

**IMPROVING COMPREHENSION IN PHYSICAL SCIENCE
THROUGH MOTHER-TONGUE SUBTITLING IN SECONDARY
EDUCATION**

JOHANNES TSIETSI MAHLASELA

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Dissertation submitted in fulfilment of the requirements for a Master's degree in Language Practice in the School of Languages at the Vaal Triangle Campus of the North-West University

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25 October 2012

Declaration

By submitting this dissertation I hereby declare that the entirety of the work contained herein is my own original work and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Signature:.....

Date: 25 October 2012

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Abstract

Research and the literature show that there is a culture of failure in science subjects in South African schools. Among many factors responsible for this state of affairs, it is assumed that lack of language proficiency in the Language of Learning and Teaching (LoLT) could be the cause. Studies indicate that mother-tongue learning is key to better academic performance in schools.

The question of which language should be used as the LoLT in South African schools is a hugely debated issue. Arguments regarding this debate centre around two main issues, namely, the Language in Education Policy (LiEP) and psycholinguistic theories.

Means have to be sought to address the issue of poor academic performance by learners in these schools. One of the central areas which needs attention to improve learners' academic performance in these schools is learner comprehension.

An empirical research study was done in an attempt to determine whether mother-tongue subtitling would improve learners' comprehension of science. A total of 93 Grade 12 learners from two schools in one township were used in this study. The participants were divided into two equivalent groups: one group watched and listened to mother-tongue subtitled science content material, and the other group watched and listened to the same science content material that was not subtitled. Both groups then wrote a physical science comprehension test after watching and listening to the video. This process was repeated over a period of six weeks during which one lesson was given and one video was shown each week. The comprehension test questions were divided into the recall and understanding domains.

The results of this experiment revealed that mother-tongue subtitling improved the science comprehension of learners in as far as recall is concerned.

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List of Abbreviations

AL	Academic Literacy
ANOVA	Analysis of Variance
CHE	Council on Higher Education
DBE	Department of Basic Education
DoE	Department of Education
DET	Department of Education and Training
DVD	Digital Video Disc
ESL	English as Second Language
HoA	House of Assembly
HSRC	Human Sciences Research Council
L1	First language
L2	Second language
LiEP	Language in Education Policy
LoLT	Language of Learning and Teaching
LTSM	Learning and Teaching Study Material
MT	Mother Tongue
PANSALB	Pan South African Language Board
SASA	South African Schools Act
TIMSS	Trends in International Mathematics and Science
VTC	Vaal Triangle Campus

Chapter 1: General Introduction

1.1 Introduction and research questions

There is a culture of poor performance in physical science in South African schools according to the Trends in International Mathematics and Science Study (TIMSS) of 1999 and 2003. The 2003 TIMSS report indicates that there was a substantial difference in science achievement between the highest and the lowest performing countries, from an average of 578 for Singapore to 244 for South Africa. It concludes that of the five lowest performing countries, the performance of South Africa's learners was the lowest Human Sciences Research Council (HSRC 2006:3). An analysis of the achievement scores categorised by pre-1994 Departments of Education (DoE) in South Africa indicates that ex-DET (Department of Education and Training) schools fared the worst and the ex-HoA (House of Assembly) schools' average was just above the international average (HSRC, 2006:63). South Africa's bottom ranking in this and other international tests is also lamented by Pretorius (2010) in her keynote address at the 2010 joint conference of linguists and language teachers in South Africa.

The above-mentioned report on TIMSS results examines several factors responsible for this poor performance by learners from South Africa. According to Reddy *et al.* (2003:2), factors such as curriculum, poverty, infrastructure of schools, low teacher qualifications, poor learning cultures in schools and language proficiency are contributory factors. The report states that learners who took the test on science in their home language achieved an average score of 370, which would have placed them above the score of Botswana on the international table, but those learners who took the test in English (where English was not the first language of the learner), did much worse. This report concludes by saying that it is difficult to determine the extent of the influence of the language of test on results, as there are other inequalities among the different school types and these also influence performance (for example socio-economic status). Deliberating upon similar results of the 1999 TIMSS tests, Reddy *et al.* (2003) of the HSRC point out that the results achieved by South African participants showed a skewed distribution of scores with many low scores and very few high scores. Reddy *et al.* (2003) observe that learners who took the tests in Afrikaans scored higher than learners who took the tests in English. They attributed these differences in results to the many inequalities which still exist among the people in South

Africa, where among other differences, Afrikaans-speaking as well as English-speaking learners are privileged to use their home language at school and even university, while for many other children in South Africa this is not the case. Probyn (2003:3) makes the following important observation about the comprehension of pupils who learn mathematics and science in the second language:

In particular, pupils who study mathematics and science in their second language tend to have difficulty articulating their answers to open-ended questions and apparently had trouble comprehending several of the questions.

A 2010 report by the Council on Higher Education (CHE) similarly emphasises the importance of language as mediating factor that influences academic performance of students at universities in South Africa (CHE, 2010:182).

Findings such as those from the TIMSS and CHE (2010) reports raise the issue that the use of an additional language as medium of learning and teaching could contribute to academic underachievement in science in South Africa. Conversely, it also raises the question about the potential contribution that use of the mother tongue could have in improving comprehension in science in South Africa.

1.2 Problem statement

It has been observed that it is difficult, and even almost impossible, to implement the policy of mother-tongue teaching in ex-DET schools despite the perceived benefits that such a policy could bring to these learners. There are many reasons for this state of affairs. De Klerk (2002), for example, has observed that African parents object to accommodating any African languages as languages of learning and teaching when she researched ex-Model C schools. Ex-DET schools where this policy could potentially be implemented with more ease due to the presence of teachers who are speakers of African languages, are under-resourced, overcrowded and have impoverished curriculums (De Klerk, 2002:3), despite attempts by the Department of Education to achieve equity of provision nationally. Parents therefore prefer to send their children to English schools (some ex-Model C schools) where the language of learning and teaching (LoLT) is English. Granville *et al.* (1997:8) also discovered that black South African parents believe that

English has material power, while Brock-Utne and Holmarsdottir (2003:7) have identified, among others, the lack African language speaking teachers in some disciplines to promote African languages as a factor as well. More recently, Beukes (2009:45-46) explained the incongruity between the multilingual language policies in South African education and the lack of implementation in schools as a result of a particular linguistic culture among African parents. African parents seem to maintain that their children know African languages and should therefore proceed to learn English and learn in English at school (Beukes, 2009:46). For these and other reasons, this study among other solutions will try and explore the possibility of implementing the policy of multilingualism by implementing the recommendation of Granville *et al.* (1997:13) that the language of power (English) should be preserved, while another language, preferably a mother tongue, should also be used to advance teaching and learning.

One way of implementing the latter proposed strategy could be to use mother-tongue subtitling for students of the ex-DET schools whose LoLT is English at second language level, while their mother tongue is any of the nine vernacular languages. Mother-tongue subtitling could be used very effectively in this context by assisting learners to comprehend learning material better.

There is a paucity of studies on mother-tongue subtitling in education. The scarcity of research that focuses on subtitling (including mother-tongue subtitling) in South African education is discussed comprehensively in Kruger *et al.* (2003:15). Kruger *et al.* are of the opinion that the use of subtitling in education in South Africa (and research on its impact on education) is still in its infancy. Although this statement was made nearly a decade ago, the situation has remained largely unchanged. The aim of this study is to contribute to the hopefully growing body of knowledge on mother-tongue subtitling in education in South Africa.

Globally, the use of subtitling in education is reported primarily in contexts where it is used as a supporting tool to help learners with special needs to overcome barriers in education. The majority of the research conducted in this context refers to deaf or hard-of-hearing learners and how subtitling is used to support their teaching and learning. For example, Neuman and Koskinen (1992:96) state that special electronic “telecaptioning” was originally developed for the hearing impaired. The initial focus of global studies in the use of subtitling was in the context of special needs in education. More recently, subtitling has become an increasingly important

application in the fields of educational psychology and multimedia design. Currently, research on subtitling in general covers a wider scope depending on the purpose of the development of subtitles. Subtitles are used in the field of entertainment and in education at different levels. Subtitling could be classified as same-language subtitling (also known as intralingual subtitling, monolingual subtitling or captioning), which is usually intended for the hard-of-hearing audience. It can also be classified as translation subtitling (also known as interlingual subtitling). There are two types of subtitling, such as mother-tongue subtitling, second language subtitling, or any other language type subtitling. The focus of this study is on mother-tongue subtitling in physical science education at secondary school level.

Based on the studies examined for this research, the following divisions of characteristics have been identified as benefiting learners' comprehension through captioning and subtitling:

- Visualisation: It assists visualisation of challenging science concepts (Kumar & Scarola, 2006:2).
- Comprehension: It could be used to close the gap between the development of abilities in reading comprehension and listening comprehension for university students (Garza, 1991), and it enhances reading projection (Markham & Peter, 2003; Markham *et al.*, 2001).
- Listening comprehension: It improves listening comprehension and facilitates word learning and comprehension (Bird & Williams, 2002); and it enhances second language listening (Markham & Peter, 2003; Markham, 1999; Thorn & Williams, 2003; Markham, 1999:1).
- Proficiency: It improves language proficiency (Cardillo, 1997).
- Learning and teaching: It helps a learner to focus on central elements (Linebarger, 2001:288).

All of the above mentioned characteristics emanating from subtitling have impact on comprehension. Visualisation means forming image in the mind and images formed in the mind help comprehension. According to the first characteristic mentioned here, subtitling assists visualization of challenging science concepts. This characteristic becomes relevant to the subject

dealt with in this study. This study would like to tap from this characteristic in order to explore the possibility of subtitling producing even better results for the purpose of this study.

In terms of comprehension as stated in the second characteristic, subtitling can be used to close the gap between the development of abilities in reading comprehension and listening comprehension for university students. This benefit can be exploited for the purpose of this study and learners. In this study we have school learners and not university students, but Grade 12 learners are not significantly different from school learners.

Apart from listening comprehension, the third characteristic emphasises that subtitling also facilitates word learning. Word learning is important for comprehension. Since the experiment will be running for six different days, observation could be made about how this trend will affect the study.

The fourth characteristic says subtitling improves language proficiency. The aim of this study is not to explore proficiency as improved by subtitling. Provision is not even made in this study to evaluate if mother-tongue subtitling will improve learners proficiency at the end.

