were made by several teachers, and even by two principals. Principals were not honest in their responses and were rather trying to “window-dress” the actual situation, which is evident from the results.

### 4.9.8 Challenges with regard to the school environment

#### Table 4.21: Challenges with regard to the teaching staff

<table>
<thead>
<tr>
<th>School</th>
<th>Shortage/ inadequacy of teachers</th>
<th>Shortage/ inadequacy of English teachers</th>
<th>Shortage/ inadequacy of mathematics teachers</th>
<th>Shortage/ inadequacy of science teachers</th>
<th>Shortage/ inadequacy of support personnel for classroom teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>School B</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>School C</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>School D</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>School E</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>School F</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>School G</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

The scoring was done using the Likert scale below:

**KEY:**

1 = A lot  
2 = Somewhat  
3 = A little  
4 = Not at all

The purpose of the data in Table 4.21 was to determine whether there is a connection between teaching staff shortages and school performance. All of the schools reported no shortage of teachers, in particular English and mathematics teachers, while the biggest shortage seems to be with support personnel for classroom teachers. This was indicated as
an inadequacy by more than half of the schools. Even so, teacher shortages don’t appear to have any significant correlation with the performance of the affected schools.

So, if there are no significant teacher shortages in these schools, perhaps one should assess the culture of teaching and learning in the schools. Considering that all the schools in the sample have properly qualified teachers (see section 4.9.5) and there is no teacher shortage, how does one explain the disparity in the performance of the various schools? Most likely, the answer lies in the culture of learning and teaching inherent in each school.

### 4.9.9 Other challenges with regard to the school environment

**Table 4.22: Environmental challenges**

<table>
<thead>
<tr>
<th></th>
<th>School A</th>
<th>School B</th>
<th>School C</th>
<th>School D</th>
<th>School E</th>
<th>School F</th>
<th>School G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low expectations of teachers</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Learner absenteeism</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Poor learner- teacher relations</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>High teacher turnover</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Lack of parental support</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Disruption of classes by learners</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Teachers not meeting the needs of individual learners</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Teacher absenteeism</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Learners skipping classes</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Learners disrespecting teachers</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Staff resisting change</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Not enough instruction time</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Use of alcohol or drugs</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Teachers too strict with learners</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Learner intimidation or bullying</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Learners discouraged from reaching their full potential</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Learners coming from poor Home environments</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

The scoring was done using the Likert scale below:

**KEY:**
1 = A lot
2 = To some extent
3 = Very little
4 = Not at all
School principals were asked to rate other challenges in the school environment that might affect learner performance. The results were captured in Table 4.22 above and compared with the assessment results in Table 4.13 (see Chapter 4 above).

Schools B and E reported to be affected a lot, and School D reported to be affected to some extent, by learner absenteeism. This is reflected in the overall performance of these schools, as they ranked in the bottom percentile of the schools sampled. Most of the schools also listed lack of parental support and poor learner home environments as major stumbling blocks to learner academic achievement. School D, the worst-performing school, also listed factors such as teacher absenteeism, learners skipping classes, staff resisting change, and teachers being too strict with learners as major problems at the school.

As mentioned in section 4.9.7, principals reported no problems with teacher morale and enthusiasm. This was disputed by the researcher and supported by principals’ assertions at some schools that teacher absenteeism is a problem. The question that comes to mind is how there can be high morale and enthusiasm among teachers if they display high levels of absenteeism. In the researcher’s opinion, high morale and enthusiasm necessarily imply maximum attendance in class, in order to perform one’s duties and improve the learning process.

4.9.10 Extramural activities available to Grade 9 learners

Learners traditionally participate in academic and non-academic activities at school and develop a sense of belonging – their friends are there, they have good relations with teachers and other students, and they identify with and value schooling outcomes. However, Willms (2003:3), in an article compiled for the Organisation for Economic Co-operation and Development (OECD) on learner engagement in school, asserts that many learners are not engaged, they do not believe that their school experience has much bearing on their future, and they do not feel accepted by their classmates or teachers. Gradually these learners withdraw from school life and become disillusioned with school. Some disaffected learners are disruptive in class, and exert a negative influence on other
learners (Willms 2003:3). These feelings and attitudes may result in these learners, in turn, becoming disaffected with school (Finn 1989; Jenkins 1995). Participating in extramural activities may help learners to explore their physical, creative, social, political, and career interests with like-minded people.

Is there a connection between the academic performance of learners and the number of extramural activities available at the schools? The researcher will use the data below to attempt to answer the question and to draw an interpretation from the findings.

Table 4.23: Extramural activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>School A</th>
<th>School B</th>
<th>School C</th>
<th>School D</th>
<th>School E</th>
<th>School F</th>
<th>School G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band/ choir</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Plays/musicals</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Media</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Volunteering</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Book clubs</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Debating</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>School clubs</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Academic club</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Art</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sports</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lectures</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Collaboration with local library</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Collaboration with local newspapers</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Cultural activities</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

The scoring was done using the Likert scale below:

KEY:
1 = Yes
2 = No

Finally, schools were asked what activities were available to Grade 9 learners. Table 4.23 above provides a breakdown of the various extramural activities available to learners in the
different schools. School A offers the most activities to Grade 9 learners, with a total of 12 out of a possible 14 opportunities being available to learners. School A offers academic club, art, sports, community outreach, and cultural activities to its learners. Other schools offering more than 50% of the listed activities include Schools B, C, E and G. Significantly, two of the three best-performing schools offer the most school activities, while the worst-performing school, School D, offers the fewest activities to learners.

By considering only the data in the table above and the overall performance of each school in this study, it can be concluded that the more extramural activities available to learners at a school, the higher the probability of academic success. Evidence of this is that three of the four best-performing schools overall in the study offer considerably more extramural activities than the poor-performing schools.

4.10 CONCLUSION

Chapter 4 dealt with an analysis of the data obtained from the assessments and the questionnaires administered to participating learners and school principals selected for the sample. It drew several comparisons between the Grade 9 learners from South Africa and their international peers, and it compared the South African learners within the different schools in Port Elizabeth. It also focused on some environmental factors that may have affected the overall performance of the various schools in the study.

The most significant general findings are as follows:

- The results for reading indicate that the majority of learners in the sample are capable of completing only the simplest reading tasks developed for PISA;
- In mathematics, the majority of learners in the sample could only answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined;
- In science, the South African learners in the study have such limited scientific knowledge that it can only be applied to a few familiar situations;
• The South African learners in the study would have ranked in the bottom percentile of countries participating in PISA in reading, mathematics, and science literacy;
• Learners from formerly advantaged schools in the study significantly outperformed learners from formerly disadvantaged schools;
• Independent/religious schools performed considerably better than public schools;
• Girls in the study outperformed boys in all three assessments;
• Native speakers of English speakers outperformed Afrikaans and isiXhosa speakers in all assessments;
• As far as the performance of different race groups within the same school is concerned, white learners surpassed Coloured learners and black learners; and
• There appears to be no significant correlation between challenges in the school environment and the overall performance of the school. The number of extramural activities offered at a school is positively correlated with improved academic performance.

The final chapter will deal with the scientific and statistical findings and recommendations pertinent to this study.
CHAPTER 5

RESEARCH FINDINGS AND RECOMMENDATIONS

5.1 CHAPTER OVERVIEW

- Introduction
- Aim and Objectives Revisited
- Findings and Interpretations
- Limitations of the Research
  - Research Design
  - Sampling Method
  - Research Measures
- Value of the Research
- Recommendations
- Recommendations for Future Research
- Summary of the Study
5.2 INTRODUCTION

In the previous chapter the research data gathered were analysed and interpreted and initial findings were indicated. This chapter will elaborate on the findings of the study and make several recommendations deduced from the findings. It is appropriate to revisit the aim and objectives of the study and point out the findings as well as look at the value of the research, limitations of the research and make the relevant recommendations.

5.3 AIM AND OBJECTIVES OF THE STUDY REVISITED

In order to understand the conclusions of the research it is necessary to revisit the aim of this study. As pointed out in Chapter 1, the primary aim of this research study is to investigate and scientifically explore the real situation in terms of language, mathematics and science knowledge and skills of Grade 9 learners in South Africa and to draw a comparison between Grade 9 learners from secondary schools in the Port Elizabeth district in South Africa and their international counterparts, using the PISA standardized international assessment. The study will also focus on the educational and environmental issues that might have affected the participant’s performance.

The objectives of this study are:

- Determine the actual skills and knowledge acquired by participants in reading, mathematics and science.
- Explore and describe the results of South African learners compared with their international peers.
- Explore and describe the difference in results between formerly privileged and previously disadvantaged schools.
- Explore and compare how results of learners in public school compare with learners in independent schools in South Africa.
- Investigate whether there is a significant difference between the performance of boys and girls.
- Explore and describe how the mother-tongue language of participants influences
results.

- Investigate whether there is an anomaly between the results of different race groups within the same school.
- Finally, explore and describe how school resources contributed to the difference in the results.

The findings of this research study will be discussed below.

5.4 FINDINGS AND INTERPRETATIONS

5.4.1 Actual knowledge and skills of South African learners sampled

The study revealed that the majority of learners who participated in the research study possess only the most basic knowledge and skills in reading, mathematics and science according to the PISA task levels explained in Chapter 3 as follows:

- The reading results suggest that the learners in the sample are capable of completing only the simplest reading tasks developed for PISA;
- In mathematics, the learners in the sample could only answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined;
- In science, the South African learners in the study have such a limited scientific knowledge that it can only be applied to a few, familiar situations.

The results also showed that this knowledge and skills are located either at Level 1 in the PISA task tables or below. Possible factors that could have impinged on the results include:

- Effect of paper-and-pencil tests
- The specific schools attend by the participants
- Socio-economic inequality
- Content taught in school being different to PISA-type tasks
• PISA units being treated as separate and isolated as opposed to integrated
• Teachers do not always know how to teach reasoning and analysis
• Differentiation between school mathematics versus literacy that is assessed in PISA
• Individuals’ understanding of context as opposed to their actual science knowledge and abilities.
• A significant number of science questions were pitched at Level 3 or higher.

5.4.2 Comparison of South African learners sampled and their international peers

From the data analysed the South African sample would rank in the bottom 5 out of a possible 57 countries that participated in reading as well as mathematics, indicating most learners sampled could not even answer the most basic questions posed by the assessment. PISA did not compile a country ranking scale for the 2006 science report, so it was not possible to draw an international comparison in science. It has to be mentioned that some of the schools included in this research study would have ranked in the top 10 percentile of countries assessed, but the South African sample was negatively influenced by the weak performing schools.

The academic non-achievement of South African exposed by the study is consistent with other international assessments highlighted in Chapters one and two in which South African learners have participated in over the last 20 years.

However it is clear from the research analysis and findings that South African Grade 9 learners do not compare favourably with learners of the same age in international countries. This spells danger for the South African youth and the country as a whole and impacts negatively of South Africans learners’ ability to participate and compete with their counterparts from other countries in terms of trendsetting jobs and top careers. This also impact negatively on South Africa’s recognition as a global worthy partner and might even affect the country’s economy as this might reduce trust of
foreign investors. This research finding could also be an added factor to the already high incidence of unemployment and poverty in South Africa as learners are not adequately prepared for the job market and do not possess the required skills and knowledge to meet with demands.

As pointed out in Chapters 2 and 4 heed must be paid when comparing across nations especially in the light of socioeconomic inequality as pointed out by Grouws (1998) and Murnane (1998) in Chapter 2. Furthermore, demarcating countries or institutions into “good” or “better” based on statistical data alone opens a can of worms in itself. Socio-economic, political and cultural factors to mention just a few, need to be considered when comparing results between countries.

5.4.3 Differences in results between formerly advantaged and formerly disadvantaged schools

This is a sad statement to make 17 years after the advent of democracy in South Africa and an indictment on the efforts of the educational authorities in the country. Why is there still such a huge disparity between educational institutions that are supposedly functioning under the same umbrella? The study also highlighted that Black learners who study at previously privileged schools significantly outperformed their counterparts in previously disadvantaged schools. So maybe the problem doesn’t lie with the ability of the learners, but rather the individual schools. This disparity should not be allowed to persist. Urgent interventions aimed at bringing previously disadvantaged ones in line academically with previously privileged schools should be explored. What works in privileged schools and can be applied uniformly to previously disadvantaged schools should also be considered.

The results showed that the learners from the privileged schools considerably outperformed learners from the disadvantaged schools in reading, mathematics, and science. The gap between skills in reading between the two groups, was however not as high as the gap of mathematics and science. As can be deduced from section 4.3 and the subsequent subsections, most of the learners from the former privileged schools were found to be
proficient in reading compared to the reverse for learners from previously disadvantaged schools. Furthermore, more than a third of learners from the privileged schools were found to be proficient in mathematics compared to not a single learner from the disadvantaged group. This scenario was also repeated with the science results.

It could thus be construed that education in previously privileged schools is still far superior to that of previously disadvantaged school even after more than 15 years of equal education, as asserted by Fleisch (2007) and Howie (2001) in Chapters 1 and 4. The PISA 2003 report specifically mentions that to understand what lies behind school differences, one must look at how socio-economic factors affect performance, how much this explains school differences, and how this relates to equity in learning opportunities. The report further mentions because schools are better able to nurture and develop young people from privileged backgrounds; it has often appeared that schools reproduce existing patterns of privilege, rather than bringing about a more equitable distribution of outcomes.

5.4.4 Results of learners in public schools compared with independent schools

The results of the study show that independent schools outperformed public schools significantly in all three disciplines assessed. If the learners from the independent group participated as a country, they would have ranked within the top 10 of the 56 countries in reading. Alarmingly, most public school participants in this study could not perform the most basic Level 1 reading literacy tasks. In mathematics, almost half the independent school’s candidates were found to be proficient compared to only 5% from public schools. Science proved to trip up participants from both independent and public schools. Although independent schools still performed better than public schools in science in this study, concern should be noted as science was the skill most participants struggled with. In addition, the public school learners who excelled in the assessments are all from privileged schools, underscoring the inequities still prevalent in the South African education system.
Another factor that probably plays a role in terms of this research finding is the fact that independent schools can to a certain extend select their learner population that will be allowed to enrol. These learners usually comes from more affluent, well-resourced communities and learners were exposed to formal education from pre-primary and supported with additional strategies at a very early stage if any learning disabilities or learning barriers were identified. This is not the case for many learners in public schools. However, this study showed that the deficiency is not with public schools in general, but rather restricted to certain public schools located in disadvantaged neighbourhoods.

Science seemed to buck the trend in this study as public schools were able to hold their own against their independent peers. The reason for this anomaly presents another possible avenue for future research.

5.4.5 Difference between the performance of boys and girls

Analysis of the data revealed that female learners outperformed males quite considerably in reading and mathematics while both genders performed equally poor in the science assessment. This finding is consistent with the PISA 2003 report that states that in most countries, the gender differences are larger within schools than they are overall, reflecting that females tend to attend the higher performing, academically oriented tracks and schools at a higher rate than males.

The scenario of girls outperforming boys in reading and mathematics could be attributed to the way both genders engage with learning. Girls are generally less competitive than boys but usually make a greater effort and are more persistent. Girls also tend to read more than boys and this leads to an increase in the general knowledge base. This finding is corroborated by the World Development Report 2012 mentioned in Chapter 4, but contrasted by Howie (1999) on the results of TIMSS Mathematics 1999 (see Appendix C). If girls are outstripping boys academically, we could perhaps look at the motivation levels of
girls, and on the reverse, the reasons for the lack of motivation on the part of boys to apply themselves academically.

5.4.6 The influence of the mother-tongue language of participants

The study reveals that the English speakers performed significantly better than speakers of the other languages in the Reading, mathematics and science assessments followed by Afrikaans-speaking learners and lastly Xhosa-speaking learners. It has to be remembered that the assessments were all done in English, which is used as a second language by Afrikaans and Xhosa-speaking learners.

When the researcher worked in a Black school, it was noted that although the medium of instruction was English, learners would only resort to English when required. Conversations, formal or informal, were always in Xhosa and Black learners simply do not receive enough exposure to English in their communities and when they do, it is usually at a very low level. Even television is mostly watched in their native language. As mentioned in Chapter 2 by the HSRC (2005:06), due to the thought processes involved in learning in a language other than your own, Xhosa, and to some extent Afrikaans learners in this study were disadvantaged by language. It is also worthwhile stressing the differences in the self-concept of the “development of reading” and the amount of effort required in reading by non-native English users as probable rationale for the gap in achievement between the native English and non-native English users as highlighted by Wang et al. (2011) in Chapter 2 and 4.

5.4.7 The performance of different race groups within the same school

Collectively, schools that have White learners in their sample groups outperformed other race groups at the same schools in all three skills assessed. Coloured and Indian learners always fared comparatively better than Black learners at the same schools. Also extracted from the data, it is worthy to note that Black learners who
stay in more affluent areas, performed significantly better than their counterparts who live in the township areas of Port Elizabeth. This scenario holds true for the Coloured learners sampled as well.

Apartheid has created major gaps between the various race groups which might take a long time to correct as proven by this finding. The current trend of corruption and poor service delivery by government and its employees is also not assisting the situation at all. Like at all other levels South Africa still has a long way to go in the education sphere.

This research study found that White learners excelled over Coloured, Indian and Black learners. Once again the academic factors behind the success of White learners need to be identified, be they social, economic, emotional etc. Similarly, what are the factors inhibiting Coloured, Indian and Black learners from performing academically? This might be due to a lack of the holistic development of learners in all contexts and the amount of informal exposure to learning, e.g. communication with educated parents, free and constant availability of Internet and other forms of technology and community resources.

5.4.8 Effect of the school environment on the results

According to the data examined in Chapter 4, there doesn’t appear to be any correlation between the results obtained by the schools and the various school admittance factors. School responses appear to be mixed and no clear cut deductions could be inferred from the data.

Results however did reveal that buildings in good condition and adequate amounts of teaching space all contribute to a physical environment that is conducive to learning. Much the same can be said for schools with adequate educational resources, such as computers, well-equipped libraries and teaching materials, including textbooks and multimedia resources for learning (PISA 2003 report). This proved to be true for the purposes of the
study as the schools with better resources and infrastructure outperformed the poorer resourced ones.

However, the three worst performing schools all reported to be affected a lot by learner absenteeism, which may provide a direct link to their performance levels. Staff shortages were also not listed as problematic by schools, especially in English, mathematics and science although most schools listed the shortage of support personnel at schools as something that requires serious attention. Another example of a past inequality that needs to be addressed is the issue of extra-mural activities. The privileged and independent schools sampled offer many more extra-mural and support activities than the previously disadvantaged school public schools.

The researcher doubted some of the responses submitted by the principals e.g. the question on teacher morale, where all principals indicated morale is very high amongst their staff members. While conducting the research and interacting with teachers, the researcher found high levels of frustration and low morale among teachers at many of the schools. Moreover, at the worst performing school in the sample, there were clear indications of an absence of a culture of learning and teaching, with many teachers absent, away from the school or not in their classes. The responses of the principals at some of the schools are thus questioned by the researcher as it does not reflect the true picture at the sites.

Interestingly, the PISA 2003 report makes the point that more than 80% of participating principals in that study reported no problems with low teacher morale and commitment. The report adds it is apparent from this that socio-economic factors seem to reinforce the impact school climate has on school performance in important ways, perhaps because learners from more advantaged socio-economic backgrounds bring with them a higher level of discipline and more positive perceptions of school values, or perhaps because parental expectations of good classroom discipline and strong teacher commitment are higher in schools with advantaged socio-economic intake. Conversely, disadvantaged schools may experience less parental pressure towards enforcing effective disciplinary practices or making sure that absent or unmotivated teachers are replaced.
Overall, then, each school factor have only a limited separate effect on performance, but contribute to the effect of socio-economic advantage.

5.4.9 There appeared to be no noteworthy relation between school environment factors and results

This was brought into question by the researcher based on personal observations. The researcher strongly believed that principals “fudged” their responses to create a favourable impression of their staff, though the reality painted a much bleaker picture. What need to be explored are the reasons why principals did not respond honestly to the survey. The same survey could also be adapted to gauge the perceptions of teachers rather than principals to try and get a more accurate idea of what is really happening in schools.

5.4.10 The amount of extra-mural activities offered at schools can be directly associated with improved academic performance

This study concluded that the more extra-mural activities at a school, the greater chance there is for academic excellence. Proof hereof is that three of the top four performing schools overall in the study offer substantially more extra-mural activities than the poor-performing schools. The question should be why there are only limited extra-mural activities available to the weak performing schools. Is the problem lack of facilities, lack of interest from learners/teachers/parents, lack of accountability from education authorities? If it can lead to increased academic performance among learners, it should definitely be explored.

5.5 VALUE OF THE RESEARCH

This body of research falls within the paradigm of comparative education as several comparisons is drawn to achieve the aim and objectives of the study. Although it is not the first comparative international assessment done involving South Africans, it is a pioneer
study involving the PISA. The data generated shed some light on the current trends in South African Education and how it correlates with its international counterparts. It provides insight into present educational practices around Grade 9 learners in the country and the environmental factors impacting on their academic abilities or lack thereof. Hence, this study contributes to the limited body of research available in this field.

Furthermore, this research generates information that could assist the education department, parents, and other allied professionals to gain a greater understanding of the challenges facing learners today. In addition, participating schools were provided with feedback of the results and it could be used as a springboard to improve educational standards in the respective institutions. A copy will also be submitted to the provincial education authorities as per agreement for permission granted to use school sites for research purposes.

5.6 LIMITATIONS OF THE RESEARCH

There are various limitations to this research relating to the research design, the participants and sampling method, and the measures employed in this study. These limitations will be discussed in the ensuing sections.

5.6.1 Limitations of the research design

One limitation in the design of the current research is the absence of qualitative information. As put forward by Elmes et al. (2003:2), “qualitative research is based on the participants’ subjective view of a changing reality, and seeks to understand the individual’s world”. Consequently, a disadvantage of using quantitative data only, stems from the fact that the individual’s story gets lost among the forced-choice questions (Elmes et al. 2003:4). An amalgamation of both quantitative and qualitative data in triangulation would have augmented the data and added a better perceptive of the sample under exploration.
Within the expansive field of quantitative research, an exploratory-descriptive design was adopted. As it is often considered as the first stage in a sequence of studies (Neuman 1997), this approach seldom yields unambiguous answers. The very nature of the data collected contributes to the trend of inquisition varying commonly as much of the information is potentially important. Another limitation was the fact that there is little or no control for extraneous variables in this kind of research. Factors that could not be accounted for include parental influence, the learner's home environment, attitudes and beliefs towards the skills assessed in the study and the influence of the formative school years. Another probable factor is the effect of paper-and pencil tests on participants as mentioned in Chapter 3.

5.6.2 Limitations of the sampling method

The nature of sampling, namely convenience non-probability sampling procedure utilized is not representative of all the learners in the Nelson Mandela Metropole and cannot safely be generalized to the general South African population (Reaves, 1992). Nevertheless, the results can be generalized to all the learners in the eight schools that were part of the assessment study.

In addition, the small sample size hindered the utilization of additional parametric procedures, which could be used to identify the relationship among variables of the sample (Harris, 1998), which would have been valuable in exploring the importance of the biographical information in relation to the outcomes of the measures employed.

5.6.3 Limitations of research measures

Although extensive biographical data was collected from the learners as part of the questionnaire, the capturing and analysis of this data was not included in this research as it does not directly relate to any of the aims and objectives. This data would have proven significant to espouse some environmental factors impacting on the results and will be analysed for further publications.
Another limitation was the fact that the medium of assessment language was English only and did not cater for non-native users of the language.

5.7 RECOMMENDATIONS

Recommendations based on the findings and interpretations are discussed in this section.

For the purposes of this discussion the recommendations are banded together under the headings of the main findings and interpretations of this study and include recommendations for learners, teachers, principals, parents and the Department of Education in the Eastern Cape as well as South Africa.

5.7.1 Recommendations for learners

- Develop a love for reading on a regular basis across a wide variety of subjects. Include articles on mathematics and science and do not give up if you do not understand everything you read the first time. Keep on trying and ask for help from knowledgeable people in your area.
- Trust yourself and do not believe myths and misconceptions, e.g. mathematics and sciences are only for boys; only some people can do mathematics and sciences, girls are cleverer than boys, etc.
- If you live in a previously disadvantaged area look for opportunities and resources in your community that can assist you, e.g. city and university libraries in your area, universities offering summer and winter school classes for free, extra classes offered at community centers, free newspaper distributed, MixIt, programmes launched by post-graduate students, etc.
- Reach out to others in the community and learners attending other schools and share ideas and notes.
- If your home language is Xhosa or Afrikaans look for opportunities to speak and read English, e.g. at the library, in shops, cell phones, face book, etc. Do not be scared to make mistakes, remember practice makes perfect.
• Share new ideas and discoveries of new ways to learn mathematics and sciences with peers on Face book, BBM, etc.
• Hold your teachers, principals and School Governing Body responsible for poor results by enquiring and questioning the reasons behind it.
• Do not just accept teacher absenteeism and non-attendance if teachers are indeed at school.
• Make use of student representative structures to address issues of concern at school like poor pass rates.

5.7.2 Recommendations for teachers

• Form clusters and support groups with neighbouring schools to augment collaboration, development and the sharing of literacy, mathematical and science skills, knowledge and expertise.
• Build positive relationships with other colleagues in your school.
• Share notes, ideas with teachers from other schools and start discussion groups. Especially teachers from privileged and well-resourced schools should reach out to teachers in disadvantage schools and share notes and ideas. Also to share new literacy, mathematics and science initiatives.
• Be more pro-active in making a difference in the lives of learners by introducing them to community resources and opportunities offered by other organizations, e.g. summer and winter schools, extra classes, etc.
• Be responsive and open to new ideas and developments. Adopt a positive attitude towards reading, mathematics and sciences and do not enhance misconceptions and perceptions that mathematics and sciences are only meant for clever learners.
• Stimulate a love for reading, by exposing learners to interesting books.
• Distributes free newspapers, pamphlets and other print media to the learners, do not keep this in the safe or foyer of the school.
• Prepare study notes and learning material that are on the level of the learners. Raise curiosity by reading snapshots from interesting books or articles that would motivate
learners to want to know more or show video, DVD and challenge learners to find out more and further understanding by own discovery and reading.

- Look out for professional development opportunities, e.g. Short Learning Programmes offered by Universities, training workshops, etc. and attend these as far as possible.
- Treat boys and girls exactly the same in terms of expectations, abilities and opportunities in terms of reading, mathematics and science.
- Familiarize yourself with the latest teaching methodologies enhance learning and teaching in your school.
- Acquaint yourself as an educator with international assessments like PISA, PIRLS etc. and incorporate their practices in your teaching to get your learners up to international standard.
- Teach learners strategies like reasoning, analysis and integration and do not just focus on content to be tested.
- Expose learners to more technologically-based and communication teaching sources to develop more techno-savvy learners.
- If possible, provide translated material in the native language of your learners to make it easier for them to grasp concepts.

5.7.3 Recommendations for school principals

- Ensure that there is a teacher in every class for every school day.
- Be pro-active in the implementation of technology practices that may enhance learning in your school.
- When asked to respond to surveys about the school, answer truthfully as opposed to creating an illusion that everything at school is fine.
- Take responsibility for poor results at your school and devise relevant strategies to address and improve the situation.
- The school principal should engage with all teachers on a regular basis and work together to create a positive school environment.
• The principal should be actively involved in all activities and be fully aware of what is happening in classroom to ensure that teachers are qualified to teach specialized subjects.

• Form partnerships with other schools in the community as well as with teachers at privileged schools and share ideas and teaching and learning activities.

• Be aware of what is happening in the community and follow up on opportunities for staff and learners, e.g. summer and winter schools offered by universities and other organizations, science expos, etc.

• Be aware of efforts of extra help for learners and motivate learners to become involved.

• Take initiatives to improve measures within the school’s control like pass rates.

• Establish buddy systems in schools where learners support and teach each other, especially for mathematics and science.

• Introduce extra classes for learners, e.g. utilize the help from student teachers at universities.

• Focus on and enhance traditional strengths and advantages between genders.

• Be aware of socio-economic issues that may hamper learner performance and use available resources.

• Investigate the successful academic models of independent and successful schools and put in an effort to implement these in your school.

• Promote action learning, coaching and mentoring amongst educators. Practical approaches are needed to assist educators in their experiential learning cycle. This will also allow educators the opportunity to learn from the experts.

• Promote action research amongst teachers to reflect on their own teaching and learning and actively look and search for alternative ways.

5.7.4 Recommendations for parents

• Become more involved in your child/children’s education by joining available structures at the school.
• Do not accept “poor service” from the school, challenge results, question and hold the school accountable for poor performances.

• Liaise with the school on a regular basis to track the progress and attendance of your child.

• Provide your child with more learning opportunities like access to a library, technological devices if possible, excursions and interactions that broaden their knowledge and skills.

5.7.5 Recommendations for the provincial and national Department of Education

• Analyse the various task levels attained by learners in this study and employ strategies to improve to at least a level of 500 points considered a pass by PISA.

• The Department of Education must provide external support to educators especially in terms of literacy, mathematics and sciences as evident from this study.

• Investigate the huge disparities in results emanating from this study, specifically between previously disadvantaged and privileged and public and independent schools.

• Investigate measures to improve the curriculum to make it more relevant to prepare learners for the national and international job market.

• The introduction of training programmes at schools with poor learners performance and assistance to educators in developing their competence to deal with learners with learning problems especially in terms of reading, mathematics and science.

• The National Department of Education in South Africa should launch an urgent investigation to ascertain the rationale behind our learners’ poor showing against their international peers in terms of language, mathematics and sciences knowledge and skills.

• Analyse what the proficient learners in the PISA and other similar assessment studies do and apply similar strategies to the weaker learners.
• Ensure regular participation of South African learners in these assessment tests and take a leaf out of the books of educational models of countries that traditionally excel under similar conditions to South Africa could also be investigated.
• Furthermore, the reasons for the continuous under-performance of South African learners in mathematics and science in international assessments need to be identified and explored.
• The Department of Education should also consider adaptations to the current school curriculum to answer to these needs. The implementation of the CAPS is a positive step in this direction.
• Establish regional links between different school types and create the opportunity for educators to experiment with new developments in the field of education in interactive, humanistic, positive and collaborative ways.

5.8 RECOMMENDATIONS FOR FUTURE RESEARCH

The following recommendations in terms of further research are provided. Because of the broad nature of this study, many opportunities exist for future research.

• Firstly, the study should definitely be replicated on a provincial as well as a national scale in South Africa as the original PISA study involves countries and not individual schools. Comparisons could be drawn between provinces and the country with its international peers.
• It is recommended that further replication of this research includes qualitative information into the data collection as this will serve to confirm and enrich the quantitative data. Because qualitative research focuses on the precise context and situation of interactions, it could be priceless in the duplication of this study in appreciating the shortcomings of education in the South African context.
• Furthermore, if the study is replicated within the same context, a larger sample size should be used to make the study more generalized to the population. This can be done by including more schools of the same probability as used in this study.
• Future assessments should be computer-based if possible to eliminate external influences.
• Finally, in order to create fairer conditions, the assessment should be made available in all the major languages studied by the participants.

5.9 SUMMARY OF THE STUDY

One of the greatest gifts individuals have power over is an immense capacity for learning. A prerequisite for successful living is exploring how we learn and finding new ways to enhance that ability and constantly kindle it in young and old, regardless of capability, it is a sacred and ceaseless undertaking. However, in South Africa, ongoing concerns surrounding the development of learners’ literacy, mathematics and science is cause for major concern in the field of education.

Various international studies and assessments namely the Third International Mathematics and Science Study (TIMSS) and Progress in International Reading Literacy Study (PIRLS) have shown major differences in the levels of proficiency of SA learners regarding mathematics & science literature levels. Up to date, no detailed analysis of this phenomenon, using an international standardized test, has been conducted in South Africa.

Another international assessment study that is administered on a regular basis in international countries is PISA. This assessment test measures the literacy, mathematics and science knowledge and skills that learners have acquired and can apply in these subjects to real-world contexts by age 15. The literacy concept emphasizes the mastery of processes, understanding of concepts, and application of knowledge and functioning in various situations within all three domains. By focusing on literacy, PISA draws not only from school curricula but also from learning that may occur outside of school. The PISA test has however up to date not been administered in South Africa.
The main aim of this research study was to administer the PISA assessment test to a representative sample of South African Grade 9 learners in order to investigate and scientifically explore the real situation in terms of language, mathematics and science knowledge and skills in South Africa and to draw a comparison between Grade 9 learners from secondary schools in the Port Elizabeth district in South Africa and their international counter parts.

The quantitative research methodology was applied to gather data and the findings were presented in a comparative manner. Various statistical tests were applied.

The study falls within the perimeters of exploratory-descriptive approach which attempts to provide a complete and accurate description of a situation by summarizing and communicating what is found in quantitative data. A questionnaire was used to conduct the survey.

The researcher made use of a non-probability convenience sampling for the purpose of the study and the sample consisted of 248 learners who were all in Grade 9 at secondary schools in Port Elizabeth. The participants were selected from 8 different secondary schools. The main criterion was that they should be in Grade 9 as the local sample would be compared with their international peers within the same age group or numbers of school years attended.

The main findings of this research revealed that most learners in the study could only perform the most basic PISA tasks in reading, mathematics and science and the South African sample would rank in the bottom 5 out of a possible 57 countries that participated in reading as well as the mathematics PISA assessment test. That learners from previously privileged South African schools considerably outperformed learners from disadvantaged schools in reading, mathematics and science and that independent schools outperformed public schools significantly in all three disciplines assessed. If the learners from the independent group participated as a country, they would have ranked within the top 10 of the 56 countries in reading.
The research findings also revealed that female learners outperformed males quite considerably in reading and mathematics and that this finding is consistent with the PISA 2003 report that states that in most countries females outperform males. The study reveals that the English speakers performed significantly better than speakers of the other languages in the reading, mathematics and science assessments followed by Afrikaans-speaking learners and lastly Xhosa-speaking learners.

This research study includes extensive recommendations for all stakeholders in education as well as for further research in this field. The research investigates a vital concern in South African education and makes a new contribution to knowledge field of South African teaching and education.

5.10 CONCLUSION

Fifteen-year-olds have many chances ahead of them, but those who do well at a young age are more likely to continue learning and studying, so poor performance at age 15 causes justifiable concern. This study was an initial attempt to gauge the literacy, mathematical and science knowledge and skills acquired by South African Grade 9 learners over their school career. The objective was to draw a comparison between the OECD countries that participated in the previous assessment with a sample from South Africa. The findings point to a massive backlog on the part of the South African education to narrow the gap between them and other countries as well as within the respective institutions within the country.

The researcher can but hope that this pioneer study will serve as a base for further research into the topic and may contribute to uplifting the poor standards of education in South Africa highlighted.
REFERENCE LIST


Murnane, R.J., 1998. What does TIMSS tell us about the factors that relate to or influence individual achievement? Memorandum commissioned by the Board on International Comparative Studies in Education. Available from the Graduate School of Education, Harvard University.


Nel, J.G. Die geografiese impak van die wet op Groepsgebiede en verwante wetgewing op Port Elizabeth. Special publication no 13. Institute for Planning Research, University of Port Elizabeth: Port Elizabeth.


Programme for International Student Assessment (PISA), 2003. Learning for Tomorrow’s World- First Results from PISA 2003: OECD.

Programme for International Student Assessment (PISA), 2009. Assessment Framework: Key competencies in reading, mathematics and science: OECD.


The Star. 2005. *When will white schools transform?* 1 August 2005: p.3


Appendix A : TIMSS 1995 Achievement in Mathematics

<table>
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<th>Country</th>
<th>Eighth Grade*</th>
<th>Average Achievement</th>
<th>Seventh Grade*</th>
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*Eighth and seventh grades in most countries. Latvia is annotated LSS for Latvian Speaking Schools only. Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures.

## Appendix B: TIMSS 1995 Achievement in Science

### Achievement in Science

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*Eighth and seventh grades in most countries. Latvia is annotated LSS for Latvian Speaking Schools only. Countries shown in italics did not satisfy one or more guidelines for sample participation rates, age/grade specifications, or classroom sampling procedures.

Appendix C: TIMSS 1999 Achievement in Mathematics

Exhibit 2.1: Distribution of Mathematics Achievement

- Singapore
- Korea, Rep. of
- Chinese Taipei
- Hong Kong, SAR
- Thailand
- Japan
- Belgium (Flemish)
- Netherlands
- Slovak Republic
- Hungary
- Canada
- Slovenia
- Russian Federation
- Australia
- Finland
- Czech Republic
- Malaysia
- Bulgaria
- Latvia (CSS)
- United States
- England
- New Zealand
- International Avg.
- Lithuania
- Norway
- Cyprus
- Romania
- Moldova
- Thailand
- Israel
- Turkey
- Jordan
- Iran, Islamic Rep.
- Indonesia
- Chile
- Philippines
- Morocco
- South Africa

Mathematics Achievement Scale Score | Average Scale Score | Years of Formal Schooling | Average Age |
--------------------------------------|--------------------|--------------------------|------------|
Singapore                            | 640 (4.2)          | 8                        | 14.4       |
Korea, Rep. of                       | 597 (2.0)          | 8                        | 14.4       |
Chinese Taipei                       | 586 (4.0)          | 8                        | 14.4       |
Hong Kong, SAR                        | 574 (4.3)          | 8                        | 14.2       |
Thailand                             | 570 (3.7)          | 8                        | 14.4       |
Japan                                 | 559 (3.3)          | 8                        | 14.1       |
Belgium (Flemish)                    | 549 (3.4)          | 8                        | 14.2       |
Netherlands                          | 534 (4.0)          | 8                        | 14.3       |
Slovak Republic                      | 532 (3.7)          | 8                        | 14.4       |
Hungary                               | 531 (2.5)          | 8                        | 14.0       |
Russia                               | 519 (2.2)          | 8                        | 14.8       |
Australia                            | 513 (2.5)          | 7                        | 13.8       |
Finland                              | 509 (4.2)          | 9                        | 14.4       |
Czech Republic                       | 503 (2.7)          | 8                        | 14.3       |
Malaysia                             | 502 (4.1)          | 8                        | 14.5       |
Bulgaria                             | 501 (4.4)          | 8                        | 14.4       |
Latvia (CSS)                         | 495 (3.4)          | 8                        | 14.8       |
United States                        | 496 (4.1)          | 8                        | 14.5       |
England                              | 496 (4.1)          | 8                        | 14.2       |
New Zealand                          | 491 (3.5)          | 8.5 to 9.5               | 14.0       |
International Avg.                   | 492 (4.7)          | 8.5                      | 14.4       |

- Country average significantly higher than international average
- No statistically significant difference between country and international average
- Country average significantly lower than international average

Significance tests adjusted for multiple comparisons

- Percentiles of Performance
  - 69% 25th 75th 90th

(1) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.

† Met guidelines for sample participation rates only after replacement schools were included (see Exhibit A.2).

‡ National Desired Population does not cover all of international Desired Population (see Exhibit A.5). Because coverage falls below 85%, Latvia is annotated LSS for Latvian Speaking Schools only.

§ National Desired Population covers less than 90 percent of National Desired Population (see Exhibit A.5).

Lithuania tested the same cohort of students as other countries, but later in 1999, at the beginning of the next school year.

(1) Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
### Appendix E: TIMSS 2003 - Distribution of Mathematics Achievement

#### Distribution of Mathematics Achievement

<table>
<thead>
<tr>
<th>Countries</th>
<th>Years of Schooling</th>
<th>Average Age</th>
<th>Mathematics Achievement Distribution</th>
<th>Average Scale Score</th>
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**Benchmarking Participants**
- Brazil, Country, Spain
- France, State, US
- Ontario Province, Can.
- Quebec Province, Can.

---

1. National Sample Population does not cover all International Sample Population (see Appendix A).
2. National Sample Population covers only 50% of National Sample Population (see Table 3).
3. Country scores significantly lower than international average.
4. Country scores significantly higher than international average.
5. Data not included for sample participation rates (see Table 2).

---

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### Distribution of Science Achievement

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<tr>
<th>Countries</th>
<th>Years of Schooling</th>
<th>Average Age</th>
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<th>Average Scale Score</th>
<th>Human Development Index</th>
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**Benchmarking Participants**

- Basque Country, Spain
- Indiana State, U.S.
- Ontario Province, Can.
- Quebec Province, Can.