The fifth characteristic states that subtitling helps a learner to focus on central elements. This could be one of the characteristics that assist comprehension. This could also be one of the factors which need to be exploited in order to entrench subtitling.

This study faces a challenge of distinguishing itself from other similar studies. For this reason it is important to point out the differences that exist between itself and other studies. The differences between this study and other studies are that: this study involves mother-tongue subtitling, where the mother tongue is Sesotho; whereas other studies might have measured the potential of subtitling to improve comprehension, this study measures it under different demographic conditions as described earlier and later under the research aims; and lastly, the aim of this study as opposed to the objectives of other studies is to investigate the ineffectiveness of mother-tongue subtitling in improving the comprehension of Grade 12 pupils in physical science as one way of implementing the multilingual Language in Education Policy (LiEP) in South Africa.

With its careful structuring of the physical science tests applied after each video session to reflect achievement in lower- and higher-order comprehension skills, and the careful structured ordinary comprehension tests, as well as carefully thought questionnaires this study hopes to advance the knowledge in the field by providing answers to specific questions, such as:

- What is the level of comprehension of physical science of the participants who learn via English additional language?
- Would an intervention where mother-tongue subtitling is used in an experimental setting improve the comprehension of physical science for participating learners?
- Based on the results of this study, what recommendations could be made to assist secondary schools with the implementation of mother-tongue subtitling aimed at improving comprehension in physical science ?

1.3 Research aims

Based on the findings in the TIMSS report, and speculation by analysts on the potential influence of the language of testing, teaching and learning on the results, this study investigates the possible influence of the use of mother-tongue subtitling in improving comprehension in physical science in secondary education, with a focus on Grade 12 learners. Subsequent to the above focus this study will explore the potential role of the LoLT in improving the understanding of physical science. It explores the use of technology in the form of subtitling in this process. This study is aimed at Grade 12 learners whose home language is Sesotho and who use English as a LoLT. In other words, English is learned and used as an additional language by these learners. According to the LiEP (South Africa, 1997), these learners used Sesotho as the LoLT during the first three years of their schooling, and English was taught from Grade 3 onwards. In Grade 4, English became the LoLT for these learners. Grade 12 learners have therefore used English as the LoLT for eight years when they enter Grade 12. The learners who participated in this study were from the same group, which is referred to as the ex-DET group in the TIMSS study discussed above.

Within the context of the language in education policies that influenced the choices of languages of learning and teaching for these learners, this study goes on to examine the extent to which

mother-tongue subtitling can improve the comprehension of physical science of these learners. The study thus includes a discussion of various language in education policies as well as related theories of language and comprehension.

The research aims in this study therefore are to:

- determine the level of comprehension of physical science of the participants who learn in English as an additional language;
- determine the potential of mother-tongue subtitling to improve the comprehension of physical science for participating learners by implementing an intervention where mother-tongue subtitling is used in an experimental setting;
- provide recommendations that could assist secondary schools with the implementation of mother-tongue subtitling with the aim of improving comprehension in physical science .

1.4 Hypothesis

The central theoretical statement or hypothesis of the study is, mother-tongue subtitling will improve comprehension of physical science in secondary education in South Africa, particularly for learners who use English as the LoLT.

1.5 Method of investigation

1.5.1 Analysis of the literature

This study examines the literature that deals with some of the following key areas related to the study.

Language policies: The relevant LiEP policy (South Africa, 1997) and other education policies for South African secondary school education will be studied and evaluated to see what they recommend in terms of the use of the mother tongue as the LoLT. The planned intervention in this study using mother-tongue subtitling in physical science in secondary education to improve comprehension will be contextualised within this policy framework.

Psycholinguistic theories: Certain psycholinguists and educationists believe that learning in one's mother tongue is beneficial. Special attention is therefore paid to the benefit of using

mother tongue comprehension. The study includes an overview of the relevant literature on the use of the mother tongue in education and focuses on the use of mother-tongue subtitling as a possible way in which mother tongue learning (because learning in one's mother tongue is easier) could be implemented to benefit learners forced by otherwise difficult circumstances to use an additional language as the LoLT.

Comprehension theories: The study includes an overview of the most prominent comprehension theories with the specific aim of guiding the design of the evaluation instruments used to measure the influence of mother-tongue subtitling on the comprehension of physical science in this investigation. It is also used to indicate the need for successful comprehension for better physical science content results.

The notion that comprehension through the mother tongue is better than comprehension through an additional language is also evaluated in this study. Scholars such as Henning *et al.* (2001:109) support this idea by indicating that students' use of their primary language and early life experiences can serve as an anchor for understanding challenging academic concepts. Other literature which supports this notion is also examined.

Mother-tongue subtitling: Research supports the notion that subtitling has the ability to improve comprehension in certain circumstances. For example, in a study by Kruger *et al.* (2003), it was found that subtitling of English visual material into English improved comprehension to a greater extent than subtitling of English visual material into Sesotho, but that subtitling of Sesotho visual material into Sesotho improved the comprehension of abstract information and the information requiring interpretation to a certain degree. This study attempts to clarify understanding of the way in which mother-tongue subtitling aids comprehension.

1.5.2 Empirical investigation

Design and variables: The results of this study will also be able to reveal the potential relationship (correlation) between language and comprehension of physical science through subtitling. The dependent variable is comprehension of physical science concepts presented in the videos and the independent variables included in the study are the different treatments related to subtitling used in the study. The control group watched the science videos without subtitles, and the experimental group watched the same science videos with Sesotho (mother-tongue)

subtitles. However, in the study of this nature, one also has to control that the experimental and the control groups display similar characteristics with regard to identified elements that could potentially explain the difference between the scores related to the dependent variable. If one does not control for the “equivalent distribution” of identified characteristics among the control and the experimental, it is possible that the effect of the independent variables (difference in treatment in this case) could be explained by confounding variables. In this study, care was taken to ensure that the following potential confounding variables were distributed equally among the control and the experimental groups of participants: Sesotho language proficiency, English language proficiency, general academic achievement at school, socio-economic status, interest in science subjects in general, and general commitment to school. Measures that gauge the distribution and nature of the potential influence of all these confounding independent variables listed above are included in the study with the aim of accounting for their influence via appropriate statistical tests such as t-tests, analysis of variance (ANOVA) calculations and Pearson product moment correlations (where applicable). The continuous assessment scores of learners for their Grade 11 year were used as an indicator of their level of physical science comprehension before the intervention. The physical science tests used during the intervention were used to gauge comprehension of the physical science video material used. The statistical analyses are explained below.

Population: In this study, the full population of 96 Grade 12 learners taken from two participating ex-DET schools from the same township participated in the study. The participating schools were identified on the following grounds: the LoLT at the school is English and English is used as an additional language, and the dominant mother tongue of learners at the schools is Sesotho. All the participating learners use Sesotho as a mother tongue. The 89 learners who made up the population of research participants were selected in the following manner: a population (Mugo, 2010:6) of all Grade 12 learners doing Physical Science as a subject at selected schools were used. Each of these learners was randomly allocated to one of the two groups formed. Numbers were written on pieces of paper and folded. Learners who chose the top half of the numbers were allocated to the first group and learners who chose the bottom half of the numbers were allocated to the second group. The first group was the control group and the second group was the experimental group. Using learners from only two ex-DET

schools limited the generalisation of findings to the entire school population with similar characteristics, but in an exploratory study of this nature, this is not regarded as problematic. No previous study of this nature was found. This is therefore a truly exploratory study which aimed at determining whether this type of intervention is useful as a possible support mechanism to assist Grade 12 physical science learners to comprehend the subject better.

Pre-test instruments: Background information about the participating students was gathered by means of a questionnaire with several sections before commencement of the experiment. The first section contained a comprehensive biographical survey that provided information about the students' use of languages, their perceptions of their language proficiencies, and their socio-economic status. A second section of the questionnaire surveyed the participants' exposure to, familiarity with, and attitudes towards subtitled TV. A third section of this questionnaire surveyed participants' attitudes towards science as a school subject, based on the standardised questionnaire developed by Wise (1985) where attitudes towards Statistics are assessed. Students were expected to take about 30 minutes to complete this questionnaire.

Pre-knowledge of science: The participants' Physical Science Continuous Assessment results were used to determine their pre-knowledge of Science. This data was used later for the analysis of factors that might have influenced the results.

Comprehension test: A comprehension test in Sesotho and English was conducted to obtain an additional measure of the participant's Sesotho and English reading comprehension skills and was different from the video material. English and Sesotho versions of the test were ordered with Sesotho and English versions in consecutive order and distributed in this manner to the participating learners. In this way a random distribution of Sesotho and English comprehension tests was obtained. All the principles of comprehension test skills as set out theoretically in the literature were followed to ensure that the comprehension test was a sensible indicator of the participating learners' comprehension of a passage in Sesotho and English. The tests took about 30 minutes each. The total test time for all pre-test exercises was 60 minutes which was done in one sitting with a break of 15 minutes in the middle.

Apart from the instruments discussed in the description of the pre-test, the following indicators were used to investigate the potential influence of mother-tongue subtitling on comprehension of

physical science: final school marks for the previous year for Sesotho and English were used as indicators of language proficiency, and the final school marks for physical science for the previous year were used as an indicator of the comprehension of physical science in this study.

It should be noted that school achievement marks is an indicator of curriculum achievement and not necessarily an indicator of proficiency in a learning area. Unfortunately, there is at present no instrument available for measuring Sesotho language proficiency. That is why a self-designed Sesotho reading comprehension test formed part of the pre-tests. This at least provided an indicator of the participants' reading comprehension in Sesotho (and English) in general.

Procedures for gathering data: The two groups of learners (the control group and the experimental group) of 48 each who were selected to participate in the study wrote the above pre-test on a specific date. Great care was taken to arrange this session and the following sessions of the experiment after school. Two weeks after that date, the first intervention took place. Each of the six interventions contained the following procedures:

- a) Both groups watched the video. The control group watched six videos (over a period of six weeks) with material related to the Grade 12 Physical Science curriculum without subtitles and an experimental group watched the same videos (over a period of 6 weeks) with Sesotho subtitles.
- b) After watching the respective videos, the participants wrote the same physical science test based on the physical science content subject material presented in the video they watched as post-test.

This procedure was repeated over a period of six weeks. Each video ran for about twenty minutes and a physical science test was written on the material presented in the video. One experiment was done each week until the end of the research. The same group of learners was used to ensure the reliability of the research, but a different theme was dealt with each week.