---

1. **National Database Population** does not cover all of International Database Population (see Table A.1).
2. **National Database Population** covers less than 90% of National Database Population (see Table A.1).
3. denotes that the same scale of students across all countries, but within 2003, the beginning of the restricted year.
4. Standard error appears if parentheses. Because results are restricted to the nation's whole students, some results may appear inaccessible.
5. A dash (-) indicates comparable data are not available.
6. Denotes years of school not counting from the first year of OECD's level 3.
8. Not possible for sample participation sites only after replacement schools were random drawn from their available list.
9. New study guidelines for sample participation sites only after replacement schools were drawn from their available list.
10. Denotes孙悟空 guideline for sample participation sites (see Table 45).
## Appendix G: TIMSS 2007 - Distribution of Mathematics Achievement

### TIMSS 2007 Distribution of Mathematics Achievement (Continued)

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### Benchmarking Participants

- Massachusetts, US
- Texas, US
- Quebec, Canada
- Ontario, Canada
- British Columbia, Canada
- Emirati Country, Saudi
- Dubai, UAE

### Notes

1. Benchmarking years of schooling counting from the first year of ICED Level 1.
3. The guidelines for sample participation rates only after replacement schools were included (see Appendix A).
4. New variant guidelines for sample participation rates only after replacement schools were included (see Appendix B).
5. Did not satisfy guidelines for sample participation rates (see Appendix B).

- **Country average significantly higher than TIMSS scale average**
- **Country average significantly lower than TIMSS scale average**

1. National Target Population does not include all of the International Target Population defined by TIMSS (see Appendix A).
2. National Target Population covers 76% to 86% of National Target Population (see Appendix A).
3. National Target Population includes 68% of National Target Population that at least 5% to 9% are in Appendix B.
4. France and Tunisia (MEN) were the same country and numbers as other countries, but later in 2007 as the beginning of the next school year.
5. Standard errors are given in parentheses. Because results are rounded to the nearest whole number, some totals may appear to round incorrectly.

A dash (-) indicates comparable data are not available. Note: See Appendix A for percentages of achievement in mathematics.
Appendix I: PIRLS 2006 Reading Achievement Distribution

<table>
<thead>
<tr>
<th>Countries</th>
<th>Reading Achievement Distribution</th>
<th>Average Scale Score</th>
<th>Years of Formal Schooling</th>
<th>Average Age</th>
<th>Human Development Index</th>
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<td>56 (5.0)</td>
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<td>9.9</td>
<td>0.592</td>
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<td>4</td>
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<td>55 (5.0)</td>
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<td>56 (5.0)</td>
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<td>10.5</td>
<td>0.920</td>
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<td>† Netherlands</td>
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<td>54 (5.0)</td>
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<td>0.937</td>
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* Represents years of schooling counting from the first year of age 6 level.
** Taken from United Nations Development Programme, Human Development Report 2005, p. 269-286, except for Chinese Taipei taken from Directorate-General of Budget, Accounting and Statistics, Executive Yuan, ROC Statistical Handbook 2005. Data for Belgium (French) and Belgium (Flemish) are for the entire country of Belgium. Data for England and Scotland are for the United Kingdom.
† National Defined Population covers less than 5% of National Defined Population (see Exhibit A.4).
‡ National Defined Population covers less than 50% of National Defined Population (see Exhibit A.4).
§ Standard errors are apparent in parentheses. Because results are rounded to the nearest whole number, some totals may appear inconsistent.
NOTE: See Exhibit 4.1 for percentiles of achievement in reading.
### Range of rank of countries/economies on the reading scale

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<td>412</td>
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<td>43</td>
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<td>410</td>
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</tr>
<tr>
<td>Sweden</td>
<td>408</td>
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<td>45</td>
</tr>
<tr>
<td>Denmark</td>
<td>406</td>
<td>20.0</td>
<td>46</td>
</tr>
<tr>
<td>Norway</td>
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<td>47</td>
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<td>20.0</td>
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</tr>
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<td>20.0</td>
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<td>Sweden</td>
<td>390</td>
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</tr>
<tr>
<td>Denmark</td>
<td>388</td>
<td>20.0</td>
<td>55</td>
</tr>
</tbody>
</table>

### Percentage of students at each proficiency level on the science scale

<table>
<thead>
<tr>
<th>Country</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>52.1</td>
<td>25.1</td>
<td>12.3</td>
<td>3.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Norway</td>
<td>52.3</td>
<td>26.2</td>
<td>13.8</td>
<td>3.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>52.5</td>
<td>26.9</td>
<td>12.8</td>
<td>3.7</td>
<td>0.5</td>
</tr>
<tr>
<td>France</td>
<td>52.7</td>
<td>27.8</td>
<td>13.9</td>
<td>3.9</td>
<td>0.7</td>
</tr>
<tr>
<td>Japan</td>
<td>53.2</td>
<td>28.3</td>
<td>14.5</td>
<td>4.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Germany</td>
<td>53.4</td>
<td>28.7</td>
<td>14.6</td>
<td>4.2</td>
<td>1.1</td>
</tr>
<tr>
<td>Italy</td>
<td>52.9</td>
<td>27.4</td>
<td>13.8</td>
<td>3.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Canada</td>
<td>53.1</td>
<td>28.0</td>
<td>14.3</td>
<td>4.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Switzerland</td>
<td>53.3</td>
<td>28.6</td>
<td>14.6</td>
<td>4.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Australia</td>
<td>53.5</td>
<td>29.2</td>
<td>14.9</td>
<td>4.4</td>
<td>1.1</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>53.7</td>
<td>29.8</td>
<td>15.2</td>
<td>4.6</td>
<td>1.2</td>
</tr>
<tr>
<td>United States</td>
<td>53.9</td>
<td>30.4</td>
<td>15.5</td>
<td>4.8</td>
<td>1.3</td>
</tr>
<tr>
<td>Japan</td>
<td>54.1</td>
<td>31.0</td>
<td>15.9</td>
<td>5.0</td>
<td>1.4</td>
</tr>
<tr>
<td>China</td>
<td>54.3</td>
<td>31.5</td>
<td>16.2</td>
<td>5.2</td>
<td>1.5</td>
</tr>
</tbody>
</table>

### Notes
- The number of students at Level 6 cannot be reliably predicted from a country's overall performance. Korea was among the highest-performing countries on the PISA science test in terms of students' performance, with an average of 522 score points, while the United States performed below the OECD average, with a score of 489. Nevertheless, the United States and Korea had similar percentages of students at Level 6 (Tables 2.1a, 2.1c).
- Over one in five students in Finland (21%) and over one in six in New Zealand (19%) reached at least Level 5 (OECD average 9%). In Japan, Australia, and Canada, and the partners Hong Kong-China and Chinese Taipei, this figure was between 14% and 16% (Table 2.1a).
Appendix L: PISA 2006 Mathematics Achievement Distribution

## Range of rank of countries/economies on the mathematics scale

<table>
<thead>
<tr>
<th>Mathematics score</th>
<th>OECD countries</th>
<th>All countries/economies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper rank</td>
<td>Lower rank</td>
</tr>
<tr>
<td>Chile</td>
<td>542</td>
<td>(4.30)</td>
</tr>
<tr>
<td>Japan</td>
<td>548</td>
<td>(4.18)</td>
</tr>
<tr>
<td>China, Hong Kong</td>
<td>547</td>
<td>(4.17)</td>
</tr>
<tr>
<td>Korea</td>
<td>547</td>
<td>(4.16)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>530</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Switzerland</td>
<td>510</td>
<td>(4.12)</td>
</tr>
<tr>
<td>Canada</td>
<td>512</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Japan</td>
<td>520</td>
<td>(4.24)</td>
</tr>
<tr>
<td>Belgium</td>
<td>522</td>
<td>(4.22)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>522</td>
<td>(4.22)</td>
</tr>
<tr>
<td>Germany</td>
<td>520</td>
<td>(4.24)</td>
</tr>
<tr>
<td>Sweden</td>
<td>510</td>
<td>(4.15)</td>
</tr>
<tr>
<td>France</td>
<td>496</td>
<td>(4.15)</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>495</td>
<td>(4.13)</td>
</tr>
<tr>
<td>Poland</td>
<td>487</td>
<td>(4.14)</td>
</tr>
<tr>
<td>Russia</td>
<td>479</td>
<td>(4.14)</td>
</tr>
<tr>
<td>Hungary</td>
<td>479</td>
<td>(4.14)</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>495</td>
<td>(4.14)</td>
</tr>
<tr>
<td>Norway</td>
<td>494</td>
<td>(4.13)</td>
</tr>
<tr>
<td>Switzerland</td>
<td>493</td>
<td>(4.13)</td>
</tr>
<tr>
<td>Belgium</td>
<td>486</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Spain</td>
<td>486</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Austria</td>
<td>480</td>
<td>(4.18)</td>
</tr>
<tr>
<td>Portugal</td>
<td>476</td>
<td>(4.18)</td>
</tr>
<tr>
<td>Italy</td>
<td>476</td>
<td>(4.18)</td>
</tr>
<tr>
<td>Greece</td>
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<td>(4.18)</td>
</tr>
<tr>
<td>Turkey</td>
<td>463</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Denmark</td>
<td>463</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Belgium</td>
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<td>(4.15)</td>
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<td>Bulgaria</td>
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</tr>
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<td>Iceland</td>
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<td>(4.15)</td>
</tr>
<tr>
<td>Mexico</td>
<td>463</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Montenegro</td>
<td>463</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Iceland</td>
<td>463</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Finland</td>
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<td>(4.15)</td>
</tr>
<tr>
<td>Netherlands</td>
<td>463</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Korea</td>
<td>463</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Norway</td>
<td>463</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Norway</td>
<td>463</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Sweden</td>
<td>463</td>
<td>(4.15)</td>
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<tr>
<td>Switzerland</td>
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<td>(4.15)</td>
</tr>
<tr>
<td>Iceland</td>
<td>463</td>
<td>(4.15)</td>
</tr>
<tr>
<td>Iceland</td>
<td>463</td>
<td>(4.15)</td>
</tr>
</tbody>
</table>

Source: OECD PISA 2006 database. Figure 6.3.18, PISA 2006: Science Competencies for Tomorrow’s World. Statisitcs in context: https://www.oecd.org/education/pisa-outcomes/34148516.pdf
Dear Sir/Madam

A COMPARATIVE ASSESSMENT TO DETERMINE LITERACY, MATHEMATICS AND SCIENCE KNOWLEDGE AND SKILLS ACQUIRED AMONG GRADE 9 LEARNERS IN PORT ELIZABETH SCHOOLS.

My name is Keith Arnolds and I am a doctoral student at the Nelson Mandela Metropolitan University (NMMU). I am conducting research on comparative assessments under the supervision of Dr Christina Jordaan. The Provincial Department of Education has given approval to approach schools for my research. A copy of their approval is contained with this letter. I invite you to consider taking part in this research. This study will meet the requirements of the Research Ethics Committee (Human) of the NMMU.

Aims of the Research
The aim of the research is to draw a comparison between Grade 9 students from secondary schools in the Port Elizabeth district in South Africa using a standardized international assessment. The study will also focus on the educational and environmental issues that might have affected the participant’s performance. Furthermore, the results of the study will be used to compare the sample of South African students with their international counterparts. The ultimate aim is that the data gathered will be used by the researcher to make recommendations to the relevant authorities to consider adaptations to the South African school curriculum in order to improve the literacy, mathematics and sciences knowledge and skills of learners in South Africa.
Significance of the Research Project

The research is significant in many ways:

- It is hoped the study will provide insight into the level of literacy, mathematics and science skills and knowledge of Grade 9 learners in Port Elizabeth as well as determine their work and career readiness.

- The results may be generalized to represent students in all South African schools.

- The findings may prove valuable with regards to the curriculum or methodology employed in the South African educational system.

- It is also hoped the investigation can contribute to the knowledge foundation of Education by providing insight into current levels of literacy, mathematics and science skills and knowledge of South African students compared to their international counterparts.

Benefits of the Research to Schools

1. Dissemination of results to schools, Eastern Cape Department of Education, and the broader public

2. The results will inform curriculum development in comparative education.

Research Plan and Method

Data will be collected via a student questionnaire, school questionnaire (to be completed by principal or designate) and standardized assessment tests involving reading, mathematics and science. Permission will be sought from the schools prior to their participation in the research. Only those schools who consent will participate. The tests will be administered by the researcher. All information collected will be treated with strictest confidence and neither the school nor individual learners will be identifiable in any reports that are written.
Participants may withdraw from the study at any time without penalty. The role of the school is voluntary and the School Principal may decide to withdraw the school’s participation at any time. The data required is not, to the researcher’s knowledge, of a sensitive nature. If a learner requires support as a result of their participation in the survey steps can be taken to accommodate this.

**School Involvement**

Once I have received your consent to approach learners to participate in the study, I will:

- arrange a suitable time with your school for the data collection to take place
- obtain informed consent from participants

**Invitation to Participate**

If you would like your school to participate in this research, please complete and return the attached form.

Thank you for taking the time to read this information.

Keith Arnolds
D Ed student and researcher
NMMU

Dr Christina Jordaan
Promotor
NMMU
School Principal Consent Form

A comparative assessment to determine knowledge and skills acquired among Grade 9 students in Port Elizabeth schools.

I give consent for you to approach learners in Grade 9 to participate in the above-mentioned survey. I have read the Project Information Statement explaining the purpose of the research project and understand that:

- The role of the school is voluntary
- I may decide to withdraw the school’s participation at any time without penalty
- Learners in grades nine will be invited to participate and that permission will be sought from them
- Only learners who consent will participate in the project
- All information obtained will be treated in strictest confidence.
- The learners’ names will not be used and individual learners will not be identifiable in any written reports about the study.
- The school will not be identifiable in any written reports about the study.
- Participants may withdraw from the study at any time without penalty.
- A report of the findings will be made available to the school.
- I may seek further information on the project from Keith Arnolds on 0792331304

_________________________________________   ___________________________
Principal Signature     Date

Please return to: 7 Daphne Street
Gelvandale
Port Elizabeth
Mr K. Amoeds
Researcher
Nelson Mandela Metropolitan University

Dear Mr Amoeds

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN SECONDARY SCHOOLS;
PORT ELIZABETH

I refer to your letter dated 07 July 2010.

Permission is hereby granted for you to conduct your research on the following conditions:

1. your research must be conducted on a voluntary basis;
2. all ethical issues relating to research must be honoured;
3. your research is subject to the internal rules of the school, including its curricular programme and its code of conduct and must not interfere in the day-to-day routine of the school.

Kindly present a copy of this letter to the principal as proof of permission.

I wish you good luck in your research.

Yours faithfully

[Signature]

Dr R. Ntsiko
DISTRICT DIRECTOR: PORT ELIZABETH

09 July 2010
Appendix O

2010 School Questionnaire Administered by Keith Arnolds
COUNTRY: South Africa DISTRICT: Port Elizabeth

General Guidelines:

1. The questionnaire should be completed by the principal or designate.

2. It should take about 30 minutes to complete.

3. If you do not know an answer precisely, your best estimation will be adequate for the purposes of the study.

4. This questionnaire asks for information about:
   - The school’s resources;
   - The number of teachers in the school and their qualifications;
   - Characteristics of the students body;
   - The relationship the school has with the students;
   - Some of the administrative structures within the school;
   - Some of the pedagogical practices of the school.

5. The information may help to establish the impact of resource distribution on learner achievements.

Preliminary note:

Sometimes you will be asked about:
   - the whole of your school; or
   - Grade 9 learners at which most 15-year-olds are studying.

Your answers will be kept confidential and your school’s name will never be mentioned. Data generated from the questionnaire will only be used for generalization purposes.

Thank you.
Q 1 Which of the following best describes the community in which your school is located?  
(Please tick only one box.)

A village, hamlet or rural area (fewer than 3 000 people) □
A small town (3 000 to about 15 000 people) □
A town (15 000 to about 100 000 people) □
A city (100 000 to about 1 000 000 people) □
Close to the centre of a city with over 1 000 000 people □
Elsewhere in a city with over 1 000 000 people □

Q 2 As at June 30, 2010, what was the total school enrolment?  

a) Number of boys: ______________

b) Number of girls: ______________

Q 3 Is your school a public or an independent school?

A public school □
(A school managed directly or indirectly by a public education authority, government agency, or governing board appointed by government or elected by public franchise.)

An independent school □
(A school managed directly or indirectly by a non-government organisation; e.g., a church, trade union, businesses, other private institutions.)

Q 4 About what percentage of your total funding for a typical school year comes from the following sources?  
(Please write a percentage in each row. Write 0 (zero) if there is none.)
<table>
<thead>
<tr>
<th>Source of Funding</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government (includes departments, local, regional, and national)</td>
<td></td>
</tr>
<tr>
<td>School fees or school charges paid by parents</td>
<td></td>
</tr>
<tr>
<td>Benefactors, donations, bequests, sponsorships, parent fund raising</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 %</strong></td>
</tr>
</tbody>
</table>
Q 5  Are the following grade levels part of your school?
(Please tick one box in each row.)

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Grade 1</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>b) Grade 2</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>c) Grade 3</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>d) Grade 4</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>e) Grade 5</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>f) Grade 6</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>g) Grade 7</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>h) Grade 8</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>i) Grade 9</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>j) Grade 10</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>k) Grade 11</td>
<td>☐ ✔</td>
<td></td>
</tr>
<tr>
<td>l) Grade 12</td>
<td>☐ ✔</td>
<td></td>
</tr>
</tbody>
</table>

Q 6  The following question refers to different aspects of instructional time for Grade 9 students in your school.
(Please write in a number in each row. Write 0 (zero) if there is none.)

a) How many instructional **weeks** are there in the school **year**? ______ weeks

b) How many **class periods** are there in the school **week**? .... ______ class periods

c) How many instructional **minutes** are there in the average **single class period**? ......................................................... ______ minutes
Q 7 How often are the following factors considered when learners are admitted to your school?
(Please tick one box in each row.)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Never</th>
<th>Sometimes</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Residence in a particular area</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b) Learner’s record of academic performance (including placement tests)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c) Recommendation of feeder schools</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d) Parents’ endorsement of the instructional or religious philosophy of the school</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e) Whether the learner requires or is interested in a special programme</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>f) Preference given to family members of current or former learners</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>g) Other</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Q 8 In your school, how important is each of the following factors in determining the study programme of Grade 9 students?
(Please tick one box on each row.)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Not important</th>
<th>Important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Learners’ choice</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b) Learners’ previous academic record</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c) A placement examination</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d) Teachers’ recommendation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e) Parents’ or guardians’ request</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Q 9  In your school, how much is the learning of Grade 9 learners hindered by:

*(Please tick one box on each row.)*

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Very little</th>
<th>To some extent</th>
<th>A lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) poor condition of buildings?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b) poor heating, cooling and/or lighting systems?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c) lack of instructional space (e.g., classrooms)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d) lack of instructional material (e.g., textbooks)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e) not enough computers for instruction?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f) lack of instructional materials in the library?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>g) lack of multi-media resources for instruction?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>h) inadequate science laboratory equipment?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i) inadequate facilities for the fine arts?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Q 10  For Grade 9 learners, do your school provide the following resources?

*(Please tick one box on each row.)*

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Extra courses on academic subjects for gifted learners</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>b) Special training in English for low achievers</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>c) Special courses in study skills for low achievers</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>d) Special tutoring by staff members</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>e) Room(s) where the learners can do their homework with staff help</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Q 11  In your school, about how many computers are available:

*(Please write in a number on each row. Write 0 (zero) if there is none.)*

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) in the school altogether?</td>
<td>______</td>
</tr>
<tr>
<td>b) available to 15-year-old learners?</td>
<td>______</td>
</tr>
<tr>
<td>c) available only to teachers?</td>
<td>______</td>
</tr>
<tr>
<td>d) available only to administrative staff?</td>
<td>______</td>
</tr>
<tr>
<td>e) connected to the Internet/World Wide Web?</td>
<td>______</td>
</tr>
<tr>
<td>f) connected to a local area network (LAN, Intranet)?</td>
<td>______</td>
</tr>
</tbody>
</table>
Q 12 In your school, how many full-time and part-time teachers:

A full-time teacher is employed at least 90% of the time as a classroom teacher. All other teachers should be considered part-time.

Note that categories b) to i) are not mutually exclusive, so the total item a) may be less than the sum of items b) to i).

(Please write in a number in each space provided. Write 0 (zero) if there is none.)