Pilot study: A pilot study was conducted among the Grade 12 learners of physical science at a comparable school. The pilot study results were used to finalise the measuring instruments.

Ethical aspects: All the participating learners and their parents were informed about the nature of the study. Both parents and learners were asked to sign informed consent forms (see

Appendix A and Appendix B). Permission to undertake the study at a selected site was also sought from the provincial department of education, as per departmental protocol; and the principal of the school was also asked for permission (see Appendix C). The same was done for the control group later so as to afford them the same benefits of the experiment.

The consent letters contained a clause advising participants of their right to withdraw from the study at any given point. All the participants therefore took part in the experiment of their own free will.

1.6 Value of the study

The value of this study is that it attempts to provide a solution to the implementation of African languages in physical science at secondary schools via mother-tongue subtitling. The exploration of the potential of African languages subtitles to improve physical science education is very important in a context where the attitudes of parents of African language speakers clearly indicate their preference for the use of English as the LoLT, despite findings that mother tongue teaching is generally accepted as a more effective medium for education. Parents might embrace the use of mother-tongue subtitling within the context of English as the LoLT more easily than accepting the idea of using Sesotho exclusively as the LoLT. Furthermore, learners who have access to Sesotho (mother tongue) subtitles might benefit from the exposure, and this may contribute to a change in their attitudes over time towards the use of Sesotho in physical science teaching.

1.7 Chapter preview

In Chapter 2, a literature survey on the themes related to the study (noted above) is presented. The empirical investigation is discussed in Chapter 3 and the results are presented in Chapter 4. In Chapter 5, the results are discussed and interpreted, and Chapter 6 gives the conclusion and recommendations.

Chapter 2: Literature Survey

2.1 Introduction

This chapter explores literature that supports the aims of this research as set out in the first chapter of this work. The aim of Chapter 1, broadly speaking, was two-fold: to review psycholinguistic ideas that consider the extent to which MT subtitling can improve the comprehension of physical science and it is socio-political in its consideration of ideas that could assist with the implementation of language in education policy by using mother-tongue subtitling in former Department of Education and Training schools (DET) (see Chapter 1, Section 1.3). In Chapter 2, the main aim is to explore the literature related to the issues of interest in the study. This includes an exploration of literature on: education policies that guide the language policies for different schools; psycholinguistic theories of subtitling; comprehension in subtitling; mother-tongue subtitling as opposed to English subtitling where the mother tongue of viewers is a language other than English; and lastly the extent to which subtitling is used in education.

National educational policies are based on the South African Constitution (South Africa, 1996b) and the national educational policies that direct specific language policies at different schools that will be explored in this chapter are the South African Schools Act 84 of 1996 (SASA), the LiEP (South Africa, 1997), and the Pan South African Language Board 59 Act of 1995 (PANSALB). It should be noted, however, that South Africa has many language policy implementing structures such as school management teams (SMT's), School Governing bodies (SGB's) that have an impact on language policy formation that will be mentioned further on. This chapter will outline the manner in which these policies create opportunities for the implementation of language strategies such as the one proposed in this work.

Literature on psycholinguistic theories will be discussed in this chapter to determine whether subtitling is potentially beneficial for the envisaged strategy of this work. The literature will reveal detail of what happens in the cognitive domain when one is using subtitling as a learning strategy in education. The literature will also reveal the extent of research already done on psycholinguistic theories and subtitling.

Literature on comprehension will elucidate the importance of comprehension in physical science and how this concept should be integrated in a study of this nature. It will also define comprehension in the context of subtitling as used in this study.

Literature on mother tongue learning will be discussed in relation to mother-tongue subtitling. The literature will be used to define the concept of mother-tongue subtitling within the broad domain of subtitling and the widely used idea of English subtitling and its benefits in education.

Literature on the scope of subtitling in education will be used to define the importance of subtitling in education. The literature will indicate major areas already covered by the strategy of subtitling all over the world and its benefits to education. It will also be used to identify areas related to subtitling and education that needs development as well as the identification of opportunities which are open for further research in education and subtitling.

Lastly, a synthesis of information from the literature discussed above will be compiled. In this synthesis various ideas outlined in this chapter will be put into perspective from a mother-tongue subtitling point of view.

2.2 Language policies

The manner in which South African language policies are implemented has led to conditions that negatively affect learners' academic performance. In this section, I will examine literature that supports the notion that such conditions exist and show how it reveals the necessity for this study. This study attempts to indicate that the situation created by the failure to implement language policies properly in South African schools has led to a situation in which coping strategies such as the one proposed by this study have become necessary.

South African language policy in general is described "as clear and progressive" by some sources (Brock-Utne & Holmarsdottir, 2003:1). Certain sources claim that it is exemplary, progressive and enabling (Beukes, 2009:35, 37). One of the reasons why it is considered as such is because almost all the languages spoken in South Africa are considered to be official and equal. There are eleven official languages according to section 6(1) the constitution (South Africa, 1996b). The eleven languages that are regarded as official are the following: Sepedi,

Sesotho, Setswana, SiSwati, Tshivenda, Xitsonga, Afrikaans, English, isiNdebele, isiXhosa and isiZulu, and “subsection 5 for the creation of the Pan South African Language Board promotes and creates conditions for the development and use of all official languages; the Khoi, Nama and San languages; and sign language” (Brock-Utne & Holmarsdottir, 2003:6). In addition to the above-mentioned reason, “South Africa boasts a wide range of language policy implementation structures, namely the Pan South African Language Board, key service delivery departments, and a national forum” (Beukes, 2009:41). Based on the National Education Policy Act 27 of 1996 (South Africa, 1996a), the LiEP grants schools, parents and learners the freedom to choose a language of learning and teaching for themselves, but the practice is that English is used as the LoLT from Grade 4 upwards in the former DET schools. In practice, parents and learners do not use their freedom to choose an African language as the language in which they would like to be taught according to the policy (Brock-Utne & Holmarsdottir, 2003a:6). “This transition policy, to use English as language of learning and teaching from Grade 4,” according to Brock-Utne and Holmarsdottir (2003a:6) is, however, “only a policy decided by individual schools and reflects the actual 1979 apartheid language policy”. Norms and Standards of policy implementation help to assist schools to apply the LiEP. This Norms and Standards policy are communicated to schools through provincial departments of education. School governing bodies are now responsible for decisions about the formulation of language policies for schools (Van Wyk, 2004:1), but these governing bodies’ decisions are dictated by the norms and standards policies of provincial structures. This scenario has created two curious repercussions for education in South Africa which are related to the aim of this study.

Based on the content of the policies cited above, the first repercussion is that it was expected that from 1996 onwards indigenous African languages would be selected as the LoLTs at schools, and that this decision would lead to the development of these languages and ultimately benefit learners. Benefits which learners would have derived would have been improved quality of teaching and learning brought about by being taught in their own mother tongue. These benefits will be discussed later on in this chapter. One would have expected that the LoLT at former DET schools would change to indigenous African languages, thereby developing them. One would have expected that provincial departments of education which came to be headed by members of

a party entrenched in African ideology would be able to promote indigenous African languages to the status of languages of learning and teaching, but to this date, this expectation has not been realised. Then, when the powers to formulate language policies for schools were transferred to school governing bodies, it was expected that finally this goal (the selection of appropriate African languages as LoLTs) would have been achieved, but this did not materialise. Instead, a new unexpected trend developed in these schools as well as other schools such as former model C schools and private schools.

English remained the most preferred LoLT in former DET schools. English continued to be taught at a second language level, thereby enjoying first additional language status according to the most recent curriculum. For many of the former DET schools this situation implied that learners would write their examinations in English in all subjects other than languages once they had passed Grade 3 according to language policies of most former DET schools. This is put into practice irrespective that the concept of the generic curriculum statement for First Additional Language itself is problematic and flawed in various areas. It is flawed because it is based on an Anglo-American English teaching model. This point is raised clearly by Van der Walt *et al.* (2011:325), quoting Coetzee-Van Rooy (2006:447), when she indicates that it is wrong to assume that South African learners' identities develop from a monolingual first language speaker through an interim bilingual phase towards the stable final state of a monolingual second language speaker. This reliance on the Anglo-American teaching model does not take into account the element of additional language teaching in a context where the additional language is used as the medium of instruction. It is difficult for learners to write their personal thoughts in a First Additional Language (Van der Walt *et al.*, 2011:327). Therefore First Additional language as a LoLT is not effective for our schools.

Because indigenous African languages are not used for tuition in other subjects, this has a negative impact on learners' academic performance (Meier, 2005:170). It has been observed by researchers that although English is used as a LoLT in the former DET schools, learners from these schools are not proficient enough in English to attain higher levels of academic performance (Beukes, 2009:37). Their failure to achieve outcomes set at school level is often reflected in their examination results. English is in fact considered to be a barrier to knowledge

acquisition to some learners at these schools, according to scholars such as Brock-Utne and Holmarsdottir (2003a:13). In their research on Grade 4 learners in a research project focusing on language policies in Xhosa schools in South Africa, Brock-Utne and Holmarsdottir found that teachers code-switch and code-mix to try and address the issue of lack of English language proficiency in a mathematics class (Brock-Utne & Holmarsdottir, 2003a:11-12).

Another study by Brock-Utne *et al.*, (2010) discovered that Grade 4 and Grade 7 learners from former DET schools could not express themselves in English or in isiXhosa. This study was conducted in schools where English was introduced as a LoLT from Grade 5 to Grade 6 (Brock-Utne *et al.*, 2010:12). It must be stated here that the decision to formulate a language policy that determined the use of English as a LoLT was taken by the staff of the school to prevent the school from losing learners to coloured schools that used English as a LoLT in the same area. The results discussed in the study by Brock-Utne *et al.*, (2010) indicated that when texts were compared that were written by the same learners both in English and isiXhosa, fewer than 50% of them were able to complete the task successfully in English, while all the participating learners (24) fared reasonably well when they had to complete an isiXhosa narrative. This trend was observed by other researchers and some examples of their results are discussed below.

The study by Henning (1993) on the concept of “light”, for example, revealed that English Second Language (ESL) pupils who had been educated through the medium of English from former DET schools were linguistically unable to successfully access the code of a conventional culture of science learning (Henning, 1993:86). She goes on to show that her population was limited in terms of communication skills. She says that “the problem was exacerbated by the fact that the first language of these pupils is structurally not always compatible with the morphological, lexical and syntactical structures of English” (Henning, 1993:89). This is another indication that second language learning restricts learner academic achievement.