<table>
<thead>
<tr>
<th></th>
<th>Full-time</th>
<th>Part-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) are there in TOTAL?..................................</td>
<td>______</td>
<td>_____</td>
</tr>
<tr>
<td>b) have a recognized qualification in teaching? ................</td>
<td>______</td>
<td>_____</td>
</tr>
<tr>
<td>c) are fully certified as teachers by SACE?....................</td>
<td>______</td>
<td>_____</td>
</tr>
<tr>
<td>d) are English teachers?....................................</td>
<td>______</td>
<td>_____</td>
</tr>
<tr>
<td>e) have a teaching qualification with a major in English?.....</td>
<td>______</td>
<td>_____</td>
</tr>
<tr>
<td>f) are mathematics teachers?.................................</td>
<td>______</td>
<td>_____</td>
</tr>
<tr>
<td>g) have a teaching qualification with a major in mathematics?</td>
<td>______</td>
<td>_____</td>
</tr>
<tr>
<td>h) are science teachers?.....................................</td>
<td>______</td>
<td>_____</td>
</tr>
<tr>
<td>i) have a teaching qualification with a major in science?......</td>
<td>______</td>
<td>_____</td>
</tr>
</tbody>
</table>

Q 13 During the last three months, what percentage of teaching staff in your school has attended a programme of professional development? _____ %

Professional development is a formal programme designed to enhance teaching skills or pedagogical practices. It may or may not lead to a recognised qualification. The total length of the programme must last for at least one day and have a focus on teaching and education.

Q 14 Generally, in your school how often are Grade 9 learners assessed using:

(Please tick one box in each row.)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Yearly</th>
<th>2 times a year</th>
<th>3 times a year</th>
<th>4 or more times a year</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Standardised tests?.................................</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b) Teacher-developed tests?............................</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c) Teachers’ judgmental ratings?......................</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d) Learner portfolios?.................................</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e) Learners assignments/projects/homework?............</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Q 15  In your school, about how often is information on the performance of Grade 9 learners formally communicated to:
(Please tick one box on each row.)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Yearly</th>
<th>2 times a year</th>
<th>3 times a year</th>
<th>4 or more times a year</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) parents?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b) school principal?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c) district/government administrators?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Q 16  In your school, are assessments of Grade 9 learners used to:
(Please tick one box on each row.)

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) inform parents about their child’s progress?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b) make decisions about retention or promotion?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c) group learners for instructional purposes?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d) compare the school to district or national performance?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e) monitor the school’s progress from year to year?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>f) make judgments about teachers’ effectiveness?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Q 17  Think about the teachers in your school. How much do you agree or disagree with the following statements?
(Please tick one box on each row.)

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) The morale of teachers in this school is high.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b) Teachers work with enthusiasm.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c) Teachers take pride in this school.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d) Teachers value academic achievement.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Q 18  In your school, is the learning of Grade 9 learners hindered by:
(Please tick one box on each row.)

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>A little</th>
<th>Somewhat</th>
<th>A lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) a shortage/inadequacy of teachers?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) a shortage/inadequacy of English teachers?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) a shortage/inadequacy of mathematics teachers?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) a shortage/inadequacy of science teachers?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) a shortage/inadequacy of support personnel for classroom teachers?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q 19  In your school, is the learning of Grade 9 learners hindered by:
(Please tick one box on each row.)

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Very little</th>
<th>To some extent</th>
<th>A lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) low expectations of teachers?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) student absenteeism?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) poor student-teacher relations?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) teacher turnover?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) lack of parental support for student learning at home?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) disruption of classes by students?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g) teachers not meeting individual students’ needs?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h) teacher absenteeism?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) students skipping classes?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j) students lacking respect for teachers?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k) staff resisting change?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>l) not enough instructional time?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m) the use of alcohol or illegal drugs?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n) teachers being too strict with students?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o) students intimidating or bullying other students?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p) students not being encouraged to achieve their full potential?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>q) students coming from poor home environments?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Q 20 In your school, who has the main responsibility for:
(Please tick as many boxes as appropriate on each row.)

<table>
<thead>
<tr>
<th>Not a school responsibility</th>
<th>Appointed or elected board</th>
<th>Principal head</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) hiring teachers?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>b) firing teachers?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>c) establishing teachers’ starting salaries?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>d) determining teachers’ salary increases?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>e) formulating the school budget?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>f) deciding on budget allocations within the school?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>g) establishing student disciplinary policies?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>h) establishing student assessment policies?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>i) approving students for admittance to school?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>j) choosing which textbooks are used?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>k) determining course content?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
<tr>
<td>l) deciding which courses are offered?</td>
<td>✑,</td>
<td>✑,</td>
<td>✑,</td>
</tr>
</tbody>
</table>

Q 21 Some schools organize instruction differently for students with different abilities. What is your school’s policy about this for students in Grade 9?
(Please tick one box in each row.)

<table>
<thead>
<tr>
<th>For all subjects</th>
<th>For some subjects</th>
<th>For no subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Students are grouped by ability into different classes</td>
<td>✗,</td>
<td>✗,</td>
</tr>
<tr>
<td>b) Students are grouped by ability within their classes</td>
<td>✗,</td>
<td>✗,</td>
</tr>
</tbody>
</table>
Q 22  This academic year, which of the following activities does your school offer to students in Grade 9?

(Please tick one box in each row)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Band, orchestra or choir</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) School play or school musical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) School yearbook, newspaper or magazine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Volunteering or service activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) Book club</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) Debating club or debating activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g) School club or school competition for foreign language, math or science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h) Academic club</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Art club or art activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>j) Sporting team or sporting activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>k) Lectures and/or seminars (e.g. guest speakers such as writers or journalists)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>l) Collaboration with local libraries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>m) Collaboration with local newspapers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n) Cultural/Traditional activities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thank you for completing this questionnaire. Your participation is appreciated.
APPENDIX P

RESEARCH LEARNER QUESTIONNAIRE

Dear Grade 9 Learner

I am currently studying towards a Doctoral Degree at the Nelson Mandela Metropolitan University. I order to successfully complete my studies I require you to complete the attached questionnaire for me as part of my research.

I would really appreciate your participation, but please note that participation is completely voluntary and you have the right to withdraw from the study at any time. The questionnaire is anonymous and you are not required to give your name or any other identifying particulars. The research results will be treated completely confidential and will only be used for academic purposes.

If you are willing to participate, please complete the attached questionnaire as honestly as possible. There is no right or wrong answers and this is not an exam.

PLEASE REMEMBER: Do not write your name on the questionnaire.

Thank you for your participation.

..................................................

(Mr) K V Arnolds
Researcher.

Date: ...............................2010
INTERNATIONAL STANDARDISED ASSESSMENT

TEST LANGUAGE: English
COUNTRY: South Africa
DISTRICT: Port Elizabeth
DATE: ........................................2010

LEARNER QUESTIONNAIRE

Dear Student

In this questionnaire you will find questions about:

- you and your family;
- your experience of your school;
- what you plan to do in the future.

Please read each question carefully and answer it as honestly as you can. Before you start with the questionnaire read the following guidelines:

- Answer only on the provided answer sheet
- Please do not answer on the questionnaire.
- Do not write your name on the answer sheet as it is not required.
- For multiple choice questions, write only the number.
- For a few questions you will need to write in a short sentence.

Please note:

1. In this questionnaire, there are no ‘right’ or ‘wrong’ answers. Your answers should be the ones that are ‘right’ for you.
2. You may ask for help if you do not understand something or are not sure how to answer a question.
3. You have 180 minutes to complete the tasks.
4. Your answers will be kept confidential.

Thank you for your cooperation.
SECTION A: Demographic Data

1. On what date were you born? ________________________________

2. What is your home language?

<table>
<thead>
<tr>
<th>English</th>
<th>Afrikaans</th>
<th>Xhosa</th>
<th>Other (specify): ________</th>
</tr>
</thead>
</table>

3. Gender

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
</table>

4. Who usually lives at home with you?

<table>
<thead>
<tr>
<th>A. Mother</th>
<th>B. Stepmother or foster mother</th>
<th>C. Father</th>
<th>D. Stepfather or foster father</th>
<th>E. Brother/s (Including stepbrothers)</th>
<th>F. Sister/s (Including stepsisters)</th>
<th>G. Grandpartens/s</th>
<th>H. Both parents</th>
<th>I. Others</th>
</tr>
</thead>
</table>

5. Age in years

<table>
<thead>
<tr>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>Other</th>
</tr>
</thead>
</table>

6. What is your race classification?

<table>
<thead>
<tr>
<th>Black</th>
<th>Coloured</th>
<th>White</th>
<th>Asian</th>
<th>Other</th>
</tr>
</thead>
</table>

241
7. How many brothers and sisters do you have?

<table>
<thead>
<tr>
<th>Brothers and sisters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Older than you</td>
<td></td>
</tr>
<tr>
<td>Younger than you</td>
<td></td>
</tr>
<tr>
<td>Same age as you</td>
<td></td>
</tr>
</tbody>
</table>

SECTION B: QUANTITATIVE QUESTIONS

Some of the following questions are about your mother and father (or those person(s) who are like a mother or father to you — for example, guardians, step-parents, foster parents, etc.).

If you share your time with more than one set of parents or guardians, please answer the following questions for those parents/step-parents/guardians you spend the most time with.

8. What is your mother currently doing?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Working full-time for pay</td>
<td></td>
</tr>
<tr>
<td>B. Working part-time for pay</td>
<td></td>
</tr>
<tr>
<td>C. Not working, but looking for a job</td>
<td></td>
</tr>
<tr>
<td>D. Other (e.g. home duties, retired)</td>
<td></td>
</tr>
</tbody>
</table>

9. What is your father currently doing?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Working full-time for pay</td>
<td></td>
</tr>
<tr>
<td>B. Working part-time for pay</td>
<td></td>
</tr>
<tr>
<td>C. Not working, but looking for a job</td>
<td></td>
</tr>
<tr>
<td>D. Other (e.g. home duties, retired)</td>
<td></td>
</tr>
</tbody>
</table>

10. What is your mother’s main job? (e.g., School teacher, nurse, sales manager)

_______________________________________________
If she is not currently employed, please tell us her last main job.

_____________________________________________________________________

11. What is your father’s main job? (e.g., School teacher, carpenter, sales manager).

_____________________________________________________________________

If he is not currently employed, please tell us his last main job.

_____________________________________________________________________

12. What is the highest school grade your mother completed?

_____________________________________________________________________

13. What is the highest school grade your father completed?

_____________________________________________________________________

14. Did your mother complete or attend university/college?

<table>
<thead>
<tr>
<th>Yes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

15. Did your father complete or attend university/college?

<table>
<thead>
<tr>
<th>Yes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

16. In what country were you born?

_____________________________________________________________________

17. In what country were your parents born?

_____________________________________________________________________

243
18. What language do you speak at home most of the time?

| Language       | English | Afrikaans | Xhosa | Other (Specify):_________
|----------------|---------|-----------|-------|--------------------------|

19. During the past year, how often have you participated in the following activities?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Never</th>
<th>Once or twice</th>
<th>3 or 4 times</th>
<th>More than 4 times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gone to the movies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visited a museum or art gallery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attended a music concert</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attended an opera, ballet or classical symphony concert</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watched live theatre</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attended sporting events</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

20. In general, how often do your parents:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Never</th>
<th>Sometimes</th>
<th>Regularly</th>
<th>Often</th>
<th>All the time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discuss political or social issues with you</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discuss books, films or television programmes with you</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listen to classical music with you</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discuss your school work with you</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eat the main meal with you around a table</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spend time just talking to you</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
21. How often do the following people work with you on your schoolwork?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Never or hardly ever</th>
<th>A few times a year</th>
<th>About once a month</th>
<th>Several times a month</th>
<th>Several times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your mother</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your father</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Your brothers and sisters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grandparents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other relatives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friends of your parents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

22. How many of these items do you have at your home?

<table>
<thead>
<tr>
<th>ITEM</th>
<th>NONE</th>
<th>ONE</th>
<th>TWO</th>
<th>THREE OR MORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellular phone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Television</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Musical Instrument</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor car</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathroom</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23. During the last three years, have you attended any of these special courses at your school to improve your results?

<table>
<thead>
<tr>
<th>Description</th>
<th>No, never</th>
<th>Yes, sometimes</th>
<th>Yes, regularly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra or additional courses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remedial courses in English</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remedial courses in other subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training to improve your study skills</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
24 During the last three years, have you attended any of these special courses *outside of your school* to improve your results?

<table>
<thead>
<tr>
<th>Description</th>
<th>No, never</th>
<th>Yes, sometimes</th>
<th>Yes, regularly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses in English</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Courses in other subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra or additional courses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remedial courses in English</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remedial courses in other subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training to improve your study skills</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private tutoring</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

25 How often do these things happen in your English, math & science lessons?
<table>
<thead>
<tr>
<th>Description</th>
<th>Never</th>
<th>Some lessons</th>
<th>Most lessons</th>
<th>Every lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>The teacher has to wait a long time for students to quieten down</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher wants students to work hard</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher tells students that they can do better</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher does not like it when students deliver careless work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher shows an interest in every student’s learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher gives students an opportunity to express opinions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher helps students with their work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher continues teaching until the students understand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher does a lot to help students</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher helps students with their learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The teacher checks students’ homework</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students cannot work well</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students don’t listen to what the teacher says</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students don’t start working for a long time after the lesson begins</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students have to learn a lot</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is noise and disorder</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At the start of class, more than five minutes are spent doing nothing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

26 In the last full week you were in school, how many class periods did you spend in:
   a. English? __________
   b. Mathematics? __________
   c. Science? __________

27 On average, about how many students are in your:
28 How many times in the previous two school weeks did you:

<table>
<thead>
<tr>
<th>Description</th>
<th>None</th>
<th>Once or twice</th>
<th>3 or 4 times</th>
<th>5 or more times</th>
</tr>
</thead>
<tbody>
<tr>
<td>miss school?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>skip classes?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>arrive late for school?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

29 How much do you disagree or agree with each of the following statements about teachers at your school?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students get along well with most teachers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most teachers are interested in students’ well-being</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most of my teachers really listen to what I have to say</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If I need extra help, I will receive it from my teachers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most of my teachers treat me fairly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

30 My school is a place where:
<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel like an outsider (or left out of things)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I make friends easily.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel like I belong.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel awkward and out of place.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other students seem to like me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel lonely.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not want to go.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I often feel bored</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

31 Please indicate how often each of these applies to you.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never</th>
<th>Sometimes</th>
<th>Most of the time</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>I complete my homework on time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do my homework while watching television.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My teachers grade my homework</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I finish my homework during the school day</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My teachers make useful comments on my homework</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am given interesting homework</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My homework is counted as part of my exam marks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

32 On average, how much time do you spend each week on homework and study in these subject areas? (When answering include time at the weekend too.)

<table>
<thead>
<tr>
<th>Subject</th>
<th>No time a week</th>
<th>less than 1 hour a week</th>
<th>Between 1 and 3 hours a week</th>
<th>3 hours a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mathematics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
33. *Each day,* about how much time do you usually spend reading for enjoyment?

<table>
<thead>
<tr>
<th>Time Spent Each Day</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I do not read for enjoyment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 minutes or less each day</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than 30 minutes to less than 60 minutes each day</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 2 hours each day</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than 2 hours each day</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

34. How much do you disagree or agree with these statements about reading?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I read only if I have to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading is one of my favourite hobbies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like talking about books with other people</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find it hard to finish books</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel happy if I receive a book as a present</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For me, reading is a waste of time</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy going to a bookstore or a library</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I read only to get information that I need</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I cannot sit still and read for more than a few minutes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

35. How often do you read these materials because you want to?
<table>
<thead>
<tr>
<th><strong>Reading Material</strong></th>
<th>Never or hardly ever</th>
<th>A few times a year</th>
<th>About once a month</th>
<th>Several times a month</th>
<th>Several times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magazines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comic books</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fictions (novels, narratives, stories)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-fiction books</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emails and Web pages</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newspapers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

36 How many books are there in your home?  
(There are usually about 40 books per metre of shelving. Do not include magazines.)

a. None
b. 1-10 books
c. 11-50 books
d. 51-100 books
e. 101-250 books
f. 251-500 books
g. More than 500 books

37 How often do you borrow books to read for pleasure from a public or school library?

a. Never or hardly ever
b. A few times per year
c. About once a month
d. Several times a month
38 At your school, about how often do you use:

<table>
<thead>
<tr>
<th></th>
<th>Never or hardly ever</th>
<th>A few times a year</th>
<th>About once a month</th>
<th>Several times a month</th>
<th>Several times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>School library?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculators?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science laboratories?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

39 What kind of job do you expect to have when you are about 30 years old?
40. In your last school report, what mark did you receive in the following subjects?

<table>
<thead>
<tr>
<th>Subject</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td></td>
</tr>
</tbody>
</table>

41. In your last school report, how did your mark compare with the pass mark in each subject?

<table>
<thead>
<tr>
<th>Subject</th>
<th>Above the pass mark</th>
<th>At the pass mark</th>
<th>Below the pass mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

42. How confident do you feel about having to do the following mathematical tasks?

<table>
<thead>
<tr>
<th>Task</th>
<th>Very confident</th>
<th>Not very confident</th>
<th>Not at all confident</th>
<th>Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using a train timetable to work out how long it will take to get from one place to another.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculating how much cheaper a TV would be after a 30% discount.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculating how many square metres of tiles you need to cover a floor.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding graphs presented in newspapers.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solving an equation like $3x + 5 = 17$.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finding the actual distance between two places on a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
map with a 1:10,000 scale

Solving an equation like 
\[ 2(x+3)=(x+3)(x-3) \]

Calculating the petrol consumption rate of a car

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I often worry that it will be difficult for me in mathematics classes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am just not good at mathematics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I get very tense when I have to do mathematics homework.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I get good marks in mathematics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I get very nervous doing mathematics problems.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I learn mathematics quickly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have always believed that mathematics is one of my best subjects.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel helpless when doing a mathematics problem.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In my mathematics class, I understand even the most difficult work.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I worry that I will get poor marks in mathematics.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### How much do you agree with the statements about science below?

<table>
<thead>
<tr>
<th>I generally have fun when I am learning science topics.</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like reading about science.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am happy doing science problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy acquiring new knowledge in science</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am interested in learning about science</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### How much do you agree with the statements below?

<table>
<thead>
<tr>
<th>Advances in broad science and technology usually improve people’s living conditions.</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science is important for helping us to understand the natural world</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some concepts in science help me see how I relate to other people</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advances in broad science and technology usually help improve the economy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will use science in many ways when I am an adult.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science is valuable to society.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science is very relevant to me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find that science helps me to understand the things around me</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advances in science and technology usually bring social benefits.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When I leave school there will be many opportunities for me to use science.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
46  How often do you do these things?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Very often</th>
<th>Regularly</th>
<th>Sometimes</th>
<th>Never or hardly ever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watch TV programmes about broad science</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borrow or buy books on science topics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visit web sites about science topics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listen to radio programmes about advances in science</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read science magazines or articles in newspapers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attend a science club</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

47  How much do you agree with the statements below?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would like to work in a career involving science.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would like to study science after secondary school.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would like to spend my life doing advanced science.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would like to work on science projects as an adult.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thank you for completing this questionnaire
Reading Unit 1: Lake Chad

Figure 1 shows changing levels of Lake Chad, in Saharan North Africa. Lake Chad disappeared completely in about 20,000 BC, during the last Ice Age. In about 11,000 BC it reappeared. Today, its level is about the same as it was in AD 1000.

Figure 2 shows Saharan rock art (ancient drawings or paintings found on the walls of caves) and changing patterns of wildlife.


Use the above information about Lake Chad to answer the questions below.

**Question 1.1**
What is the depth of Lake Chad today?
A. About two metres.
B. About fifteen metres.
C. About fifty metres.
D. It has disappeared completely.
E. The information is not provided.

**Question 1.2**
In about which year does the graph in Figure 1 start?

**Question 1.3**
Why has the author chosen to start the graph at this point?
Appendix Q

READING UNIT 1: LAKE CHAD

Figure 1 shows changing levels of Lake Chad, in Saharan North Africa. Lake Chad disappeared completely in about 20,000 BC, during the Last Ice Age. In about 11,000 BC it reappeared. Today, its level is about the same as it was in AD 1000.

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D. It has disappeared completely.
E. The information is not provided.

QUESTION 1.2
In about which year does the graph in Figure 1 start?

QUESTION 1.3
Why has the author chosen to start the graph at this point?
QUESTION 1.4

Figure 2 is based on the assumption that:
A. the animals in the rock art were present in the area at the time they were drawn.
B. the artists who drew the animals were highly skilled.
C. the artists who drew the animals were able to travel widely.
D. there was no attempt to domesticate the animals which were depicted in the rock art.