Lack of academic performance according to De Klerk (2002), among other factors, in former DET schools led some parents to remove their children from these schools and place them in former model C and private schools. De Klerk (2002) embarked upon a study that investigated the reasons why parents placed their children in former model C and private schools and came up

with reasons for this trend. One of the strongest reasons for doing so was that they could acquire better English proficiency (De Klerk, 2002:6). Explaining why they had chosen an English school for their children, 51% of the respondents referred to the benefits that can be derived from English (De Klerk, 2002:2). Beukes (2009:46) quotes the motivation for selecting English as the LoLT from as early as possible in school expressed by an isiZulu parent (in a study conducted by Murray (2002)) as follows:

By school-going age a child is already a fluent speaker of Zulu ... so there is no need for that child to dance on spot ... that child must learn English and be taught in English.

This “linguistic culture” issue (Beukes, 2009:45) features prominently in discussions about LoLT for learners who use an African language as mother tongue.

The 1997 LiEP allowed more African language-speaking learners to move to former model C schools. Some researchers have observed that former model C and private schools came to experience language needs similar to that of the former DET schools in the post-1994 dispensation (Meier, 2005:170). There has been an influx of learners to the former model C and private schools (Kamwangamalu, 2001:367) during this dispensation. The literature indicates that parents preferred to send their children to former model C and private schools to get the best education which such schools could offer. Most of the learners from African language-speaking backgrounds faced challenges similar to those faced by learners in former DET schools. According to Meier’s study,

some of the black learners who were accepted into formerly white schools found it very difficult to adjust to the new educational environment because they lacked the language skills and required background knowledge to deal with the curriculum content and medium of instruction (Afrikaans and/or English) used in formerly white schools (Meier, 2005:170).

The two above-mentioned trends (the use of English as the LoLT, knowing that experts are of the opinion that it inhibits access to learning and teaching in schools, and the insistence of parents on the use of English as the LoLT) are made possible by the language policy

arrangements for schools in South Africa. Meier (2005:170) states that sometimes an interpreter is needed to explain to black learners in their mother tongue (an indigenous African language) what the teacher is saying. Brock-Utne and Holmarsdottir (2003:1) mention translations, code-mixing and code-switching as coping strategies for helping learners who are not fully proficient in English to improve their academic performance in former DET schools.

It has been discovered from the literature that mother tongue learning and teaching is a hotly contested issue (cf. Beukes (2009) (quoting Heugh, 2000; Murray, 2002; Wolff, 2005). Brock-Utne and Holmarsdottir point out that certain authors cite negative attitudes on the part of the speakers of African languages as the major obstacle in promoting African languages; other authors cite insufficient learning and teaching materials in African languages (Brck-Utne & Holmarsdottir, 2003:7). Closely related to the issue of attitudes towards indigenous African languages is the observation that was made by Kamwangamalu (2010:427) that urban African language speakers prefer English over indigenous African languages and that they use African languages only when communicating with neighbours and older members of the family. This is an indication, according to Kamwangamalu that indigenous African languages do not find support from urban African speakers and they are still far from being established as a LoLT in schools. A report that was submitted to the Minister of Education in 2003 on the development of African languages as a medium of instruction for higher education painted a bleak picture of the future of African languages if this approach prevails (Beukes, 2009:44). This issue has still not been resolved and working solutions to the prevailing practice of selecting English as the LoLT must be explored.

Based on the contents of the LiEP of South Africa (South Africa, 1997), it seems impossible that English, and to an extent Afrikaans, will be challenged as the sole media of instruction in education at this moment. The language policy dispensations in South Africa clearly indicate that all languages should receive equal treatment. The core characteristics of these policy arrangements according to Barnes (2012:50) are flexibility, freedom of choice, equity and practicability. It might be precisely the flexibility of the language policy arrangements that has led to the lack of implementation of African languages as widely used languages of teaching and

learning in South Africa (noted by scholars such as (Du Plessis, 2000; Beukes, 2009; Webb, 1999).

Based on the variety of languages used in South Africa, it is a great challenge for policy makers to decide on the implementation of a functional language policy for all the country's people. As already stated in the beginning of this chapter, the education language policy of South Africa is commended for its outstanding features such as its flexibility and respect for the equality of languages. The contents of the LiEP of South Africa (South Africa, 1997) should result in the promotion of additive multilingualism (Kamwangamalu, 2010:428). This implies maintaining home languages while providing access to and the effective acquisition of additional languages (Kamwangamalu, 2010:410). In reality, English is being used increasingly as the LoLT, whereas African languages are not being selected as the LoLT and therefore are not being developed to serve higher-level functions in South Africa.

The aim of this study as mentioned is to investigate the usefulness of mother-tongue subtitling as one option to assist in the implementation of a LiEP that aims at the promotion of additive multilingualism. The LiEP supports the notion that an additional language (such as English) could be used to help understanding in the classroom, provided that language is not used at the expense of the home language, because that would lead to subtractive bilingualism. The literature review of the LiEP in South Africa revealed that the ideal of the policy has not been achieved at all. It seems that schools in different contexts struggle to support the use of African languages as LoLTs and adding of English as an important additional language, because parents insist on the use of English as the LoLT as soon as possible in the school. From the literature survey it is clear that all types of schools in South Africa need a strategy to enable the use of the African language as the LoLT, because the community and the parents do not request it. The strategy proposed in this study is to use the mother tongue via subtitling to complement teaching and learning in English to assist learners to comprehend such as physical science. The results of this study provide some information about the feasibility of this proposal as a supportive measure to implement an additive multilingual LiEP in South Africa.

2.3 Psycholinguistic theories

In this section literature related to the cognitive processes involved in understanding subtitled material will be examined. Explanations based on psycholinguistic theories will be presented to focus attention on the relationship between physical science comprehension and the potential of mother-tongue subtitling to improve learners' understanding. The review of the relevant literature should reveal the extent to which mother-tongue subtitling could be beneficial to physical science comprehension.

In order to understand the above expectations, one has to understand the cognitive processes of comprehension in subtitling. Comprehension is normally part of the so-called cognitive processes of the revised Bloom's taxonomy (Krathwohl, 2002:218). This revised taxonomy is divided into two processes, namely the Knowledge processes and Cognitive processes. The first cluster of cognitive functions is often referred to as simply the domain of "remembering" and the second cluster of cognitive functions is referred to as the domain of "understanding". The objective of knowledge is based on these dimensions, and every other cognitive process that is discussed here is based on the fundamental distinction between these two broad clusters of cognitive functions as they appear in the revised taxonomy of Bloom.

Knowledge and comprehension are processed as part of "remembering" in the domain of memory. Memory is divided into three types according to this theory: sensory memory, working memory and long-term memory. Knowledge is received through the senses and carried into the memory. Several senses receive different kinds of knowledge through different channels on a continuous basis. These channels might be visual-pictorial and auditory-verbal in nature (Mayer, 2002:60). This knowledge enters the cognitive system in various forms and is processed in its own channel before it is "uploaded" into its relevant memory type. The first memory type in which knowledge is cognitively processed is the sensory memory, then the working memory, and lastly the long-term memory. The cognitive theory helps us to understand how we can make best use of the different types of memories that we have access to and this information is useful to educationists because it helps us to direct and control learning.

The notion of memory has been discussed in the context of the use of multimedia and subtitling and the outcomes thereof on learning. Mayer (2002:60) identifies three theory-based assumptions that are important for my study. These are the dual channel assumption, the limited capacity assumption and the active processing assumption. According to the dual channel assumption, both the visual-pictorial and the auditory-verbal channels process knowledge that enters through the eyes and the ears respectively. According to the limited capacity assumption, every channel has a limited capacity for holding and manipulating knowledge, and according to the active processing assumption learning occurs when learners engage in active processing within the channels, including selecting relevant words and pictures, organising them into coherent pictorial and verbal models, and integrating them with each other and appropriate prior knowledge (Mayer, 2002:60). As knowledge processing in subtitling is a multimedia activity, these principles have certain implications for this study. This leads us to ask whether subtitling with its different representations of knowledge is not having either negative or positive results.

When one examines the knowledge conveyed through mother-tongue subtitling, one discovers that in terms of the dual channel assumption it should benefit learners because they receive the knowledge through several channels of cognitive processing. This is a strategy opposite to that used in traditional ways of spreading knowledge. Traditionally, knowledge is mostly spread by means of verbal modes of instruction. According to Mayer, verbal modes of instruction are based on words and include spoken text (Mayer, 2002:61). Mother-tongue subtitling combines the two modes of instruction: it includes both the verbal and the pictorial modes of instruction. Pictorial modes of instruction are based on pictures and static and dynamic graphics, according to Mayer, (2002:61).

In order to clarify the above-mentioned assumptions, which are related to the definition of cognitive processing of knowledge, Figure 1 below, which is a combination of similar figures by Mayer (2002:61) and Van der Walt *et al.* (2011:8) is suggested for the purpose of this study:

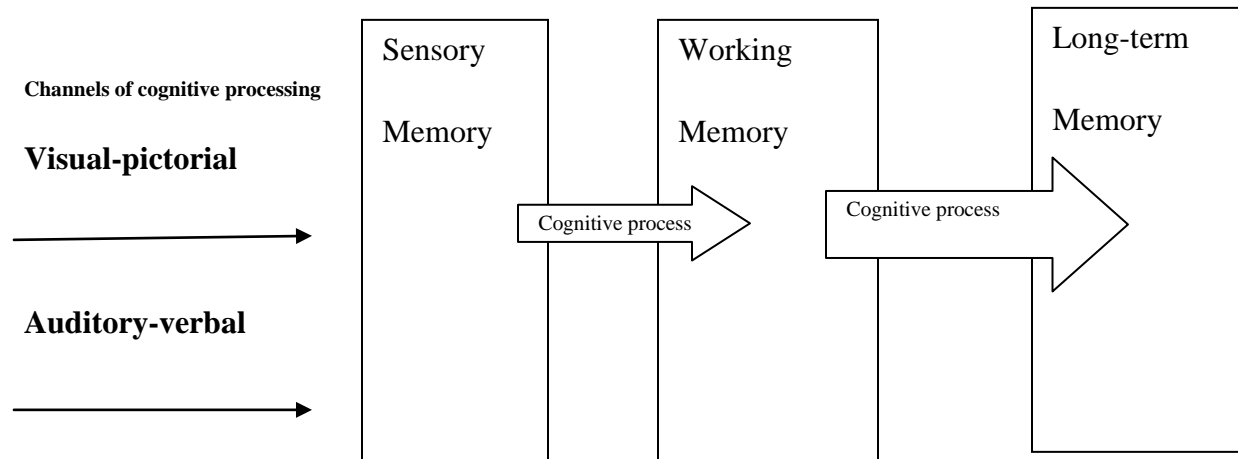


Figure 1: Representation of cognitive processing of knowledge

Apart from the above explanations of cognitive theory assumptions, we also have access to the cognitive theory of multimedia learning principles which we can use to understand how learning occurs in multimedia. When we understand this theory, we will also be in a better position to determine the extent to which mother-tongue subtitling assists learning.

There is a contradiction between the common sense view of learning and the cognitive theory of multimedia learning (Mayer, 2002:61). The common sense view says that learners who receive verbal information in the form of narration will perform in a test like learners who receive multimedia explanations in the form of narration and concurrent animation. The reason given for this is that both learning situations carry the same information and redundancy occurs. The cognitive theory of multimedia says that learners who receive knowledge through explanation in the form of narration and concurrent animation will do better in a test. The reason for this, according to Mayer (2002:62), is because the multimedia presentation encourages the learner to build a pictorial mental model and to connect it mentally with the verbal mental model.

The outcome of a multimedia presentation was envisaged when the decision to embark upon this study was taken. The expectation was that since mother-tongue subtitling also includes multimedia presentation in the form of text on a screen, it was likely to improve the

comprehension of learners in physical science. This implication of cognitive theory, combined with the advantages of mother tongue learning theory, raised the expectation that learner performance in physical science would improve.

Multimedia learning is also described in terms of the contiguity principle (Mayer, 2002:63). According to this principle, simultaneous presentation is more effective than successive presentation. Successive presentation is a kind of presentation whereby animation is preceded by verbal narration, and simultaneous presentation is when narration and animation occur together. Common sense will tell you that successive presentation should produce better learning because learners spend twice as much time processing information in successive learning than they do in simultaneous learning, but the reality is different according to cognitive theory. Simultaneous learning promotes meaningful learning because multimedia presentations promote deep learning via the combination of sound and visual cues occurring at the same time (Mayer, 2002:64). Learning via subtitling is simultaneous because the words spoken by the narrator and the subtitles occur at the same time. This promotes deep learning according to the assumptions of multimedia learning theories.

Another way in which multimedia learning may be described is through the use of extra relevant material in the video clip. This is referred to as the coherence theory by Mayer (2002:65). Common sense will tell you that this extra material will enhance learning, but research indicates that extra material is disruptive to learning, especially if used without reasonable consideration. According to Mayer, research by Kozma (1991) reports that the audio portions of a television presentation can attract people's attention momentarily to various irrelevant features of the images on the screen (quoted in Mayer, 2002:65).

It is important to note that in the subtitled videos that were used in this study, the faces of the narrators were consistently removed from the screen when material that demonstrated concepts appeared on the screen. This could have been one way of reducing extra features that could potentially interfere with learning material.

Another measure that has an impact on multimedia cognitive theory is an approach whereby animation, narration and screen text are introduced in a clip. The purpose of this approach is to

check whether redundancy improves learning. This approach has a detrimental effect on learning. The cognitive theory of multimedia suggests that the text added on screen competes with the animation for cognitive resource in the visual-pictorial channel, thereby creating a split-attention effect. In subtitling such as that applied in the experiment in this study, the approach is different. The combination of media applied included the use of narration and the subtitled texts conforming to the multimedia cognitive principle for maximum learning mentioned at the beginning.

A conversational-style approach adds value to multimedia presentations. Research reveals that a conversational style in multimedia presentations offers another condition that promotes meaningful learning, which is referred to as the personalisation effect (Mayer, 2002:67). It is expected that the same approach will be observed from the presenters who gave physical science lessons in our experiment.

The last of the series of principles of multimedia cognitive theory by Mayer is the signalling principle. This principle requires the incorporation of signals in the narrated animation in order to improve learning. Signals according to this principle imply the outline of steps via concepts such as first, second and third. It also implies the indication of headings and/or subheadings used in narration; making use of linking words; making use of pointing words, for example “like”, “such as”, “because”, etc.; and indicating positions where information can be found on the imaginary structure. Research regarding the use of this principle found that learners acquire deep learning when multimedia explanations are signalled rather than those that appear without clear signalling text (Mayer 2002:69). The material used in this study was produced by the Learning Channel – an experienced South African educational media company. The narrators in the videos that were used in this study used these principles, and this enables the optimal use of multimedia, which could have an impact on the improvement of the academic performance of learners in physical science.

Another factor worth considering here about the manner in which information is processed in subtitling is the Dual Coding Theory. According to this theory, a combination of imagery and verbal information improves the processing of information (Sydorenko, 2010). This theory is

important to this study because it is considered under multimedia learning, and subtitling is also a form of multimedia learning.

An empirical research project that accepted the assumptions of the Dual Coding Theory was done by Sydorenko (2010) to determine the extent to which input Modality influenced aural and written word recall. Learners were divided into three groups. In one group, the learners' aural and written recall were examined via the use of visual and auditory modalities (video, audio and captions) (VAC). The aural and written recall in the second group was examined via the use of video with audio (VA). In the last group, video and captions (VC) were used and the learners' aural and written word recall were tested. Each group watched a video according to the conditions described above. At the end of the sessions, each participant completed a written and aural vocabulary test and a questionnaire. The results indicated that the groups in which VAC and VC were used scored higher on written than on aural recognition of word forms. The VA group scored higher on the aural than the written word forms. The findings of this study indicate that multiple modalities improve language acquisition and it concurs with the Dual Coding Theory suppositions mentioned above. In this study, subtitling used with educational material on video is seen as a form of both the Dual Coding process and the use of a multiple modality process. Based on the findings of studies such as those conducted by Sydorenko (2010), it can be expected that the impact on recall might be more or less similar in the study reported on in this dissertation, despite the obvious differences in context and use of the mother tongue.

In addition to the above-mentioned psycholinguistic theories that have an impact on the subtitling of films, Zarei (2009) mentions the following theoretical advantages. It should be noted that some of the basics of these advantages are similar to the theories discussed above.

Zarei mentions Krashen's second language acquisition theory as one basis upon which subtitling is advantageous to film making. According to this theory, four specific conditions are important for optimal input in subtitling: it should be comprehensible, interesting and relevant, not form-focused, and quantitative input (Zarei, 2009:72). Another important theory that Zarei mentions is the cognitive theory of multimedia learning. This theory was elaborated upon at length at the beginning of this section. At this stage mention can be briefly made to Zarei's perspective that

the essence of the theory is to activate prior knowledge and the meaningful connection of new information to the previously learnt information (Zarei, 2009:72). Subtitled films can help learners to activate their existing schemata and reduce the cognitive load of learning, according Zarei (2009:72). Zarei also refers to the information processing theory as a basis upon which subtitled films can help learners to encode information. As already seen in the discussion of this theory above, Zarei also says that based on elaboration and distributed practice that is found in subtitling, two processes are used to move information to long-term memory (Zarei, 2009:72). Lastly, Zarei refers to the dual coding theory as the basis upon which subtitling is effective as a learning approach. It uses three independent systems which lead to better processing and recall because of the additive effects of both image and translation (Zarei, 2009:72).

Based on the survey of literature on psycholinguistic theories, it seems plausible that the use of subtitles could improve the learning of a school subject such as physical science. The attempt in this study to investigate the use in educational videos of mother-tongue subtitles with English medium physical science content is new. There were no previous studies to compare with in terms of, for example, design. That is why similar or related studies were used to inform the design of this study.

2.4 Comprehension

In this section the rationale behind using comprehension to measure the effectiveness of mother-tongue subtitling (MTS) in physical science is supported via a literature review. The most prominent theories of comprehension are also included in the discussion to direct a definition of comprehension in subtitling as used in this study. Literature on the relationship between comprehension in the mother tongue and comprehension in a second language will also be explored.

Comprehension is one of the major determinants of learning in most subjects taught at school. Comprehension was included in the second cluster or category of the objectives of intended learning outcomes in the old Bloom's taxonomy (Krathwohl, 2002:213). Comprehension is one of the learning outcomes that are most frequently assessed in the school sector. In Bloom's taxonomy comprehension is divided into three levels: remembering, understanding and applying.

It is upon this rationale that the effectiveness of mother-tongue subtitling was assessed in this study. Two separate notions of comprehension are investigated: recall and understanding. In this study, two separate notions of comprehension are investigated: the recall part and the understanding part.

The scope of comprehension is broad and cannot be fully covered in this section. This section will cover only those types of comprehension that is integral to this study. An attempt will be made not to dwell too much on psycholinguistic theories of comprehension as they have already been covered in the previous section.

Types of comprehension which must obviously be identified in this study are viewing and listening comprehension. The cognitive interaction which takes place between these two types of comprehension has been covered in the psycholinguistic theories mentioned above. In this section there is a stronger focus on the social dynamics of listening and viewing because it is widely accepted that education is a social act.

Hoven (1999) takes a sociocultural stance based on Vygotsky's work about how listening comprehension is utilised in the multimedia setting, such as the subtitling exercise in this study. Hoven's stance encompasses two types of comprehension, namely listening and viewing, which are integral to this study.

According to Hoven's perspective, multimedia has certain advantages for student learning. Multimedia, according to this perspective, offers the learner an opportunity to interact with other students in a variety of ways. Some of these ways include communication between learners who may be next to each other at the terminals (Hoven, 1999:1). These ways enhance listening comprehension according to this perspective, as learners communicate and explain facts to each other at the terminals. Listening comprehension is viewed as interaction between listening and viewing activities, which took place between learners in this study. This view emanates from the premise that a learner is able to listen and see and get help from his fellow learners at the same time via multimedia, and thereby listening comprehension is enhanced.