QUESTION 1.5

For this question you need to draw together information from Figure 1 and Figure 2.
The disappearance of the rhinoceros, hippopotamus and ariocasts from Saharan rock art happened:
A. at the beginning of the most recent Ice Age.
B. in the middle of the period when Lake Chad was at its highest level.
C. after the level of Lake Chad had been falling for over a thousand years.
D. at the beginning of an uninterrupted dry period.
ACOL VOLUNTARY FLU IMMUNISATION PROGRAM

As you are no doubt aware the flu can strike rapidly and extensively during winter. It can leave its victims ill for weeks.

The best way to fight the virus is to have a fit and healthy body. Daily exercise and a diet including plenty of fruit and vegetables are highly recommended to assist the immune system to fight this invading virus.

ACOL has decided to offer staff the opportunity to be immunised against the flu as an additional way to prevent this insidious virus from spreading amongst us. ACOL has arranged for a nurse to administer the immunisations at ACOL, during a half-day session in work hours in the week of May 17. This program is free and available to all members of staff.

Participation is voluntary. Staff taking up the option will be asked to sign a consent form indicating that they do not have any allergies, and that they understand they may experience minor side effects.

Medical advice indicates that the immunisation does not produce influenza. However, it may cause some side effects such as fatigue, mild fever and tenderness of the arm.

Who should be immunised?

Anyone interested in being protected against the virus.

This immunisation is especially recommended for people over the age of 65. But regardless of age, ANYONE who has a chronic debilitating disease, especially cardiac, pulmonary, bronchial or diabetic conditions.

In an office environment ALL staff are at risk of catching the flu.

Who should not be immunised?

Individuals hypersensitive to eggs, people suffering from an acute febrile illness and pregnant women.

Check with your doctor if you are taking any medication or have had a previous reaction to a flu injection.

If you would like to be immunised in the week of May 17 please advise the personnel officer, Fiona McSweeney, by Friday May 7. The date and time will be set according to the availability of the nurse, the number of participants and the time convenient for most staff. If you would like to be immunised for this winter but cannot attend at the arranged time please let Fiona know. An alternative session may be arranged if there are sufficient numbers.

For further information please contact Fiona on ext. 5577.
Appendix Q

Fiona McSweeney, the personnel officer at a company called ACOL, prepared the information sheet on the previous page for ACOL staff. Refer to the information sheet to answer the questions which follow.

**QUESTION 2.1**
Which one of the following describes a feature of the ACOL flu immunisation program?
- A. Daily exercise classes will be run during the winter.
- B. Immunisations will be given during working hours.
- C. A small bonus will be offered to participants.
- D. A doctor will give the injections.

**QUESTION 2.2**
We can talk about the content of a piece of writing (what it says),
We can talk about its style (the way it is presented).
Fiona wanted the style of this information sheet to be friendly and encouraging.
Do you think she succeeded?
Explain your answer by referring in detail to the layout, style of writing, pictures or other graphics.

**QUESTION 2.3**
This information sheet suggests that if you want to protect yourself against the flu virus, a flu injection is
- A. more effective than exercise and a healthy diet, but more risky.
- B. a good idea, but not a substitute for exercise and a healthy diet.
- C. as effective as exercise and a healthy diet, and less troublesome.
- D. not worth considering if you have plenty of exercise and a healthy diet.

**QUESTION 2.4**
Part of the information sheet says:
Who should be immunised?
Anyone interested in being protected against the virus.
After Fiona had circulated the information sheet, a colleague told her that she should have left out the
words "Anyone interested in being protected against the virus" because they were misleading.
Do you agree that these words are misleading and should have been left out?
QUESTION 2.5

According to the information sheet, which one of these staff members should contact Fiona?

A. Steve from the stores who does not want to be immunised because he would rather rely on his natural immunity.

B. Julie from sales, who wants to know if the immunisation program is compulsory.

C. Alice from the mailroom who would like to be immunised this winter but is having a baby in two months.

D. Michael from accounts who would like to be immunised but will be on leave in the week of May 17.
Appendix Q

READING UNIT 3: GRAFFITI

I'm simmering with anger as the school wall is cleaned and repainted for the fourth time to get rid of graffiti. Creativity is admirable but people should find ways to express themselves that do not inflict extra costs upon society.

Why do you spoil the reputation of young people by painting graffiti where it is forbidden? Professional artists do not hang their paintings in the streets, do they? Instead they seek funding and gain fame through legal exhibitions.

In my opinion buildings, fences and park benches are works of art in themselves. It's really pathetic to spoil this architecture with graffiti and what's more, the method destroys the ozone layer. Really, I can't understand why these criminal artists bother as their "artistic works" are just removed from sight over and over again.

Helga

Source: Matt Harake

There is no accounting for taste. Society is full of communication and advertising. Company logos, shop names, large intrusive posters on the streets. Are they acceptable? Yes, mostly, but graffiti acceptable? Some people say yes, some, no.

Who pays the price for graffiti? Who is ultimately paying the price for advertisements? Correct...the consumer.

Have the people who put up billboards asked your permission? No. Should graffiti painters do so then? Isn't it all just a question of communication -- your own name, the names of gangs and large works of art in the street.

Think about the striped and chequered clothes that appeared in the stores a few years ago. And sui wear. The patterns and colours were stolen directly from the flowery concrete walls. It's quite amusing that these patterns and colours are accepted and admired but that graffiti in the same style is considered dreadful.

Times are hard for art.

Sophia

The two letters above come from the Internet and are about graffiti. Graffiti is illegal painting and writing on walls and elsewhere. Refer to the letters to answer the questions below.

QUESTION 3.1

The purpose of each of these letters is to
A. explain what graffiti is.
B. present an opinion about graffiti.
C. demonstrate the popularity of graffiti.
D. tell people how much it cost removing graffiti.

QUESTION 3.2

Why does Sophia refer to advertising?
QUESTION 3.3
Which of the two letter writers do you agree with? Explain your answer by using your own words to refer to what is said in one or both of the letters.

QUESTION 3.4
We can talk about what a letter says (its content).
We can talk about the way a letter is written (its style).
Regardless of which letter you agree with, in your opinion, which do you think is the better letter? Explain your answer by referring to the way one or both letters are written.
The tree diagram below shows the structure of a country’s labour force or “working-age population”. The total population of the country in 1995 was about 2.4 million.

The Labour Force Structure year ended 31 March 1995 (000s)

1. Numbers of people are given in thousands (000s).
2. The working-age population is defined as people between the ages of 15 and 65.
3. People “Not in labour force” are those not actively seeking work and/or not available for work.

Source: D. Miller, Fem 6 Economics, OCA Publications, 990 9411, Newton, Auckland, New Zealand, p. 64.

Use the information about a country’s labour force shown above to answer the questions below.

**QUESTION 4.1**

What are the two main groups into which the working-age population is divided?

A. Employed and unemployed.
B. Of working age and not of working age.
C. Full-time workers and part-time workers.
D. In the labour force and not in the labour force.

**QUESTION 4.2**

How many people of working age were not in the labour force? (Write the number of people, not the percentage.)
Appendix Q

QUESTION 4.3
In which part of the tree diagram, if any, would each of the people listed in the table below be included? Show your answer by placing a cross in the correct box in the table.
The first one has been done for you.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A part-time waiter, aged 35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A business woman, aged 43, who works a sixty-hour week</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A full-time student, aged 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A man, aged 28, who recently sold his shop and is looking for work</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A woman, aged 55, who has never worked or wanted to work outside the home</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A grandmother, aged 80, who still works a few hours a day at the family’s market stall</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

QUESTION 4.4
Suppose that information about the labour force was presented in a tree diagram like this every year.
Listed below are four features of the tree diagram. Show whether or not you would expect these features to change from year to year, by circling either “Change” or “No change”. The first one has been done for you.

<table>
<thead>
<tr>
<th>Feature of Tree Diagram</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>a The labels in each box (e.g. “in labour force”)</td>
<td>Change / No change</td>
</tr>
<tr>
<td>b The percentages (e.g. “64.2%”)</td>
<td>Change / No change</td>
</tr>
<tr>
<td>c The numbers (e.g. “26662”)</td>
<td>Change / No change</td>
</tr>
<tr>
<td>d The footnotes under the tree diagram</td>
<td>Change / No change</td>
</tr>
</tbody>
</table>

QUESTION 4.5
The information about the labour force structure is presented as a tree diagram, but it could have been presented in a number of other ways, such as a written description, a pie chart, a graph or a table.
The tree diagram was probably chosen because it is especially useful for showing:
A. changes over time.
B. the size of the country’s total population.
C. categories within each group.
D. the size of each group.
# Appendix Q

## PLAN International Program Results Financial Year 1996

### Region of Eastern and Southern Africa

#### RESA

<table>
<thead>
<tr>
<th>Region</th>
<th>EGYPT</th>
<th>ETHIOPIA</th>
<th>EQUATORIA</th>
<th>MADAGASCAR</th>
<th>MAURITANIA</th>
<th>NIGERIA</th>
<th>NIGER</th>
<th>RHODESIA</th>
<th>SWAZILAND</th>
<th>ZAMBIA</th>
<th>ZIMBABWE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health post built with 4 rooms or less</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>9</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health workers trained for 1 day</td>
<td>1053</td>
<td>0</td>
<td>719</td>
<td>0</td>
<td>423</td>
<td>1201</td>
<td>20</td>
<td>20</td>
<td>1045</td>
<td>4685</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children given nutritional supplements 1 week</td>
<td>1015</td>
<td>0</td>
<td>2</td>
<td>240</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>230</td>
<td>301</td>
<td>26627</td>
<td></td>
</tr>
<tr>
<td>Children given financial help with health/viral treatment</td>
<td>984</td>
<td>0</td>
<td>996</td>
<td>0</td>
<td>305</td>
<td>0</td>
<td>581</td>
<td>0</td>
<td>17</td>
<td>2183</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Learning

| Trackers trained for 1 week | 0     | 0        | 367       | 0          | 570        | 115      | 561   | 0        | 101       | 2320    |
| School teachers bought/booked/donated | 460   | 0        | 0         | 41291      | 0          | 106      | 0     | 150      | 0         | 115123  |
| School text books bought/booked/donated | 0     | 0        | 49900     | 9669       | 3152       | 6700     | 7263  | 150      | 58387     | 131623  |
| Uniforms bought/booked/donated | 887    | 0        | 5761      | 0          | 2305       | 6060     | 0     | 434      | 23152     |
| Children helped with school fees/scholarship | 1232   | 0        | 1990      | 9          | 154        | 0        | 0     | 0        | 2014      | 6987    |
| School desks bought/booked/donated | 3200   | 0        | 5689      | 259        | 1564       | 1725     | 1764  | 0        | 4199      | 16351   |
| Permanent classrooms built | 64     | 0        | 503       | 8          | 431        | 31       | 45    | 0        | 81        | 309     |
| Classrooms repaired | 0     | 0        | 34        | 0          | 0          | 14       | 0     | 33       | 81        |
| Adults receiving training in literacy this financial year | 1140  | 0        | 3000      | 568        | 3677       | 0        | 0     | 350      | 6995      |

#### Habitat

| Latrines or toilets dug/built | 50      | 0        | 2403      | 0          | 57         | 162       | 25    | 49       | 4311      | 7102    |
| House connected to a new sewage system | 143     | 0        | 0         | 0          | 0          | 0        | 0     | 0        | 143       |
| Wells dug/improved for spring lavatory | 0     | 0        | 15        | 0          | 7          | 13       | 0     | 0        | 154       |
| New positive boreholes drilled | 0     | 0        | 8         | 50         | 14         | 0        | 27    | 0        | 220       |
| Gravity fed drinking water system built | 0     | 0        | 28        | 0          | 1          | 0        | 0     | 0        | 29        |
| Drinking water systems repaired/improved | 0     | 0        | 392       | 0          | 2          | 0        | 0     | 0        | 31        |
| Houses improved with PLAN project | 265    | 0        | 370       | 0          | 0          | 1        | 0     | 2        | 788       |
| New houses built for beneficiaries | 273    | 0        | 356       | 0          | 2          | 0        | 0     | 313      | 1842      |
| Community halls built or improved | 0     | 0        | 3         | 0          | 3          | 0        | 0     | 2        | 12        |
| Community leaders trained for 1 day or more | 2214   | 95       | 3522      | 232        | 200        | 373      | 814   | 20       | 2093      | 13446   |
| Kilometers of roadway improved | 12     | 0        | 26        | 0          | 0          | 0        | 0     | 2        | 24        |
| Bridges built | 0     | 0        | 4         | 21        | 11         | 0        | 0     | 1        | 18        |
| Families benefited directly from erosion control | 0     | 0        | 1692      | 0          | 1500       | 0        | 0     | 0        | 1645      |
| Houses newly served for electrification project | 648    | 0        | 2         | 0          | 0          | 0        | 0     | 0        | 648       |

Source: Adapted from PLAN International Program Output Chain financial year 1996, appendix to Quarterly Report to the International Board for quarter 1997.
The table on the previous page is part of a report published by PLAN International, an international aid organisation. It gives some information about PLAN's work in one of its regions of operation (Eastern and Southern Africa). Refer to the table to answer the questions below.

**QUESTION 5.1**
What does the table indicate about the level of PLAN International's activity in Ethiopia in 1996, compared with other countries in the region?
A. The level of activity was comparatively high in Ethiopia.
B. The level of activity was comparatively low in Ethiopia.
C. It was about the same as in other countries in the region.
D. It was comparatively high in the Habitat category, and low in the other categories.

**QUESTION 5.2**
In 1996 Ethiopia was one of the poorest countries in the world. Taking this fact and the information in the table into account, what do you think might explain the level of PLAN International's activities in Ethiopia compared with its activities in other countries?
Appendix Q

Reading Unit 6: Police

A murder has been committed but the suspect denies everything. He claims to not know the victim. He says he never knew him, never went near him, never touched him... The police and the judge are convinced that he is not telling the truth. But how to prove it?

Scientific Police Weapons

At the crime scene, investigators have gathered evidence: fibres from fabrics, hairs, fingerprint markings, cigarette ends... The few hairs found on the victim's jacket are red. And they look strangely like the suspect's. If it could be proved that these hairs are indeed his, this would be evidence that he had in fact met the victim.

Every individual is unique

Specialists set to work. They examine some cells at the root of these hairs and some of the suspect's blood cells. In the nucleus of each cell in our bodies there is DNA. What is it? DNA is like a necklace made of two twisted strands of pearls.

We are made up of billions of cells

Every living thing is made up of lots of cells. A cell is very small indeed. It can only be seen using a microscope which magnifies it many times. Each cell has an outer membrane and a nucleus in which the DNA is found.

Genetic what?

DNA is made up of a number of genes, each consisting of thousands of "pears". Together these genes form the genetic identity card of a person.

Imagine that these pearls come in four different colours and that thousands of coloured pearls (which make up a gene) are strung in a very specific order. In each individual this order is exactly the same in all the cells in the body: those of the hair roots as well as those of the big toe, those of the liver and those of the stomach or blood. But the order of the pearls can vary from one person to another.

Given the number of pearls strung in this way, there is very little chance of two people having the same DNA, with the exception of identical twins. Unique to each individual, DNA is that sort of genetic identity card.

Geneticists are therefore able to compare the suspect's genetic identity card determined from his blood with that of the person with the red hair. If the genetic card is the same, they will know that the suspect did in fact go near the victim he said he had never met.

Just one piece of evidence

More and more often in cases of sexual assault, murder, theft or other crimes, the police are having genetic analysis done. Why? To try to find evidence of contact between two people, two objects or a person and an object.

Proving such contact is often very useful to the investigation. But it does not necessarily provide proof of a crime. It is just one piece of evidence among many others.

Anne Versailles

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How is the genetic identity card revealed?

The geneticists take the few cells from the base of the hairs found on the victim, or from the saliva left on a cigarette end. He puts them into a product which destroys everything around the DNA of the cells. He then does the same thing with some cells from the suspect's blood. The DNA is then specially prepared for analysis. After this, it is placed in a special gel and an electric current is passed through the gel. After a few hours, this produces stripes similar to a bar code like the ones on things we buy which are visible under a special lamp. The bar code of the suspect's DNA is then compared with that of the hairs found on the victim.
Refer to the magazine article on the opposite page to answer the questions below.

QUESTION 6.1
To explain the structure of DNA, the author talks about a pearl necklace. How do these pearl necklaces vary from one individual to another?
A. They vary in length.
B. The order of the pearls is different.
C. The number of necklaces is different.
D. The colour of the pearls is different.

QUESTION 6.2
What is the purpose of the box headed "How is the genetic identity card revealed"?
To explain
A. what DNA is.
B. what a bar code is.
C. how cells are analysed to find the pattern of DNA.
D. how it can be proved that a crime has been committed.

QUESTION 6.3
What is the author's main aim?
A. To warn.
B. To amuse.
C. To inform.
D. To convince.

QUESTION 6.4
The end of the introduction (the first shaded section) says: "But how to prove it!"
According to the passage, investigators try to find an answer to this question by
A. interrogating witnesses.
B. carrying out genetic analysis.
C. interrogating the suspect thoroughly.
D. going over all the results of the investigation again.
Feeling good in your runners

For 14 years the Sports Medicine Centre of Lyon (France) has been studying the injuries of young sports players and sports professionals. The study has established that the best course is prevention...and good shoes.

Knocks, falls, wear and tear...

Eighteen per cent of sports players aged 8 to 12 already have heel injuries. The cartilage of a footballer’s ankle does not respond well to shocks, and 25% of professionals have discovered for themselves that it is an especially weak point. The cartilage of the delicate knee joint can also be irreparably damaged and it care is not taken right from childhood (10-12 years of age).

The hip does not escape damage either and, particularly when tired, players run the risk of fractures as a result of falls or collisions.

According to the study, footballers who have been playing for more than ten years have bony outgrowths either on the tibia or on the heel. This is what is known as "footballer’s foot", a deformity caused by shoes with soles and ankle parts that are too flexible.

Protect, support, stabilise, absorb

If a shoe is too rigid, it restricts movement. If it is too flexible, it increases the risk of injuries and sprains. A good sports shoe should meet four criteria:

Firstly, it must provide exterior protection: resisting knocks from the ball or another player, coping with unevenness in the ground, and keeping the foot warm and dry even when it is freezing cold and raining.

It must support the foot, and in particular the ankle joint, to avoid sprains, swelling and other problems, which may even affect the knee.

It must also provide players with good stability so that they do not slip on a wet ground or skid on a surface that is too dry.

Finally, it must absorb shocks, especially those suffered by volleyball and basketball players who are constantly jumping.

Dry feet

To avoid minor but painful conditions such as blisters or even splits or athlete’s foot (fungal infections), the shoe must allow evaporation of perspiration and must prevent outside dampness from getting in. The ideal material for this is leather, which can be waterproofed to prevent the shoe from getting soaked the first time it rains.

Appendix Q

Use the article on the previous page to answer the questions below.

**QUESTION 7.1**
What does the author intend to show in this text?
A. That the quality of many sports shoes has greatly improved.
B. That it is best not to play football if you are under 12 years of age.
C. That young people are suffering more and more injuries due to their poor physical condition.
D. That it is very important for young sports players to wear good sports shoes.

**QUESTION 7.2**
According to the article, why should sports shoes not be too rigid?

**QUESTION 7.3**
One part of the article says, "A good sports shoe should meet four criteria." What are these criteria?

**QUESTION 7.4**
Look at this sentence from near the end of the article. It is presented here in two parts:

"To avoid minor but painful conditions such as blisters or even splits or athlete's foot (fungal infections), ...." (first part)

"...the shoe must allow evaporation of perspiration and must prevent outside dampness from getting in." (second part)

What is the relationship between the first and second parts of the sentence?
The second part
A. contradicts the first part.
B. repeats the first part.
C. illustrates the problem described in the first part.
D. gives the solution to the problem described in the first part.
Appendix Q

READING UNIT 8: GIFT

THE GIFT

How many days, she wondered, had she sat like this, watching the cold brown water inch up the dissolving bluff. She could just faintly remember the beginning of the rain, driving in across the swamp from the south and beating against the shell of her house. Then the river itself started rising, slowly at first until at last it paused to turn back. From hour to hour it slithered up creeks and ditches and poured over low places. In the night, while she slept, it claimed the road and surrounded her so that she sat alone, her boat gone, the house like a piece of drift lodged on its bluff. Now even against the tarred planks of the supports the waters touched. And still they rose.