Although this model of language learning is meant for second language learning, it is still relevant to the aim of this study. Subtitling employs both the listening and viewing processes and if this interaction is advantageous for language learning, it should also have a similar impact on the learning of the content of other subjects. Material studied in subtitling is transferred to learners in the same way in which other multimedia knowledge is transferred to them. Hoven covers every type of multimedia which is used in education today. She classifies these media as non-verbal channels of communication (Hoven, 1999:4).

Jones and Plass (2002) conducted an experiment which supplies information about listening comprehension relevant to the use of multimedia. Their experiment was based on several theories of multimedia learning which posit that supportive information (pictorial or written) with an aural text positively affects students' listening comprehension (Jones & Plass, 2002:548). Although this experiment was based on selective annotation, it was able to confirm other theories of listening comprehension that combining written words and pictorial information enhance listening comprehension. Subtitling as another form of combining two channels of perception could therefore also be effective in enhancing comprehension. While this theory somehow explains the interaction between the written and spoken word, it is still important to examine the actual effects of mother-tongue subtitling on students' learning.

The manner in which mother-tongue subtitling enhances comprehension will now be dealt with. The notion that mother-tongue subtitling can improve learners' comprehension was derived from the idea that use of the mother tongue is known to improve learners' comprehension. That is why in certain countries learning in the second language is delayed until learners have acquired full proficiency in their mother tongue (Modiano, 1968:34). It is easy to comprehend material that is written in one's mother tongue because language is inextricably linked to attitudes, culture and cognitive development (Modiano, 1968:34). Attitudes, culture, and cognitive development are learnt within the mother-tongue environment before they are redefined by the outside language environment.

Modern theories of language learning attest to the notion that mother-tongue learning is important for comprehension. Certain studies advocate the use of the mother-tongue for support

of foreign language learning comprehension, especially those languages that cannot be wished away due to their strong economic value in certain societies. It is believed that rather than abolish the use of a non-mother tongue as the LoLT, the mother-tongue could assist the learning of those languages. Phrases from articles such as “without it there would be blank incomprehension”; and “mother-tongue word would still be a suitable point for comprehension” (Butzkamm, 2003:31-32) support this notion. This point of view is supported by a study by Schweers where Spanish mother-tongue nguespeakers indicated that the use of Spanish as MT facilitated their comprehension of English second language when used together (Schweers, 1999:7).

Of particular importance regarding this notion is another study on the ability of doctors to retain information written on paper and on screen in both English and three Scandinavian languages (Norwegian, Danish and Swedish). The results of this research indicated that reading in the MT significantly enhances retention (and retention is a comprehension skill) of both paper and screen information (Gulbrandsen, 2002: 2852).

A few of the studies mentioned above concur in many ways with major studies that have been done before. It has almost become common knowledge that MT learning improves learner comprehension in many ways. It is thus on that score that a decision was taken to see if MT learning would have more or less the same impact on learners’ comprehension of physical science as a content subject when subtitling is used. Literature on this has revealed that besides the cognitive benefits derived from mother tongue learning, enhanced comprehension can also be used to assist second language learning. This study is based on the use of mother-tongue subtitling where the audio of the video is done in English and the written subtitles on screen are in the mother tongue. When one examines the outcomes reported in some of the studies mentioned above, the aim of this study is broadened even further. It goes beyond just testing comprehension, but examines other ancillary issues such as readability of text and vocabulary issues in the context of physical science as a content subject.

2.5 Subtitling: mother tongue vs. English second language contexts

Based on the above information on psycholinguistic theories and comprehension as a basis for mother-tongue subtitling, it is evident that the mother tongue can be used as an effective device to improve second language learning, in other words improvement in English proficiency where English is L2. It is expected that information from various studies reported in the literature will support the notion that mother-tongue subtitling can assist the learning of other such as physical science via English as a second language used as the LoLT.

Cognitive language processing theories highlight ways in which multimedia learning can be implemented in such a way that information overload can be avoided. The following technical explanation gives a clear understanding of how the processes of multimedia learning prevents cognitive learning overload from occurring. Subtitling also undergoes the same process to maximise learning.

It is generally accepted that performance degrades at the cognitive load extremes of either excessively low load (underload) or excessively high load (overload). Under conditions of both underload and overload, learners may cease to learn. So whereas learning situations with low processing demands will benefit from practice conditions that increase the load and challenge the learner, learning situations with an extremely high load will benefit from practice conditions that reduce the load to more manageable levels (Paas *et al*, 2004:1). There is no evidence that the same process takes place in subtitling, but since subtitling is also a form of multimedia learning, similar benefits may be present. Perhaps more studies could be undertaken along this line to investigate this process.

In the discussion of comprehension as a concept integral to this study, it was also observed that mother-tongue learning enhances comprehension in many different ways. Certain instances of mother-tongue learning and its relationship to the improvement of comprehension were revealed. Ways in which mother-tongue subtitling helps the instruction of second language learning and the instruction of content subjects in second language will be dealt with in detail in this section.

The study by Schweers (1999) mentioned above has indicated that the use of the mother-tongue supports second language learning (meaning that Sesotho via subtitles will improve English

proficiency). Kavaliauskiene (2000:3) agrees, and from the results of his work he was able to show that learners customarily rely on their mother tongue in learning in English where English is a second language. The aim of this study is to explore the potential of the relationship that exists between mother-tongue subtitling and learning through an L2. The aim is to exploit the mother tongue proficiency of learners to assist them in their learning of physical science as a content subject where the second language is used as the LoLT.

A general overview of areas where subtitling was used in previous research is presented below. From previous research on the impact of subtitling on comprehension in education, some of the following observations were made: subtitling could be used to bridge the gap between the development of abilities in reading comprehension and listening comprehension among university students (Garza, 1991). Same language subtitling or captioning improves listening comprehension and facilitates word learning and comprehension for university students (Bird & Williams, 2002). The use of multilingual captions enhances second language listening and reading of university students and by projection, secondary-level foreign language students (Markham & Peter, 2003). University-level ESL students derive substantial listening benefits from viewing second language captioned video material (Markham, 1999). Integrating subtitled foreign films into foreign language teaching in a private high school improved second language proficiency at all levels (Cardillo, 1997). Advanced students liked uncaptioned television whereas less advanced students liked captioned television (Weasenforth, 1994).

Studies that focused on the impact of subtitling on science comprehension in secondary education where captioning or same language subtitling was used, such as the study by Kumar and Scarola (2006:2), found that integrating video technology as part of classroom instruction was helpful in assisting ESL students to visualise challenging science concepts. Another important point made in this article is that when closed captions are added to existing video technology, ESL students are offered an additional layer of contextual language support aiding comprehension via subtitling.

A study by Thorn and Williams (1993) showed that interlingual subtitling enhances the skill of listening as it requires a higher level of decoding skill than ordinary television watching.

A study by Linebarger on 76 second grade children about caption use, sound and reading behaviour, showed that television captions appeared to help a child focus on central elements away from distracting information, including sound effects and visual glitz (Linebarger, 2001:288).

A study by Markham (1999) on word recognition showed that captions improve ESL students' ability to recognise words in the video recordings, which leads to the recommendation that captions be used for listening and reading comprehension of university-level students (Markham, 1999:1).

A study by Markham *et al.* (2001) revealed that multilingual soundtracks and multilingual captions enhance the language reading and listening comprehension of foreign language students.

Markham (2001:331) shows that both religious background and knowledge and captions contribute substantially to the comprehension of university-level ESL students.

A study by Ayonghe (2009) showed that subtitles had a positive effect on university students' Academic Literacy (AL) levels. This was revealed by a pilot study involving 150 students from the University of Buea, Cameroon. This study was done on the so-called freshmen which is a term used for first-year students at that university. The aim was to determine whether subtitled popular films had the potential to improve AL students' levels – the results were positive as mentioned above.

The difference between previous research and this research is that the aim of this study was to examine the potential of mother-tongue subtitling to improve learners' comprehension in physical science where English (the L2) is used as the LoLT. If there is a statistically significant improvement in learners' comprehension of physical science, the hypothesis of this study shall have been proven correct; and if the hypothesis of this study is proven correct, then the major aim of this study will have been achieved, which is to assist learners' comprehension in those schools where their comprehension is compromised due to their lack of proficiency in the LoLT when it is English as a second language.

2.6 Subtitling in education

Every area where subtitling is used holds benefits for education, be it subtitling for special educational needs, for ordinary educational improvements, and/or for entertainment purposes. It is clear from this scope that subtitling is a very broad field of study. Some of the benefits of subtitling for education were broadly summarised in the previous sections. Based on this state of affairs, a disturbing question that must be answered is why subtitling, despite its proven benefits for education, is rarely used in mainstream education.

It is not easy to conclude that subtitling is one of the best strategies for the improvement of listening comprehension, as some of the psycholinguistic and comprehension theories indicate. Some scholars maintain that there is criticism against subtitling as a coping strategy in education. Zarei (2009:70) quotes the following advantages from King (2002) of watching films without subtitles, for instance it:

1. helps students develop a high tolerance of ambiguity
2. enhances listening strategies such as guessing meaning from context, etc.
3. promotes active viewing and listening for key words and main ideas
4. encourages learners to make use of authentic materials on their own
5. gives learners a sense of accomplishment and self-assurance.

These advantages of watching films without subtitles are used in education to discourage the implementation of subtitles in education. Despite these concerns, Zarei immediately observes that a greater number of studies favour the use of subtitling over films without subtitles (Zarei, 2009:70).

Some of the reasons for not using subtitles in education could be that, like all other supporting strategies, subtitling as such is not regulated by policy, particularly in mainstream education. It remains up to the practitioner to decide to what extent he or she wishes to use it. Practitioners continue to use other supporting strategies, such as translation, code-mixing and code-switching

even though policy does not explicitly give permission to do so (Brock-Utne & Holmarsdottir, 2003:7).

Another reason for the lack of implementation of subtitles could be the unavailability of resources as subtitling depends on multimedia equipment. For schools this could be expensive as multimedia is expensive. It needs specialised software and skills to produce. If schools cannot produce their own software and programmes, they will have to buy from suppliers and this could also be expensive considering that it is viewed as mere support resource. However, lack of resources for implementing best strategies for the improvement of education is not a valid argument. Producers of any material are likely to increase production if such material is promoted and supported by policy.

Since the scope of subtitling in education was mostly covered in the previous section, it is appropriate to finalise this part by discussing the state of mother-tongue subtitling in education in this section. It was stated in Chapter 1 that there was a scarcity of the use of mother-tongue subtitling and research on its use in education. Mother-tongue subtitling is referred to as standard subtitling, according to Zanon's divisions of subtitling (Zarei, 2009:68). Zanon distinguishes between three kinds of subtitling, namely bimodal, standard, and reversed subtitling. Bimodal subtitling means English dialogues with English subtitles; standard subtitling refers to English dialogues with subtitles in the learners' mother tongue; and reversed subtitling refers to dialogues in the learners' mother tongue with English subtitles. For the purposes of clarity, a point is made here that the type of subtitling which is used in this study is standard. This helps to describe the scope of subtitling which is used in this study.

It is believed that mother-tongue subtitling could be used to entrench the concept of multilingualism in South African education. Most schools are multiracial and multilingual in nature, and for that reason the level of learners' English proficiency in these schools is low. Mother-tongue subtitling could be used to support learners who need coping strategies to enhance their English comprehension in various . Exactly how this could be done will be discussed in Chapter 5.

It has already been stated that parents prefer their children to retain English as the language of upward mobility and economic advancement, and research indicates that this is not about to change in the near future (De Klerk, 2002:2). At the same time research indicates that there are psycholinguistic advantages and cultural pride in the use of indigenous African languages in education. The ideal LoLT arrangement in this context would therefore imply the use of both the mother tongue and English in education. This study proposes that mother-tongue subtitling in English LoLT contexts such as in secondary schools in South African could be used as one of the possible strategies to achieve this aim.

2.7 Summary

The literature survey reported in this chapter reveals that language policies in South Africa are open to too many interpretations and, due to their flexible nature, have not led to the increased use and development of indigenous African languages as languages of learning and teaching. These policies have not been able to promote any indigenous African languages to the status of languages of learning and teaching in schools.

Psycholinguistic theories have revealed that multimedia learning is beneficial to listening comprehension and that subtitling as another form of multimedia learning can be used to enhance comprehension. Comprehension theories as one type of psycholinguistic theory support cognitive processing theories of learning where subtitling is involved.

It has also been discovered from various sources that mother-tongue learning supports learning through L2. The concepts of added bilingualism and multilingualism were proven to be central to better language learning strategies. Since the literature reveals that the mother tongue is a strong basis for second language learning, it is accepted that mother-tongue subtitling would be a good strategy towards that objective.

Lastly, it was observed from various sources that subtitling has extensive benefits for education and that these benefits can be extrapolated to mother-tongue subtitling. It was, however, also observed that there is some criticism of subtitling, but that more research supports it as a major strategy towards educational enhancement (Zarei, 2009:70).

Based upon evidence from the literature, it is clear that the major aim of this study is feasible, which is to use mother-tongue subtitling as a supportive strategy for implementing the policy of additive multilingualism in South African education. In contexts where a particular African language acts as a strong regional language, this strategy would be highly beneficial, however, where a variety of African languages are spoken by Grade 12 learners this strategy may not be effective.

Chapter 3: Empirical Investigation

3.1 Introduction

The main research question in this study is whether mother-tongue subtitling can improve learner comprehension in physical science. To investigate this phenomenon, an intervention was done to test whether English Physical Science videos with mother-tongue subtitles improved the comprehension of physical science as a Grade 12 subject. Two types of comprehension were investigated: recall of physical science content and understanding of physical science content. A classical experimental design was followed where an experimental group watched mother-tongue subtitled physical science videos (where the presenter spoke English and the subtitles were in Sesotho) and a control group watched the same videos without the subtitles.

In the rest of this chapter, the preparation of the subtitles for the empirical investigation and design will be described. Attention will be given to the subtitling process, the pre-test instruments, the questionnaires used, the comprehension tests used and the ethical aspects of the empirical project. The description of the subtitling process is necessary to enable researchers working on subtitling to review the rigour with which the quality assurance of the subtitles was conducted. If this is not done properly, it could become a confounding variable that might be the cause of differences in the scores of participants in the experiment rather than the intervention itself. Pre-test instruments and questionnaires were used to determine important information that could assist the researcher to study the potential influence of confounding variables that could explain differences in the scores of the participants in the empirical project. Ethical considerations are important when one works with children, and therefore these are discussed fully in this chapter. Lastly, the procedure that was followed to collect data is also discussed.

3.2 The mother-tongue subtitling process

Six video lessons from the Learning Channel TV Programme on the themes Electromagnetic Spectrum, Electromagnetic Radiation, Energy and Penetrating Ability, Transmission and Scattering, the Photoelectric effect and Absorption and Emission Spectra were used as stimulus material for this research. The videos were prepared by the Learning Channel producers, and permission was obtained from the producers to subtitle them. The audio language for these

videos is English and the subtitles are in Sesotho. The videos were subtitled by staff at the North-West University's (NWU) Language Laboratory using the professional subtitling software programme "Tempo" from Cavena, a Swedish company. The Sesotho translations were done by the researcher. Members of the academic staff of the African Languages Department of the North-West University (Vaal Triangle Campus) performed quality control checks on the translations of the subtitles. The quality check was based mostly on options that exist for translating science texts such as the ones used in this study. Help was acquired regarding the most appropriate choice of translation strategy based on best practice in the translation market. It was largely agreed that original Sesotho constructions be retained as far as possible if retaining such constructions and meanings of words and sentences would not be too difficult for learners to understand. Instances where such challenges were experienced other translation strategies such as borrowing, paraphrasing, loaning of words, translation with a more general word, equivalence, etc. were used.

The six video lessons mentioned above were in DVD format, all on a single DVD. The lessons were originally divided into four separate lessons: Lesson 13 to Lesson 16. The first two Lessons, namely Lessons 13 and 14, were subdivided by the researcher into two separate lessons for the purpose of the experiment. Lesson 13 was divided into lesson 13a with the theme Electromagnetic Spectrum, and lesson 13b had the theme Electromagnetic Radiation. Lesson 14 was divided into lesson 14a with the theme Energy and Penetrating ability and lesson 14b had as its theme Transmission and Scattering. This division into shorter lessons was deemed important to ensure that the learners would be confronted with video sessions that were focused on specific themes that were short enough for them to be able to concentrate on adequately during the experiment. Lesson 13 originally had duration of 30 minutes 23 seconds, and lesson 14 had a duration of 38 minutes 29 seconds. After the division, lesson 13(a) had duration of 14 minutes and 56 seconds and Lesson 13(b) a duration of 16 minutes and 07 seconds Lesson 14(b) had a duration of 23 minutes and 09 seconds and Lesson 14(b) took 15 minutes 20 seconds after they were divided. For the remaining videos, Lesson 15 (the Photoelectric effect) took 20 minutes and 37 seconds to view and Lesson 16 (Absorption and Emission Spectra) took 16 minutes and

20 seconds to view. A summary of the themes and duration of the videos used in the experiment is presented in Table 1 below.

Table 1: Summary of the video content used in the study

LESSON NUMBER	THEME	DURATION
13 (a)	Electromagnetic Spectrum	14 minutes 56 seconds
13(b)	Electromagnetic Radiation	16 minutes 07 seconds
14(a)	Energy and Penetrating Ability	23 minutes 09 seconds
14(b)	Transmission and Scattering	15 minutes 20 seconds
15	The Photoelectric Effect	20 minutes 37 seconds
16	Emission Spectra	16 minutes 20 seconds

The subtitles of all of the above videos were created according to international subtitling standards. These standards determine that a maximum of 37 characters be used per line, and it assumes a reading speed of approximately 140 wpm (Karamitroglou, 1997). The subtitles were created in English and then translated into Sesotho by the researcher and back-translated by independent translators to check for accuracy. The Sesotho subtitles were adjusted to meet the norms and standards of subtitling before they were finally embedded in the video. This was done by staff members who were charged with the process of subtitling together with the researcher.

The topics of the selected videos are part of the physical science National Curriculum Statement (NCS) for Grade 12. All the topics were derived from the Physics part of the physical science learning programme called Electricity and Magnetism. This material was selected for this research because the concept of electronics is foreign to the Sesotho language culture. This is confirmed by McDonald (quoted by Henning, 1994:89) who states that the first languages of learners doing science in English which are South African indigenous languages are structurally not always compatible with the morphological, lexical and syntactical structures of English for

them to be languages of science and technology. It is important to note that McDonald is not suggesting that African languages are unable to express these concepts. She is simply noting that African language development in some domains of science has not progressed to these topics in some cases. This paradigm (the lack of familiarity with themes such as electronics in the Sesotho language and culture, and the ordinariness of these concepts in English) helps to set Sesotho and English a safe distance apart in terms of culture. In other words, one can safely conclude that there is a proven “language difference” observed in the context of the experiment. The concept of “language difference” is derived from a translation consideration which is observed when translating material from a language in which certain concepts are culturally familiar, to a language in which these concepts are not culturally familiar. This implies that there is little overlap between the two languages in terms of language pre-knowledge and terminology regarding this concept. This serves to eliminate the possibility of certain students having a better understanding of the target language than others because of the area of origin or home language circumstances.

3.3 Subjects/participants

The population for this investigation consisted of learners from two former Department of Education and Training secondary schools in the Free State Province district of Fezile Dabi in the northern part of the province, which shall be referred to as School A and school B. These are the only two former Department of Education and Training secondary schools in this identified area, namely the town of Heilbron. This is a typical South African small farming town with a population of approximately 55 196 according to the GeoNames database (Wikipedia, 2012:2). The socio-economic state of this town is poor, especially in the township where the participating schools are situated. The challenges that are facing small towns in the Free State are well known, and include issues such as a housing backlog, inadequate physical and social infrastructure, a skewed pattern of resource allocation, a high level of illiteracy and a poor skills base among a large part of the population, and income as well as infrastructure disparities.

The typical qualification profile of the parents of children who participated in this study is an indication of these challenges. In the case of the participants in this study, in general more

mothers had higher qualifications than fathers. The data related to highest qualifications of mothers and fathers of the participants are presented in Tables 2 and 3 below.

Table 2: Highest qualifications of mothers of the participants

Highest qualification of mother	Number
I do not know	19 (27.14%)
Grade 7 (former Std 5)	14 (20%)
Grade 12 (former Std 10)	27 (38.5%)
Post-school qualification	10 (14.28%)
TOTAL	70 (100%)

The percentage of mothers who achieved qualifications beyond Grade 12 was 14.28% and that of fathers was 20%. The percentage of fathers who attained Grade 12 was 23, 07%, while 38.28% of the mothers attained Grade 12. The percentage of mothers who completed Grade 7 was 14%, compared to 12.3% of the fathers. Lastly, the percentage of mothers whose qualification profiles were not known to the children was 27.14%, compared with 44.6% of fathers.