As far as she could see, to the treetops where the opposite banks had been, the swamp was an empty sea, awash with sheets of rain, the river lost somewhere in its vastness. Her house with its boat bottom had been built to ride just such a flood. If one ever came, but now it was old. Maybe the boards underneath were partly rotted away. Maybe the cable mooring the house to the great live oaks would snap loose and let her go turning downstream, the way her boat had gone.

No one could come now. She could cry out but it would be no use, no one would hear. Down the length and breadth of the swamp others were fighting to save what little they could, maybe even their lives. She had seen a whole house go floating by, so quiet she was reminded of sitting at a funeral. She thought when she saw it she knew whose house it was. It had been bad seeing it drift by, but the owners must have escaped to higher ground. Later, with the rain and darkness pressing in, she had heard a panther scream sprier.

Now the house seemed to shudder around her like something alive. She reached out to catch a lamp as it tilted off the table by her bed and put it between her feet to hold it steady. Then creaking and groaning with effort the house struggled up from the clay, floated free, bobbing like a cork and swung out slowly with the pull of the river. She gripped the edge of the bed. Swaying from side to side, the house moved to the length of its mooring. There was a jolt and a complaining of old timbers and then a pause. Slowly the current released it and let it swing back, rasping across its resting place. She caught her breath and sat for a long time feeling the slow pendulous sweeps. The dark sifted down through the incessant rain, and, head on arm, she slept holding on to the bed.

Sometime in the night the cry awoke her, a sound so anguished she was on her feet before she was awake. In the dark she stumbled against the bed. It came from out there, from the river. She could hear something moving, something large that made a dredging, sweeping sound. It could be another house. Then it hit, not head on but glancing and sliding down the length of her house. It was a tree. She listened as the branches and leaves cleared themselves and went on downstream, leaving only the rain and the lappings of the flood, sounds so constant now that they seemed a part
of the silence. Huddled on the bed, she was almost asleep again when another cry sounded; this time so close it could have been in the room. Staring into the dark, she eased back on the bed until her hand caught the cold shape of the rifle. Then crouched on the pillow, she cradled the gun across her knees. "Who's there?" she called.

The answer was a repeated cry, but less shrill, tired sounding, then the empty silence closing in. She drew back against the bed. Whatever was there she could hear it moving about on the porch. Planks creaked and she could distinguish the sounds of objects being knocked over. There was a scratching on the wall as if it would tear its way in. She knew now what it was, a big cat, deposited by the uprooted tree that had passed her. It had come with the flood, a gift.

Unconsciously she pressed her hand against her face and along her tightened throat. The rifle rocked across her knees. She had never seen a panther in her life. She had heard about them from others and heard their cries, like suffering, in the distance.

The cat was scratching on the wall again, rattling the window by the door. As long as she guarded the window and kept the cat hemmed in by the wall and water, caged, she would be all right. Outside, the animal paused to rake his claws across the rusted outer screen. Now and then, it whined and growled.

When the light filtered down the rain at last, coming like another kind of dark, she was still sitting on the bed, still and cold. Her arms, used to moving on the river, ached from the stillness of holding the rifle. She had hardly allowed herself to move for fear any sound might give strength to the cat. Rigid, she swayed with the movement of the house. The rain still fell as if it would never stop. Through the grey light, finally, she could see the rain-pitted flood and far away the cloudy shape of drowned treetops. The cat was not moving now. Maybe he had gone away. Laying the gun aside she slipped off the bed and moved without a sound to the window. It was still there, crouched at the edge of the porch, staring up at the live oak, the mooring of her house, as if gauging its chances of leaping to an overhanging branch. It did not seem so frightening now that she could see it. Its coarse fur matted into twigs, its sides pinched and ribs showing. It would be easy to shoot it where it sat, its long tail whipping back and forth. She was moving back to get the gun when it turned around. With no warning, no crouch or tensing of muscles, it sprang at the window, shattering a pane of glass. She fell back, stifling a scream, and taking up the rifle, she fired through the window. She could not see the panther now, but she had missed. It began to pace again. She could glimpse its head and the arch of its back as it passed the window.

Shivering, she pulled back on the bed and lay down. The lulling constant sound of the river and the rain, the penetrating chill, drained away her purpose. She watched the window and kept the gun ready. After waiting a long while she moved again to look. The panther had fallen asleep, its head on its paws, like a housecat. For the first time since the rains began she wanted to cry, for herself, for all the people, for everything.
Appendix Q

80. In the flood, sliding down on the bed, she pulled the quilt around her shoulders. She should have got out when she could, while the roads were still open or before her boat was washed away. As she rocked back and forth with the sway of the house, a deep ache in her stomach reminded her she hadn't eaten. She couldn't remember for how long. Like the cat, she was starving. Throwing into the kitchen, she made a fire with the few remaining sticks of wood. If the flood lasted, she would have to burn the chair, maybe even the table itself. Taking down the remnants of a smoked ham from the ceiling, she cut thick slices of the brownish-red meat and placed them in a skillet. The smell of the frying meat made her dizzy. There were stale biscuits from the last time she had cooked and she could make some coffee. There was plenty of water.

90. While she was cooking her food, she almost forgot about the cat until it whined. It was hungry, too. "Let me eat," she called to it, "and then I'll see to you." And she laughed under her breath. As she hung the rest of the ham back on its nail, the cat growled a deep throaty rumble that made her hand shake.

95. After she had eaten, she went to the bed again and took up the rifle. The house had risen so high now it no longer scraped across the bluff when it swung back from the river. The flood had warmed her. She could get rid of the cat while light still hung in the rain. She crept slowly to the window. It was still there, mewing, beginning to move about the porch. She stared at it for a long time, unafraid. Then without thinking, what she was doing, she laid the gun aside and started around the edge of the bed to the kitchen. Behind her the cat was moving, fretting. She took down what was left of the ham and making her way back across the swaying floor to the window, she shoved it through the broken pane. On the other side there was a hungry snarl and something like a shock passed from the animal to her. Stunned by what she had done, she drew back to the bed. She could hear the sounds of the panther tearing at the meat. The house rocked around her.

100. The next time she awoke she knew at once that everything had changed. The rain had stopped. She felt for the movement of the house but it no longer swayed on the flood. Drawing her door open, she saw through the torn screen a different world. The house was resting on the bluff where it always had. A few feet down, the river still raced on in a torrent, but it no longer covered the few feet between the house and the live oak. And the cat was gone. Loading from the porch to the live oak and doubtless on into the swamp were tracks, indistinct and already disappearing into the soft mud. And there on the porch, gnawed to whiteness, was what was left of the ham.


Use the story "The Gift" on the previous three pages to answer the questions which follow. (Note that line numbers are given in the margin of the story to help you find parts which are referred to in the questions.)
QUESTION 8.1
What is the woman's situation at the beginning of the story?
A. She is too weak to leave the house after days without food.
B. She is defending herself against a wild animal.
C. Her house has been surrounded by flood waters.
D. A flooded river has swept her house away.

QUESTION 8.2
When the woman says, "and then I'll see to you" (line 92) she means that she is
A. sure that the cat won't hurt her.
B. trying to frighten the cat.
C. intending to shoot the cat.
D. planning to feed the cat.

QUESTION 8.3
Do you think that the last sentence of "The Gift" is an appropriate ending?
Explain your answer, demonstrating your understanding of how the last sentence relates to the story's meaning.

QUESTION 8.4
"Then creaking and groaning with effort the house struggled up..." (line 24)
What happened to the house in this part of the story?
A. It fell apart.
B. It began to float.
C. It crashed into the oak tree.
D. It sank to the bottom of the river.

QUESTION 8.5
Here are some of the early references to the panther in the story.
"the cry awoke her, a sound so anguished..." (line 32)
"The answer was a repeated cry, but less shrill, tired sounding..." (line 44)
"She had...heard their cries, like suffering, in the distance." (lines 51–52)
Considering what happens in the rest of the story, why do you think the writer chooses to introduce the panther with these descriptions?
QUESTION 8.6
What does the story suggest was the woman's reason for feeding the panther?

QUESTION 8.7
Here is part of a conversation between two people who read "The Gift":

I think the woman in the story is heartless and cruel.

How can you say that? I think she's a very compassionate person.

Give evidence from the story to show how each of these speakers could justify their point of view.
Speaker 1: ......................................................
Speaker 2: ......................................................
Appendix Q

READING UNIT 9: AMANDA AND THE DUCHESS

Text 1

AMANDA AND THE DUCHESS

Summary: Since Léocadie’s death, the Prince, who was in love with her, has been inconsolable. At a shop called résdà Soeurs, the Duchess, who is the Prince’s aunt, has met a young shop assistant, Amanda, who looks amazingly like Léocadie. The Duchess wants Amanda to help her set the Prince free from the memories which haunt him.

Across the room, a circular bench around a small obelisk… evening is falling.

AMANDA

I still don’t understand. What can I do for him, ma’am? I can’t believe you could possibly have thought... And why me? I’m not particularly pretty. And even if someone were very pretty— who could suddenly come between him and his memories like that?

THE DUCHESS

No-one but you.

AMANDA, sincerely surprised

Me?

THE DUCHESS

The world is so foolish, my child. It sees only parades, gestures, badges of office... that must be why you have never been told. But my heart hasn’t deceived me—I almost cried out at Résdà Soeurs the first time I saw you. To someone who knew more of her than just her public image, you are the living likeness of Léocadie.

A silence. The evening birds have now taken over from the afternoon birds. The grounds are filled with shadows and twittering.

AMANDA, very gently

I really don’t think I can, ma’am. I have nothing, I am nothing, and those lovers… that was my fancy, don’t you see?

She has got up. As if about to leave, she has picked up her small autograph.

THE DUCHESS, gently also, and very wearily

Of course, my dear. I apologise.

She in turn gets up, with difficulty, like an old woman. A benedict bell is heard in the evening air, she gives a start... Listen… it’s him! Just show yourself to him, leaning against this little obelisk where he first met her. Let him see you, even if it’s just this once, let him call out, take a sudden interest in this likeness, in this stratagem which I shall confess to him tomorrow and for which he will hate me—in anything but this dead girl who’ll take him away from me one of these days. I’m sure. (She has taken her by the arm.) You will do that, won’t you? I beg you most humbly, young lady. (She looks at her, heartrending, and quickly adds.) And then, that way, you’ll see him too. And... I can feel that I’m blushing again from saying this to you—Life is just too mad! That’s the third time I’ve blushed in sixty years, and the second time in ten minutes—you’ll see him, and if he could ever (why not him, since he’s handsome and charming and he wouldn’t be the first?) if he could ever have the good fortune, for himself and for me, to take your fancy for one moment... The bell again in the shadows, but very close now.

AMANDA, in a whisper

What should I say to him?

THE DUCHESS, gripping her arm

Simply say: “Excuse me, Sir, can you tell me the way to the sea?”

She has hurried into the deeper shadows of the trees. Just in time. There is a pale blur. It is the Prince on his bicycle. He passes very close to the pale blur of Amanda by the obelisk. She warms.

AMANDA

Excuse me, Sir...

He stops, dismounts from the bicycle, takes off his hat and looks at her.

THE PRINCE

Yes?

AMANDA

Can you tell me the way to the sea?
THE PRINCE
Take the second turning on your left.

He bows, sadly and courteously, gets back on the bicycle and rides away. The bell is heard again in the distance. The Duchess comes out of the shadows, very much on old woman.

AMANDA, gently, after a while
He didn’t recognise me...

THE DUCHESS
It was dark... And then, who knows what face he gives her now, in his dreams? (She asks timidly.)

THE CURTAIN FALLS

Source: Jean Anouilh, Leonce and Lena. Published by La Table Ronde, 1984.

Text 2
Definitions of some theatrical occupations

Actor: plays a character on stage.

Director: controls and oversees all aspects of a play. He not only positions the actors, arranges their entrances and exits and directs their acting, but also suggests how the script is to be interpreted.

Wardrobe staff: produce the costumes from a model.

Set designer: designs models of the sets and costumes. These models are then transformed into their full size in the workshop.

Props manager: in charge of finding the required props. The word “props” is used to mean everything that can be moved: armchairs, letters, lamps, bunches of flowers, etc. The sets and costumes are not props.

Sound technician: in charge of all sound effects required for the production. He is at the controls during the show.

Lighting assistant or lighting technician: in charge of lighting. He is also at the controls during the show. Lighting is so sophisticated that a well-equipped theatre can employ up to ten lighting technicians.

On the previous two pages there are two texts. Text 1 is an extract from the play Leonce and Lena by Jean Anouilh. Text 2 gives definitions of theatrical occupations. Refer to the texts to answer the questions which follow.

QUESTION 9.1
What is this extract from the play about? The Duchess thinks of a trick:

A. to get the Prince to come and see her more often.
B. to get the Prince to make up his mind finally to get married.
C. to get Amanda to make the Prince forget his grief.
D. to get Amanda to come and live at the castle with her.
**QUESTION 9.2**

A. In the script of the play, in addition to the words to be spoken by the actors, there are directions for the actors and theatre technicians to follow.

B. How can these directions be recognised in the script?

---

**QUESTION 9.3**

The table below lists theatre technicians involved in staging this extract from *Leocadia*. Complete the table by indicating one stage direction from Text 1 which would require the involvement of each technician. The first one has been done for you.

<table>
<thead>
<tr>
<th>Theatre technician</th>
<th>Stage direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Set designer</td>
<td>A circular bench around a small obelisk.</td>
</tr>
<tr>
<td>B. Prop manager</td>
<td></td>
</tr>
<tr>
<td>C. Sound technician</td>
<td></td>
</tr>
<tr>
<td>D. Lighting technician</td>
<td></td>
</tr>
</tbody>
</table>
QUESTION 9.4
The director positions the actors on the stage. On a diagram, the director represents Amanda with the letter A and the Duchess with the letter D.
Put an A and a D on the following diagram of the set to show approximately where Amanda and the Duchess are when the Prince arrives.

QUESTION 9.5
Towards the end of the extract from the play, Amanda says, "He didn't recognise me...". What does she mean by that?
A. That the Prince didn't look at Amanda.
B. That the Prince didn't realise that Amanda was a shop assistant.
C. That the Prince didn't realise that he'd already met Amanda.
D. That the Prince didn't notice that Amanda looked like Léocadie.
Appendix Q

CENTRE ON INTERNAL AND EXTERNAL MOBILITY

WHAT IS CIEM?
CIEM stands for Centre on internal and External Mobility, an initiative of the personnel department. It is a number of workers in the department work in CIEM, together with members from other departments and outside career consultants.

CIEM is available to help employees in their search for another job inside or outside the Canco Manufacturing Company.

WHAT DOES CIEM DO?
CIEM supports employees who are seriously considering other work through the following activities:

- **Job Data Bank**
  After an interview with the employee, information is entered into a data bank that tracks job seekers and job openings at Canco and at other manufacturing companies.

- **Guidance**
  The employee's potential is explored through career counselling discussions.

- **Courses**
  Courses are being organized (in collaboration with the department for information and training) that will deal with job search and career planning.

- **Career Change Projects**
  CIEM supports and coordinates projects to help employees prepare for new careers and new perspectives.

- **Mediation**
  CIEM acts as a mediator for employees who are threatened with dismissal resulting from reorganisation, and assists with finding new positions when necessary.

HOW MUCH DOES CIEM COST?
Payment is determined in consultation with the department where you work. A number of services of CIEM are free. You may also be asked to pay, either in money or in time.

HOW DOES CIEM WORK?
CIEM assists employees who are seriously considering another job within or outside the company.

That process begins by submitting an application. A discussion with a personnel counsellor can also be useful. It is obvious that you should talk with the counsellor first about your wishes and the internal possibilities regarding your career. The counsellor is familiar with your abilities and with developments within your unit.

Contact with CIEM in any case is made via the personnel counsellor. He or she handles the application for you, after which you are invited to a discussion with a CIEM representative.

FOR MORE INFORMATION
The personnel department can give you more information.
Use the announcement from a personnel department on the previous page to answer the questions below.

**QUESTION 10.1**
According to the announcement, where could you get more information about CIEM?

**QUESTION 10.2**
List two ways in which CIEM helps people who will lose their jobs because of a departmental reorganisation.
CHAPTER 3

Mathematics
sample tasks
Appendix Q

MATHEMATICS UNIT 1: FARMS

Here you see a photograph of a farmhouse with a roof in the shape of a pyramid.

Below is a student's mathematical model of the farmhouse roof with measurements added.

The attic floor, ABCD in the model, is a square. The beams that support the roof are the edges of a block (rectangular prism) EFGHJKLM. E is the middle of AE, F is the middle of BT, G is the middle of CT and H is the middle of DT. All the edges of the pyramid in the model have length 12 m.

QUESTION 1.1
Calculate the area of the attic floor ABCD.
The area of the attic floor ABCD = __________ m²

QUESTION 1.2
Calculate the length of EF, one of the horizontal edges of the block.
The length of EF = __________ m
MATHMATICS UNIT 2: WALKING

The picture shows the footprints of a man walking. The pascalength $P$ is the distance between the rear of two consecutive footprints.

For men, the formula, $p = \frac{140}{n}$, gives an approximate relationship between $n$ and $P$ where,

$n$ = number of steps per minute, and

$P$ = pascalength in metres.

QUESTION 2.1

If the formula applies to Heiko's walking and Heiko takes 70 steps per minute, what is Heiko's pascalength? Show your work.

QUESTION 2.2

Bernard knows his pascalength is 0.80 metres. The formula applies to Bernard's walking. Calculate Bernard's walking speed in metres per minute and in kilometres per hour. Show your working out.
Mathematics Unit B: Apples

A farmer plants apple trees in a square pattern. In order to protect the apple trees against the wind he plants conifer trees all around the orchard.

Here you see a diagram of this situation where you can see the pattern of apple trees and conifer trees for any number (n) of rows of apple trees:

\[ \begin{array}{c}
\times = \text{conifer} \\
\bullet = \text{apple tree}
\end{array} \]

\[ \begin{array}{c}
n = 1 \\
\times \times \times \\
\bullet \bullet \times \\
\times \times \times
\end{array} \]

\[ \begin{array}{c}
n = 2 \\
\times \times \times \times \\
\bullet \bullet \times \\
\times \times \\
\times \bullet \bullet \times \\
\times \times \times
\end{array} \]

\[ \begin{array}{c}
n = 3 \\
\times \times \times \times \times \\
\bullet \bullet \bullet \times \\
\times \times \\
\times \bullet \bullet \bullet \\
\times \times \times \times \\
\times \times \times \times \\
\times \bullet \bullet \bullet \\
\times \times \times \times \\
\times \times \times \times \\
\times \times \times \times
\end{array} \]

\[ \begin{array}{c}
n = 4 \\
\times \times \times \times \times \times \\
\bullet \bullet \bullet \bullet \times \\
\times \times \times \\
\times \bullet \bullet \bullet \bullet \\
\times \times \times \times \\
\times \times \times \times \\
\times \bullet \bullet \bullet \bullet \\
\times \times \times \times \\
\times \times \times \times \\
\times \times \times \times
\end{array} \]
QUESTION 3.1
Complete the table:

<table>
<thead>
<tr>
<th>n</th>
<th>Number of apple trees</th>
<th>Number of conifer trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

QUESTION 3.2
There are two formulas you can use to calculate the number of apple trees and the number of conifer trees for the pattern described on the previous page:

Number of apple trees = n
Number of conifer trees = 6n
where n is the number of rows of apple trees.

There is a value of n for which the number of apple trees equals the number of conifer trees. Find the value of n and show your method of calculating this.

QUESTION 3.3
Suppose the farmer wants to make a much larger orchard with many rows of trees. As the farmer makes the orchard bigger, which will increase more quickly: the number of apple trees or the number of conifer trees? Explain how you found your answer.
**QUESTION 4.1**

In this photograph you see six dice, labelled (a) to (f). For all dice there is a rule:

The total number of dots on two opposite faces of each die is always seven.

Write in each box the number of dots on the bottom face of the die corresponding to the photograph.

```
(a)    (b)    (c)

(d)    (e)    (f)
```
Below is a map of Antarctica.

**QUESTION 5.1**

Estimate the area of Antarctica using the map scale. Show your working out and explain how you made your estimate. (You can draw over the map if it helps you with your estimation.)

---

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Mathematics Unit 6: Growing Up

Youth grows taller

In 1998 the average height of both young males and young females in the Netherlands is represented in this graph.

![Graph showing average height growth over age]

**Average height of young males 1998**

**Average height of young females 1998**

**Age (Years)**

**Height (cm)**

**QUESTION 6.1**

Since 1980, the average height of 20-year-old females has increased by 2.8 cm, to 170.6 cm. What was the average height of a 20-year-old female in 1980?

**Answer:** ________ cm

**QUESTION 6.2**

Explain how the graph shows that on average, the growth rate for girls slows down after 12 years of age.

**QUESTION 6.3**

According to this graph, on average, during which period in their lives are females taller than males of the same age?
**Appendix Q**

**MATHEMATICS UNIT 7: SPEED OF RACING CAR**

This graph shows how the speed of a racing car varies along a flat 3 kilometre track during its second lap.

**Speed of a racing car along a 3 km track**

(Second lap)

![Graph showing speed variation along a track](image)


**QUESTION 7.1**

What is the approximate distance from the starting line to the beginning of the longest straight section of the track?

A. 0.5 km  
B. 1.0 km  
C. 2.5 km  
D. 2.6 km

**QUESTION 7.2**

Where was the lowest speed recorded during the second lap?

A. at the starting line  
B. at about 0.8 km  
C. at about 1.5 km  
D. halfway around the track.

**QUESTION 7.3**

What can you say about the speed of the car between the 2.6 km and 2.8 km marks?

A. The speed of the car remains constant  
B. The speed of the car is increasing  
C. The speed of the car is decreasing  
D. The speed of the car cannot be determined from the graph.
QUESTION 7.4

Here are pictures of five tracks.

Along which one of these tracks was the car driven to produce the speed graph shown earlier?

S: Starting point
Appendix Q

MATHEMATICS UNIT 8: TRIANGLES

QUESTION 8.1
Circle the one figure below that fits the following description.

Triangle POR is a right triangle with right angle at R. The line RQ is less than the line PR. M is the midpoint of the line PQ and N is the midpoint of the line QR. S is a point inside the triangle. The line MN is greater than the line MS.

A

B

C

D

E
Appendix Q

MATHEMATICS UNIT 9: ROBBERIES

QUESTION 9.1
A TV reporter showed this graph and said:
"The graph shows that there is a huge increase in the number of robberies from 1998 to 1999."

Do you consider the reporter's statement to be a reasonable interpretation of the graph? Give an explanation to support your answer.
Appendix Q

## MATHEMATICS UNIT 10: CARPENTER

### QUESTION 10.1

A carpenter has 32 metres of timber and wants to make a border around a garden bed. He is considering the following designs for the garden bed.

![Diagram](image)

Circle either "Yes" or "No" for each design to indicate whether the garden bed can be made with 32 metres of timber.

<table>
<thead>
<tr>
<th>Design</th>
<th>Using this design, can the garden bed be made with 32 metres of timber?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design A</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Design B</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Design C</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Design D</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>
**MATHEMATICS UNIT 11: INTERNET RELAY CHAT**

Mark (from Sydney, Australia) and Hans (from Berlin, Germany) often communicate with each other using "chat" on the Internet. They have to log on to the Internet at the same time to be able to chat.

To find a suitable time to chat, Mark looked up a chart of world times and found the following:

- **Greenwich Midday:** 12:00 AM
- **Berlin 1:00 AM**
- **Sydney 10:00 AM**

---

**QUESTION 11.1**

At 7:00 PM in Sydney, what time is it in Berlin?

**Answer:**

---

**QUESTION 11.2**

Mark and Hans are not able to chat between 9:00 AM and 4:30 PM their local time, as they have to go to school. Also, from 11:00 PM till 7:00 AM their local time they won't be able to chat because they will be sleeping.

When would be a good time for Mark and Hans to chat? Write the local times in the table.

<table>
<thead>
<tr>
<th>Place</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney</td>
<td></td>
</tr>
<tr>
<td>Berlin</td>
<td></td>
</tr>
</tbody>
</table>

---
Appendix Q

MATHEMATICS UNIT 12: EXCHANGE RATE

Mei-Ling from Singapore was preparing to go to South Africa for 3 months as an exchange student. She needed to change some Singapore dollars (SGD) into South African rand (ZAR).

**QUESTION 12.1**
Mei-Ling found out that the exchange rate between Singapore dollars and South African rand was 1 SGD = 4.2 ZAR.
Mei-Ling changed 3000 Singapore dollars into South African rand at this exchange rate.
How much money in South African rand did Mei-Ling get?

Answer: ____________________________

**QUESTION 12.2**
On returning to Singapore after 3 months, Mei-Ling had 3 900 ZAR left. She changed this back to Singapore dollars, noting that the exchange rate had changed to 1 SGD = 4.0 ZAR.
How much money in Singapore dollars did Mei-Ling get?

Answer: ____________________________

**QUESTION 12.3**
During these 3 months the exchange rate had changed from 4.2 to 4.0 ZAR per SGD.
Was it in Mei-Ling’s favour that the exchange rate now was 4.0 ZAR instead of 4.2 ZAR, when she changed her South African rand back to Singapore dollars? Give an explanation to support your answer.
**QUESTION 13.1**

What was the total value (in millions of zeds) of exports from Zeland in 1998?

Answer: ____________________

**QUESTION 13.2**

What was the value of fruit juice exported from Zeland in 2000?

A. 1.8 million zeds.
B. 2.3 million zeds.
C. 2.4 million zeds.
D. 3.4 million zeds.
E. 3.8 million zeds.
Appendix Q

MATHEMATICS UNIT 14: COLOURED CANDIES

QUESTION 14.1
Robert's mother lets him pick one candy from a bag. He can't see the candies. The number of candies of each colour in the bag is shown in the following graph:

What is the probability that Robert will pick a red candy?
A. $\frac{1}{5}$
B. $\frac{2}{5}$
C. $\frac{3}{5}$
D. $\frac{4}{5}$

MATHEMATICS UNIT 15: SCIENCE TESTS

QUESTION 15.1
In Mei Lin's school, her science teacher gives tests that are marked out of 100. Mei Lin has an average of 60 marks on her first four science tests. On the fifth test she got 80 marks.

What is the average of Mei Lin's marks in Science after all five tests?
Average: ___________________________
**Appendix Q**

**Mathematics Sample Tasks**

**Mathematics Unit 16: Bookshelves**

**Question 16.1**
To complete one set of bookshelves a carpenter needs the following components:

- 4 long wooden panels,
- 6 short wooden panels,
- 12 small clips,
- 2 large clips and
- 14 screws.

The carpenter has in stock 26 long wooden panels, 33 short wooden panels, 200 small clips, 26 large clips and 510 screws.

How many sets of bookshelves can the carpenter make?

**Answer:**

**Mathematics Unit 17: Litter**

**Question 17.1**
For a homework assignment on the environment, students collected information on the decomposition time of several types of litter that people throw away:

<table>
<thead>
<tr>
<th>Type of Litter</th>
<th>Decomposition time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana peel</td>
<td>1–3 years</td>
</tr>
<tr>
<td>Orange peel</td>
<td>1–3 years</td>
</tr>
<tr>
<td>Cardboard boxes</td>
<td>0.5 year</td>
</tr>
<tr>
<td>Chewing gum</td>
<td>20–25 years</td>
</tr>
<tr>
<td>Newspapers</td>
<td>A few days</td>
</tr>
<tr>
<td>Polystyrene cups</td>
<td>Over 100 years</td>
</tr>
</tbody>
</table>

A student thinks of displaying the results in a bar graph.

Give one reason why a bar graph is unsuitable for displaying these data.

**Answer:**

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Appendix Q

MATHEMATICS UNIT 18: EARTHQUAKE

QUESTION 18.1
A documentary was broadcast about earthquakes and how often earthquakes occur. It included a discussion about the predictability of earthquakes.

A geologist stated: "In the next twenty years, the chance that an earthquake will occur in Zed City is two out of three".

Which of the following best reflects the meaning of the geologist's statement?

A. \( \frac{2}{3} \times 20 = 13.3 \), so between 13 and 14 years from now, there will be an earthquake in Zed City.

B. \( \frac{2}{3} \) is more than \( \frac{1}{2} \), so you can be sure there will be an earthquake in Zed City at some time during the next 20 years.

C. The likelihood that there will be an earthquake in Zed City at some time during the next 20 years is higher than the likelihood of no earthquake.

D. You cannot tell what will happen, because nobody can be sure when an earthquake will occur.

MATHEMATICS UNIT 19: CHOICES

QUESTION 19.1
In a pizza restaurant, you can get a basic pizza with two toppings: cheese and tomato. You can also make up your own pizza with extra toppings. You can choose from four different extra toppings: olives, ham, mushrooms and salami.

Ross wants to order a pizza with two different extra toppings.

How many different combinations can Ross choose from?

Answer: __________________, combinations.
Appendix Q

MATHEMATICS UNIT 20: TEST SCORES

QUESTION 20.1

The diagram below shows the results on a Science test for two groups, labelled as Group A and Group B.

The mean score for Group A is 62.0 and the mean for Group B is 64.5. Students pass this test when their score is 50 or above.

Scores on a Science test

<table>
<thead>
<tr>
<th>Score</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9</td>
<td>1</td>
</tr>
<tr>
<td>10-19</td>
<td>2</td>
</tr>
<tr>
<td>20-29</td>
<td>3</td>
</tr>
<tr>
<td>30-39</td>
<td>4</td>
</tr>
<tr>
<td>40-49</td>
<td>5</td>
</tr>
<tr>
<td>50-59</td>
<td>6</td>
</tr>
<tr>
<td>60-69</td>
<td>7</td>
</tr>
<tr>
<td>70-79</td>
<td>2</td>
</tr>
<tr>
<td>80-89</td>
<td>1</td>
</tr>
<tr>
<td>90-100</td>
<td>1</td>
</tr>
</tbody>
</table>

Looking at the diagram, the teacher claims that Group B did better than Group A in this test.

The students in Group A don't agree with their teacher. They try to convince the teacher that Group B may not necessarily have done better.

Give one mathematical argument, using the graph, that the students in Group A could use.

______________________________________________________________________________________

______________________________________________________________________________________

______________________________________________________________________________________

______________________________________________________________________________________

______________________________________________________________________________________
CHAPTER 4

Science sample tasks
Semmelweis' Diary Text 1

'July 1846. Next week I will take up a position as "Herr Doktor" at the First Ward of the maternity clinic of the Vienna General Hospital. I was frightened when I heard about the percentage of patients who die in this clinic. This month not less than 36 of the 208 mothers died there, all from puerperal fever. Giving birth to a child is as dangerous as first-degree pneumonia.'

These lines from the diary of Ignaz Semmelweis (1818-1865) illustrate the devastating effects of puerperal fever, a contagious disease that killed many women after childbirth. Semmelweis collected data about the number of deaths from puerperal fever in both the First and the Second Wards (see diagram).

Diagram

Physicians, among them Semmelweis, were completely in the dark about the cause of puerperal fever. Semmelweis' diary again:

'December 1846. Why do so many women die from this fever after giving birth without any problems? For centuries science has told us that it is an invisible epidemic that kills mothers. Causes may be changes in the air or some extraterrestrial influence or a movement of the earth itself, an earthquake.'

Nowadays not many people would consider extraterrestrial influence or an earthquake as possible causes of fever. We now know it has to do with hygienic conditions. But in the time Semmelweis lived, many people, even scientists, did! However, Semmelweis knew that it was unlikely that fever could be caused by extraterrestrial influence or an earthquake. He pointed at the data he collected (see diagram) and used this to try to persuade his colleagues.

QUESTION 1.1

Suppose you were Semmelweis. Give a reason (based on the data Semmelweis collected) why puerperal fever is unlikely to be caused by earthquakes.

Suppose you were Semmelweis. Give a reason (based on the data Semmelweis collected) why puerperal fever is unlikely to be caused by earthquakes.

Suppose you were Semmelweis. Give a reason (based on the data Semmelweis collected) why puerperal fever is unlikely to be caused by earthquakes.
Semmelweis' Diary Text 2

Part of the research in the hospital was dissection. The body of a deceased person was cut open to find a cause of death. Semmelweis recorded that the students working on the first ward usually took part in dissections on women who died the previous day, before they examined women who had just given birth. They did not pay much attention to cleaning themselves after the dissections. Some were even proud of the fact that you could tell by their smell that they had been working in the mortuary, as this showed how industrious they were! One of Semmelweis' friends died after having cut himself during such a dissection. Dissection of his body showed he had the same symptoms as mothers who died from puerperal fever. This gave Semmelweis a new idea.

**QUESTION 1.2**

Semmelweis' new idea had to do with the high percentage of women dying in the maternity wards and the students' behaviour.

What was this idea?

A. Having students clean themselves after dissections should lead to a decrease of puerperal fever.
B. Students should not take part in dissections because they may cut themselves.
C. Students smell because they do not clean themselves after a dissection.
D. Students want to show that they are industrious, which makes them careless when they examine the women.

**QUESTION 1.3**

Semmelweis succeeded in his attempts to reduce the number of deaths due to puerperal fever. But puerperal fever even today remains a disease that is difficult to eliminate.

Fevers that are difficult to cure are still a problem in hospitals. Many routine measures serve to control this problem. Among these measures are washing sheets at high temperatures.

Explain why high temperature (while washing sheets) helps to reduce the risk that patients will contract a fever.

---

**QUESTION 1.4**

Many diseases may be cured by using antibiotics. However, the success of some antibiotics against puerperal fever has diminished in recent years.

What is the reason for this?

A. Once produced, antibiotics gradually lose their activity.
B. Bacteria become resistant to antibiotics.
C. These antibiotics only help against puerperal fever, but not against other diseases.
D. The need for these antibiotics has been reduced because public health conditions have improved considerably in recent years.
SCIENCE UNIT 2: OZONE

Read the following section of an article about the ozone layer.

The atmosphere is an ocean of air and a precious natural resource for sustaining life on the Earth. Unfortunately, human activities based on national/personal interests are causing harm to this common resource, notably by depleting the fragile ozone layer, which acts as a protective shield for life on the Earth.

Ozone molecules consist of three oxygen atoms, as opposed to oxygen molecules which consist of two oxygen atoms. Ozone molecules are exceedingly rare, fewer than ten in every million molecules of air. However, for nearly a billion years, their presence in the atmosphere has played a vital role in safeguarding life on Earth. Depending on where it is located, ozone can either protect or harm life on Earth. The ozone in the troposphere (up to 10 kilometres above the Earth's surface) is "bad" ozone which can damage lung tissues and plants. But about 90 percent of ozone found in the stratosphere (between 10 and 40 kilometres above the Earth's surface) is "good" ozone which plays a beneficial role by absorbing dangerous ultraviolet (UV-B) radiation from the Sun.

Without this beneficial ozone layer, humans would be more susceptible to certain diseases due to the increased incidence of ultra-violet rays from the Sun. In the last decades the amount of ozone has decreased. In 1974 it was hypothesised that chlorofluorocarbons (CFCs) could be a cause for this. Until 1987, scientific assessment of the cause-effect relationship was not convincing enough to implicate CFCs. However, in September 1987, diplomats from around the world met in Montreal (Canada) and agreed to set sharp limits to the use of CFCs.

Source: Connect, UNESCO International Science, Technology & Environmental Education Newsletter. Section from an article entitled 'The Chemistry of Atmospheric Policy', Vol. XLI, No. 2. 1997 (spelling adapted.)

QUESTION 2.1

In the text above nothing is mentioned about the way ozone is formed in the atmosphere. In fact each day some ozone is formed and some other ozone disappears. The way ozone is formed is illustrated in the following comic strip.

Suppose you have an uncle who tries to understand the meaning of this strip. However, he did not get any science education at school and he doesn't understand what the author of the strip is explaining. He knows that there are no little fellows in the atmosphere but he wonders what those little fellows in the strip stand for, what those strange notations O, O2 and O3 mean and which processes the strip represents. He asks you to explain the strip. Assume that your uncle knows that O is the symbol for oxygen:

what atoms and molecules are.

Write an explanation of the comic strip for your uncle.

In your explanation, use the words atoms and molecules in the way they are used in lines 5 and 6.
Appendix Q

SCIENCE SAMPLE TASKS

QUESTION 2.2
Ozone is also formed during thunderstorms. It causes the typical smell after such a storm. In lines 9–13 the author of the text distinguishes between "bad ozone" and "good ozone".

In terms of the article, is the ozone that is formed during thunderstorms "bad ozone" or "good ozone"?
Choose the answer and the explanation that is supported by the text.

<table>
<thead>
<tr>
<th>Bad ozone or good ozone?</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Bad</td>
<td>It is formed during bad weather.</td>
</tr>
<tr>
<td>B Bad</td>
<td>It is formed in the troposphere.</td>
</tr>
<tr>
<td>C Good</td>
<td>It is formed in the stratosphere.</td>
</tr>
<tr>
<td>D Good</td>
<td>It smells good.</td>
</tr>
</tbody>
</table>

QUESTION 2.3

Lines 14 and 15 state: "Without this beneficial ozone layer, humans would be more susceptible to certain diseases due to the increased incidence of ultra-violet rays from the Sun."

Name one of these specific diseases.
Appendix Q

SCIENCE UNIT 3: DAYLIGHT

Read the following information and answer the questions that follow.

Daylight on 22 June 2002

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rise</td>
<td>5:55 am</td>
<td>14 hours and 47 minutes of daylight.</td>
</tr>
<tr>
<td>Set</td>
<td>8:42 pm</td>
<td></td>
</tr>
</tbody>
</table>

Today, as the Northern Hemisphere celebrates its longest day, Australians will experience their shortest. In Melbourne*, Australia, the Sun will rise at 7:36 am and set at 5:08 pm, giving nine hours and 32 minutes of daylight.

Compare today to the year’s longest day in the Southern Hemisphere, expected on 22 December, when the Sun will rise at 5:55 am and set at 8:42 pm, giving 14 hours and 47 minutes of daylight.

The President of the Astronomical Society, Mr Perry Vibes, said the existence of changing seasons in the Northern and Southern Hemispheres was linked to the Earth’s 23-degree tilt.

*Melbourne is a city in Australia at a latitude of about 38 degrees South of the equator.

Source: The Age newspaper, Melbourne, Australia, 22nd June 1990 (adapted).

QUESTION 3.1

Which statement explains why daylight and darkness occur on Earth?

A. The Earth rotates on its axis.
B. The Sun rotates on its axis.
C. The Earth’s axis is tilted.
D. The Earth revolves around the Sun.
QUESTION 3.2

In the Figure light rays from the Sun are shown shining on the Earth.

Figure: light rays from Sun

Suppose it is the shortest day in Melbourne.
Show the Earth's axis, the Northern Hemisphere, the Southern Hemisphere and the Equator on the Figure. Label all parts of your answer.
A copying machine for living beings?

Without any doubt, if there had been elections for the animal of the year 1997, Dolly would have been the winner! Dolly is a Scottish sheep that you see in the photo. But Dolly is not just a simple sheep. She is a clone of another sheep, a clone means: a copy. Cloning means copying 'from a single master copy'. Scientists succeeded in creating a sheep (Dolly) that is identical to a sheep that functioned as a 'master copy'.

It was the Scottish scientist Ian Wilmut who designed the 'copying machine' for sheep. He took a very small piece from the udder of an adult sheep (sheep 1). From that small piece he removed the nucleus, then he transferred the nucleus into the egg-cell of another (female) sheep (sheep 2). But first he removed from that egg-cell all the material that would have determined sheep 2 characteristics in a lamb produced from that egg-cell. Ian Wilmut implanted the manipulated egg-cell of sheep 2 into yet another (female) sheep (sheep 3). Sheep 3 became pregnant and had a lamb; Dolly. Some scientists think that within a few years it will be possible to clone people as well. But many governments have already decided to forbid cloning of people by law.
QUESTION 4.1
Which sheep is Dolly identical to?
A. Sheep 1
B. Sheep 2
C. Sheep 3
D. Dolly's father

QUESTION 4.2
In line 14 the part of the udder that was used is described as "a very small piece". From the article text you can work out what is meant by "a very small piece".
That "very small piece" is
A. a cell
B. a gene
C. a cell nucleus
D. a chromosome

QUESTION 4.3
In the last sentence of the article it is stated that many governments have already decided to forbid cloning of people by law.
Two possible reasons for this decision are mentioned below.
Are these reasons scientific reasons?
Circle either "Yes" or "No" for each.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Scientific?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloned people could be more sensitive to certain diseases than normal people.</td>
<td>Yes / No</td>
</tr>
<tr>
<td>People should not take over the role of a Creator.</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>
Appendix Q

Science Unit 5: Greenhouse

Read the text and answer the questions that follow.

The greenhouse effect: fact or fiction?

Living things need energy to survive. The energy that sustains life on the Earth comes from the Sun, which radiates energy into space because it is so hot. A tiny proportion of this energy reaches the Earth.

The Earth's atmosphere acts like a protective blanket over the surface of our planet, preventing the variations in temperature that would exist in an airless world.

Most of the radiated energy coming from the Sun passes through the Earth's atmosphere. The Earth absorbs some of this energy, and some is reflected back from the Earth's surface. Part of this reflected energy is absorbed by the atmosphere.

As a result of this the average temperature above the Earth's surface is higher than it would be if there were no atmosphere. The Earth's atmosphere has the same effect as a greenhouse, hence the term greenhouse effect.

The greenhouse effect is said to have become more pronounced during the twentieth century.

It is a fact that the average temperature of the Earth's atmosphere has increased. In newspapers and periodicals the increased carbon dioxide emission is often stated as the main source of the temperature rise in the twentieth century.

A student named André becomes interested in the possible relationship between the average temperature of the Earth's atmosphere and the carbon dioxide emission on the Earth.

In a library he comes across the following two graphs.

![Graph 1: Carbon dioxide emission (thousands of tonnes per year)]

![Graph 2: Average temperature of the Earth's atmosphere (°C)]


André concludes from these two graphs that it is certain that the increase in the average temperature of the Earth's atmosphere is due to the increase in the carbon dioxide emission.
Appendix Q

**SCIENCE SAMPLE TASKS**

**QUESTION 5.1**
What is it about the graphs that supports André’s conclusion?

**QUESTION 5.2**
Another student, Jeanne, disagrees with André’s conclusion. She compares the two graphs and says that some parts of the graphs do not support his conclusion. Give an example of a part of the graphs that does not support André’s conclusion. Explain your answer.

**QUESTION 5.3**
André presents his conclusion that the average temperature rise of the Earth’s atmosphere is caused by the increase in the carbon dioxide emission. But Jeanne thinks that his conclusion is premature. She says, “Before accepting this conclusion you must be sure that other factors that could influence the greenhouse effect are constant.” Name one of the factors that Jeanne means.
A team of British scientists is developing "intelligent" clothes that will give disabled children the power of "speech". Children wearing waistcoats made of a unique electretile, linked to a speech synthesiser, will be able to make themselves understood simply by tapping on the touch-sensitive material.

The material is made up of normal cloth and an ingenious mesh of carbon-impregnated fibres that can conduct electricity. When pressure is applied to the fabric, the pattern of signals that passes through the conducting fibres is altered and a computer chip can work out where the cloth has been touched. It then can trigger whatever electronic device is attached to it, which could be no bigger than two boxes of matches.

"The smart bit is in how we weave the fabric and how we send signals through it – and we can weave it into existing fabric designs so you cannot see it's in there," says one of the scientists.

Without being damaged, the material can be washed, wrapped around objects or scrunched up. The scientist also claims it can be mass-produced cheaply.

**QUESTION 6.1**

Can these claims made in the article be tested through scientific investigation in the laboratory?

Circle either "Yes" or "No" for each.

<table>
<thead>
<tr>
<th>The material can be</th>
<th>Can the claim be tested through scientific investigations in the laboratory?</th>
</tr>
</thead>
<tbody>
<tr>
<td>washed without being damaged</td>
<td>Yes / No</td>
</tr>
<tr>
<td>wrapped around objects without being damaged</td>
<td>Yes / No</td>
</tr>
<tr>
<td>scrunched up without being damaged</td>
<td>Yes / No</td>
</tr>
<tr>
<td>mass-produced cheaply</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

**QUESTION 6.2**

Which piece of laboratory equipment would be among the equipment you would need to check that the fabric is conducting electricity?

A. Voltmeter  
B. Light box  
C. Micrometer  
D. Sound meter
Appendix Q

**SCIENCE UNIT 7: THE GRAND CANYON**

The Grand Canyon is located in a desert in the USA. It is a very large and deep canyon containing many layers of rock. Sometime in the past, movements in the Earth's crust lifted these layers up. The Grand Canyon is now 1.6 km deep in parts. The Colorado River runs through the bottom of the canyon.

See the picture below of the Grand Canyon taken from its south rim. Several different layers of rock can be seen in the walls of the canyon.

![Diagram of the Grand Canyon showing layers of rock](image)

**QUESTION 7.1**

The temperature in the Grand Canyon ranges from below 0°C to over 40°C. Although it is a desert area, cracks in the rocks sometimes contain water. How do these temperature changes and the water in rock cracks help to speed up the breakdown of rocks?

A. Freezing water dissolves warm rocks.
B. Water cements rocks together.
C. Ice smooths the surface of rocks.
D. Freezing water expands in the rock cracks.

**QUESTION 7.2**

There are many fossils of marine animals, such as clams, fish and corals, in the Limestone A layer of the Grand Canyon. What happened millions of years ago that explains why such fossils are found there?

A. In ancient times, people brought seafood to the area from the ocean.
B. Oceans were once much rougher and sea life washed inland on giant waves.
C. An ocean covered this area at that time and then receded later.
D. Some sea animals once lived on land before migrating to the sea.
### QUESTION 7.3

About five million people visit the Grand Canyon national park every year. There is concern about the damage that is being caused to the park by so many visitors.

Can the following questions be answered by scientific investigation? Circle “Yes” or “No” for each question.

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Yes / No</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Can the question be answered by scientific investigation?</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>How much erosion is caused by use of the walking tracks?</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Is the park area as beautiful as it was 100 years ago?</td>
<td></td>
</tr>
</tbody>
</table>

### QUESTION 7.4 (ATTITUDE)

How much do you agree with the following statements?

Tick only one box in each row.

<table>
<thead>
<tr>
<th></th>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>The systematic study of fossils is important.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Action to protect National Parks from damage should be based on scientific evidence.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Scientific investigation of geological layers is important.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix Q

SCIENCE UNIT 8: SUNSCREENS

Mimi and Dean wondered which sunscreen product provides the best protection for their skin. Sunscreen products have a Sun Protection Factor (SPF) that shows how well each product absorbs the ultraviolet radiation component of sunlight. A high SPF sunscreen protects skin for longer than a low SPF sunscreen.

Mimi thought of a way to compare some different sunscreen products. She and Dean collected the following:

- two sheets of clear plastic that do not absorb sunlight;
- one sheet of light-sensitive paper;
- mineral oil (M) and a cream containing zinc oxide (ZnO); and
- four different sunscreens that they called S1, S2, S3, and S4.

Mimi and Dean included mineral oil because it lets most of the sunlight through, and zinc oxide because it almost completely blocks sunlight.

Dean placed a drop of each substance inside a circle marked on one sheet of plastic, then put the second plastic sheet over the top. He placed a large book on top of both sheets and pressed down.

Mimi then put the plastic sheets on top of the sheet of light-sensitive paper. Light-sensitive paper changes from dark grey to white (or very light grey), depending on how long it is exposed to sunlight. Finally, Dean placed the sheets in a sunny place.

QUESTION 8.1

Which one of these statements is a scientific description of the role of the mineral oil and the zinc oxide in comparing the effectiveness of the sunscreens?

A. Mineral oil and zinc oxide are both factors being tested.
B. Mineral oil is a factor being tested and zinc oxide is a reference substance.
C. Mineral oil is a reference substance and zinc oxide is a factor being tested.
D. Mineral oil and zinc oxide are both reference substances.
QUESTION 8.2
Which one of these questions were Mimi and Dean trying to answer?
A. How does the protection for each sunscreen compare with the others?
B. How do sunscreens protect your skin from ultraviolet radiation?
C. Is there any sunscreen that gives less protection than mineral oil?
D. Is there any sunscreen that gives more protection than zinc oxide?

QUESTION 8.3
Why was the second sheet of plastic pressed down?
A. To stop the drops from drying out.
B. To spread the drops out as far as possible.
C. To keep the drops inside the marked circles.
D. To make the drops the same thickness.

QUESTION 8.4
The light-sensitive paper is a dark grey and fades to a lighter grey when it is exposed to some sunlight, and to white when exposed to a lot of sunlight.
Which one of these diagrams shows a pattern that might occur? Explain why you chose it.
Answer: ...........................................................
Explanation: ........................................................................................................................................
..........................................................................................................................................................
Appendix Q

SCIENCE UNIT 9: MARY MONTAGU

Read the following newspaper article and answer the questions that follow.

The History of Vaccination

Mary Montagu was a beautiful woman. She survived an attack of smallpox in 1715 but she was left covered with scars. While living in Turkey in 1717, she observed a method called inoculation that was commonly used there. This treatment involved scratching a weak type of smallpox virus into the skin of healthy young people who then became sick, but in most cases only with a mild form of the disease.

Mary Montagu was so convinced of the safety of these inoculations that she allowed her son and daughter to be inoculated.

In 1796, Edward Jenner used inoculations of a related disease, cowpox, to produce antibodies against smallpox. Compared with the inoculation of smallpox, this treatment had less side effects and the treated person could not infect others. The treatment became known as vaccination.

QUESTION 9.1

What kinds of diseases can people be vaccinated against?

A. Inherited diseases like haemophilia.
B. Diseases that are caused by viruses, like polio.
C. Diseases from the malfunctioning of the body, like diabetes.
D. Any sort of disease that has no cure.

QUESTION 9.2

If animals or humans become sick with an infectious bacterial disease and then recover, the type of bacteria that caused the disease does not usually make them sick again. What is the reason for this?

A. The body has killed all bacteria that may cause the same kind of disease.
B. The body has made antibodies that kill this type of bacteria before they multiply.
C. The red blood cells kill all bacteria that may cause the same kind of disease.
D. The red blood cells capture and get rid of this type of bacteria from the body.

QUESTION 9.3

Give one reason why it is recommended that young children and old people, in particular, should be vaccinated against influenza (flu).
### QUESTION 9.4 (ATTITUDE)

How much do you agree with the following statements?
Tick only one box in each row:

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. I am in favour of research to develop vaccines for new strains of influenza.

B. The cause of a disease can only be identified by scientific research.

C. The effectiveness of unconventional treatments for diseases should be subject to scientific investigation.
Appendix Q

**SCIENCE UNIT 10: ACID RAIN**

Below is a photo of statues called Caryatids that were built on the Acropolis in Athens more than 2500 years ago. The statues are made of a type of rock called marble. Marble is composed of calcium carbonate.

In 1986, the original statues were transferred inside the museum of the Acropolis and were replaced by replicas. The original statues were being eaten away by acid rain.

![Caryatids](image)

**QUESTION 10.1**

Normal rain is slightly acidic because it has absorbed some carbon dioxide from the air. Acid rain is more acidic than normal rain because it has absorbed gases like sulfur oxides and nitrogen oxides as well. Where do these sulfur oxides and nitrogen oxides in the air come from?

The effect of acid rain on marble can be modelled by placing chips of marble in vinegar overnight. Vinegar and acid rain have about the same acidity level. When a marble chip is placed in vinegar, bubbles of gas form. The mass of the dry marble chip can be found before and after the experiment.

**QUESTION 10.2**

A marble chip has a mass of 2.0 grams before being immersed in vinegar overnight. The chip is removed and dried the next day. What will the mass of the dried marble chip be?

A. Less than 2.0 grams
B. Exactly 2.0 grams
C. Between 2.0 and 2.4 grams
D. More than 2.4 grams

**QUESTION 10.3**

Students who did this experiment also placed marble chips in pure (distilled) water overnight. Explain why the students included this step in their experiment.

---

### QUESTION 10.4 (ATTITUDE)
How much do you agree with the following statements?
Tick only one box in each row.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Knowing which human activities contribute most to acid rain</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>B</td>
<td>Learning about technologies that minimise the emission of gases that cause acid rain</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>C</td>
<td>Understanding the methods used to repair buildings damaged by acid rain</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

### QUESTION 10.5 (ATTITUDE)
How much do you agree with the following statements?
Tick only one box in each row.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Preservation of ancient ruins should be based on scientific evidence concerning the causes of damage</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>B</td>
<td>Statements about the causes of acid rain should be based on scientific research.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
SCIENCE UNIT 11: PHYSICAL EXERCISE
Regular but moderate physical exercise is good for our health.

QUESTION 11.1
What are the advantages of regular physical exercise? Circle "Yes" or "No" for each statement.

<table>
<thead>
<tr>
<th>A</th>
<th>Is the aim of regular physical exercise?</th>
<th>Yes / No</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Physical exercise helps prevent heart and circulation illnesses.</td>
<td>Yes / No</td>
</tr>
<tr>
<td>C</td>
<td>Physical exercise leads to a healthy diet.</td>
<td>Yes / No</td>
</tr>
<tr>
<td>D</td>
<td>Physical exercise helps to avoid becoming overweight.</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

QUESTION 11.2
What happens when muscles are exercised? Circle "Yes" or "No" for each statement.

<table>
<thead>
<tr>
<th>A</th>
<th>Does this happen when muscles are exercised?</th>
<th>Yes / No</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Muscles get an increased flow of blood.</td>
<td>Yes / No</td>
</tr>
<tr>
<td>C</td>
<td>Fats are formed in the muscles.</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

QUESTION 11.3
Why do you have to breathe more heavily when you're doing physical exercise than when your body is resting?

SCIENCE UNIT 12: GENETICALLY MODIFIED CROPS

GM Corn Should Be Banned

Wildlife conservation groups are demanding that a new genetically modified (GM) corn be banned.

This GM corn is designed to be unaffected by a powerful new herbicide that kills conventional corn plants. This new herbicide will kill most of the weeds that grow in cornfields.

The conservationists say that because these weeds are food for small animals, especially insects, the use of the new herbicide with the GM corn will be bad for the environment. Supporters of the use of the GM corn say that a scientific study has shown that this will not happen.

Here are details of the scientific study mentioned in the above article:

- Corn was planted in 200 fields across the country.
- Each field was divided into two. The genetically modified (GM) corn treated with the powerful new herbicide was grown in one half, and the conventional corn treated with a conventional herbicide was grown in the other half.
- The number of insects found in the GM corn, treated with the new herbicide, was about the same as the number of insects in the conventional corn, treated with the conventional herbicide.

QUESTION 12.1

What factors were deliberately varied in the scientific study mentioned in the article? Circle "Yes" or "No" for each of the following factors.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was this factor deliberately varied in the study?</td>
<td>Yes or No</td>
<td></td>
</tr>
<tr>
<td>The number of insects in the environment</td>
<td>Yes / No</td>
<td></td>
</tr>
<tr>
<td>The types of herbicide used</td>
<td>Yes / No</td>
<td></td>
</tr>
</tbody>
</table>

QUESTION 12.2

Corn was planted in 200 fields across the country. Why did the scientists use more than one site?

A. So that many farmers could try the new GM corn.
B. To see how much GM corn they could grow.
C. To cover as much land as possible with the GM crop.
D. To include various growth conditions for corn.
**QUESTION 12.3 (ATTITUDE)**

How much do you agree with the following statements?
Tick only one box in each row.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Learning about the process by which plants are genetically modified.</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>B. Learning why some plants are not affected by herbicides</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>C. Understanding better the difference between cross-breeding and genetic modification of plants</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
Biodiversity is the key to managing environment

An ecosystem that retains a high biodiversity (that is, a wide variety of living things) is much more likely to adapt to human-caused environment change than is one that has little.

Consider the two food webs shown in the diagram. The arrows point from the organism that eats to the one that eats it. These food webs are highly simplified compared with food webs in real ecosystems, but they still illustrate a key difference between more diverse and less diverse ecosystems.

Food web B represents a situation with very low biodiversity, where at some levels the food path involves only a single type of organism. Food web A represents a more diverse ecosystem, with a result, many more alternative feeding pathways.

Generally, loss of biodiversity should be regarded seriously, not only because the organisms that have become extinct represent a big loss for both ethical and utilitarian (useful benefit) reasons, but also because the organisms that remain have become more vulnerable (exposed) to extinction in the future.

Source: Adapted from Steve Malcolm, 'Biodiversity is the key to managing environment', The Age, 16 August 1994.
QUESTION 13.1
In lines 9 and 10 it is stated that "Food web A represents a more diverse ecosystem with, as a result, many more alternative feeding pathways."
Look at FOOD WEB A. Only two animals in this food web have three direct (immediate) food sources. Which two animals are they?
A. Native Cat and Parastic Wasp
B. Native Cat and Butcher Bird
C. Parastic Wasp and Leaf Hopper
D. Parastic Wasp and Spider
E. Native Cat and Honeyeater

QUESTION 13.2
Food webs A and B are in different locations. Imagine if Leaf Hopper died out in both locations. Which one of these is the best prediction and explanation for the effect this would have on the food webs?
A. The effect would be greater in food web A because the Parastic Wasp has only one food source in web A.
B. The effect would be greater in food web A because the Parastic Wasp has several food sources in web A.
C. The effect would be greater in food web B because the Parastic Wasp has only one food source in web B.
D. The effect would be greater in food web B because the Parastic Wasp has several food sources in web B.
Appendix Q

SCIENCE UNIT 14: BUSES

QUESTION 14.1

A bus is driving along a straight stretch of road. The bus driver, named Ray, has a cup of water resting on the dashboard:

Suddenly Ray has to slam on the brakes.

What is most likely to happen to the water in the cup?
A. The water will stay horizontal.
B. The water will spill over side 1.
C. The water will spill over side 2.
D. The water will spill but you cannot tell if it will spill at side 1 or side 2.

QUESTION 14.2

Ray’s bus is, like most buses, powered by a petrol engine. These buses contribute to environmental pollution.

Some cities have trolley buses: they are powered by an electric engine. The voltage needed for such an electric engine is provided by overhead lines (like electric trains).

The electricity is supplied by a power station using fossil fuels. Supporters for the use of trolley buses in a city say that these buses don’t contribute to environmental pollution.

Are they supporters right? Explain your answer:

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
Appendix Q

SCIENCE UNIT 15: CLIMATE CHANGE

Read the following information and answer the questions which follow.

WHAT HUMAN ACTIVITIES CONTRIBUTE TO CLIMATE CHANGE?

The burning of coal, oil and natural gas, as well as deforestation and various agricultural and industrial practices, are altering the composition of the atmosphere and contributing to climate change. These human activities have led to increased concentrations of particles and greenhouse gases in the atmosphere.

The relative importance of the main contributors to temperature change is shown in Figure 1.

<table>
<thead>
<tr>
<th>Relative Importance</th>
<th>Heating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling</td>
<td></td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td></td>
</tr>
<tr>
<td>Methane</td>
<td></td>
</tr>
<tr>
<td>Particles</td>
<td></td>
</tr>
<tr>
<td>Particle effects on clouds</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1: Relative importance of the main contributors to changes in the temperature of the atmosphere.

Figure 1 shows that increased concentrations of carbon dioxide and methane have a heating effect. Increased concentrations of particles have a cooling effect in two ways, labelled 'Particles' and 'Particle effects on clouds'.

Bars extending to the right of the centre line indicate a heating effect. Bars extending to the left of the centre line indicate a cooling effect. The relative effect of 'Particles' and 'Particle effects on clouds' are quite uncertain: in each case the possible effect is somewhere in the range shown by the light grey bar.

Source: US Global Change Research Information Office. Adapted from http://www.gcri.org/gpcc/qs/q104.html

QUESTION 15.1

Use the information in Figure 1 to develop an argument in support of reducing the emission of carbon dioxide from the human activities mentioned:

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________
6 June 2012
Mr KV Arnolds / Dr C Jordaan
Education Faculty
NMMU

Dear Mr Arnolds / Dr Jordaan

A COMPARATIVE ASSESSMENT TO DETERMINE MATHEMATICS, LANGUAGE AND SCIENCE KNOWLEDGE AND SKILLS ACQUIRED AMONG GRADE 9 STUDENTS IN PORT ELIZABETH SCHOOLS

Your above-entitled application for ethics approval was approved by the Faculty Research, Technology and Innovation Committee of Education (ERTIC) meeting on 6 March 2012.

We take pleasure in informing you that the application was approved by the Committee. The ethics clearance reference number is H12-EDU-ITE-003.

We wish you well with the project. Please inform your co-investigators of the outcome, and convey our best wishes.

Yours sincerely

Ms J Elliott-Gentry
Secretary: ERTIC