Table 3: Highest qualifications of fathers of the participants

Highest qualification of father	Number
I do not know	29 (44.6%)
Grade 7 (former Std 5)	8 (12.3%)
Grade 12 (former Std 10)	15 (23.07%)
Post-school qualification	13 (20%)
TOTAL	65 (100%)

In the area of Heilbron, the language distribution of home languages is as follows: Sesotho 53.3%, Afrikaans 33.4%, IsiZulu 9,4%, IsiXhosa 2,2%, English 0,1%, other 1,6% (Frith, 2012:1). The data are presented in Figure 2 below.

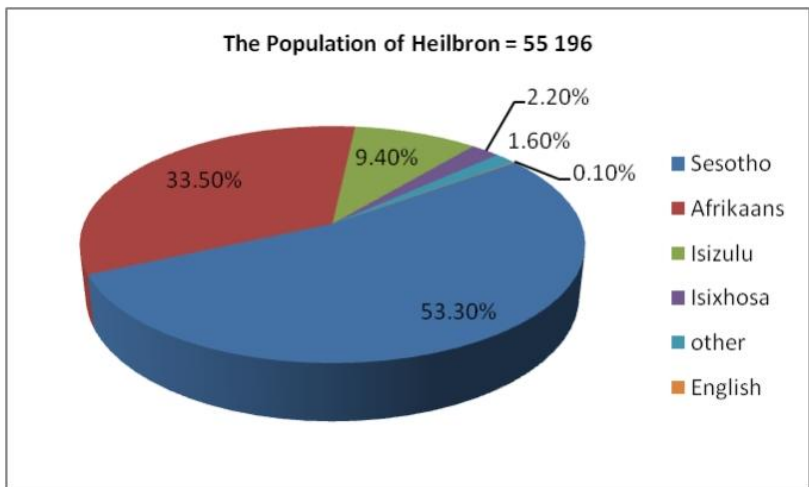


Figure 2: Home Language distribution of the population of Heilbron

The total number of learners enrolled at each of the participating schools in 2011 was: School A had 1 338 learners and School B had 1 193 learners. Of the 1 338 learners that were enrolled at school A in 2011, 107 learners were enrolled for Grade 12. Of the 1 193 enrolled at school B in 2011, 84 were enrolled for Grade 12. Of the 107 Grade 12 learners in School A, 26 learners took physical science as one of their subjects for Grade 12; and of the 84 Grade 12 learners in School B, 74 learners took Physical Science as a Grade 12 subject. The enrolment information for the participating schools is presented in Figure 3 below.

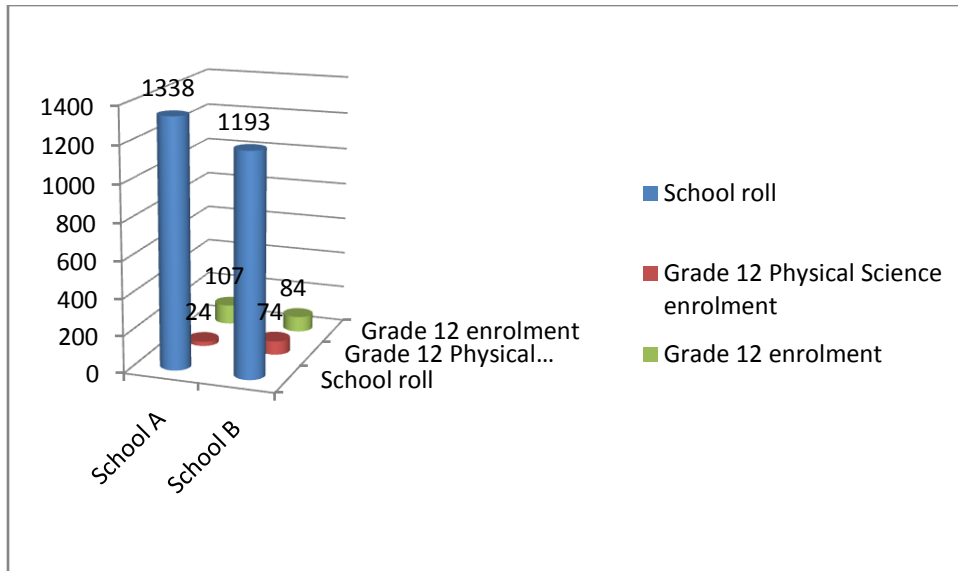


Figure 3: Enrolment data of participating schools in 2011

The home language distribution reported by the participants is presented in Figure 4 below.

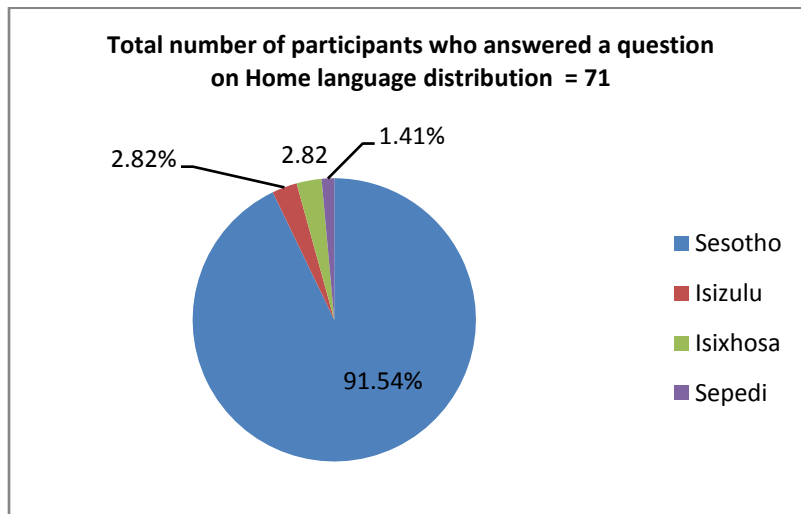


Figure 4: Home language distribution of the participants

The home language distribution of the participants reflects that of the area. In other words, the majority of the learners use Sesotho as their home language. The home language distribution displays relative homogeneity as well.

The subject combinations available at the participating schools were the same in many respects. The only difference in subject combinations available occurred in the case where school A, offered Mathematical Literacy and Computer Technology Applications together with five other subjects in a curriculum. At the other school School B, learners could take pure Mathematics and/or Geography together with the same five subjects available at the other school. Table 4 below captures subjects done at each of the participating schools.

Table 4: Distribution of participants for the subjects offered in Grade 12 at participating schools

Grade 12 Subjects	Number	%
Sesotho Home Language	88	100%
English First Additional Language	89	100%
Physical Science	89	100%
Mathematical Literacy	23	25.80%
Mathematics	66	74.15%
Computer Applications Technology	46	63%
Geography	27	36.90%
Life sciences	89	100%
Life Orientation	89	100%

In conclusion, these two schools were considered as ideal participants in the project for the following reasons:

- Both schools use English as the language of learning and teaching (LoLT). This includes the learning and teaching of physical science.
- English as a subject is done at a first additional language level.
- The vernacular language spoken by the majority of the people living in this area is Sesotho. Sesotho as a school subject is done at a home language level at both schools.

- The subjects available to learners were fairly similar with only one exception as stated above.

The relative homogeneity of the community in which the participating schools is situated provides an ideal context for an investigation that aims at determining the specific effect of an intervention.

As is the case with an experiment that runs over a period of a few weeks, it is to be expected that not all the participants will attend all the sessions. The highest number of learners who attended some of the sessions peaked at 89: 23 learners from School A and 66 learners from the School B. Even at these early stages of the experiment it was obvious that the normal type of absenteeism would also be observed in this experiment. On the one hand, learners experienced participation in the experiment as supportive of their preparation for their Grade 12 physical science national examination. On the other hand, the experiment ran from 19/09/2011 to 29/10/2011 and the approaching Grade 12 national examination resulted in various pressures on the learners also to attend to other subjects. However, 73 learners participated on average in the six-week intervention. This is a sizable number of participants for statistical analyses.

Table 5: Distribution of participants at the participating schools

Participating Schools	Number of learners
School A	23 (25,8%)
School B	66 (74,15%)
TOTAL	89 (100%)

Stage 1 of the empirical investigation commenced on 19/09/2011 with an introduction to the project (including obtaining informed assent from the learners) and the completion of the questionnaires. The introduction to the project took about 30 minutes and the completion of the pre-test questionnaires took about thirty minutes at each school. Physical science teachers at the schools helped to monitor the learners when they were busy filling in the questionnaires. The teachers were eager to see what the project entailed. The schools at which this project took place are impoverished compared with many other schools in the province. They are the type of

schools that do not have facilities such as large halls or well-equipped laboratories. The venue that was used for this experiment was formerly a biology laboratory in School A., but now the equipment had been removed and it only contained desks. The same venue was used for this project throughout its duration. School B did not have a bigger venue which could accommodate all the learners at the same time, hence School A was requested to accommodate the learners from School B as well. This did not pose any problem in terms of travelling because the two schools are only approximately 4 km from each other and both attract learners from the same area.

The second stage of the empirical investigation involved the experimental group watching the physical science videos with Sesotho subtitles (while the presenter spoke English) and the control group watched the same videos without the Sesotho subtitles. The learners were allocated to the two different groups as follows: learners at both schools with odd “project participation numbers” were allocated to the control group and learners with even numbers were allocated to the experimental group. An average of 73 learners took part in the project over the six-week period. The number of female learners who took part was 43 and the number of male learners was 30. The number of boys and girls who together formed the experimental group was 37, and there were 36 boys and girls who together formed the control group.

Table 6: Cross-tabulation for gender of and allocation to groups

Gender	Experimental group (+subtitles)	Control group (-subtitles)	Totals
Female	19	24	43
Male	18	12	30
Totals	37	36	73

The mean age of participants was 18,90. This average was in line with the national enrolment figure for Grade 12. The age of 14–18 is considered to be for the FET band of secondary education in South Africa (DoE., 2009). This age cohort for Grade 12 is normal in a South African township school. It cannot be said that the learners in this age bracket are over aged.

Table 7: Mean age of participants

Valid N	Mean	Minimum	Maximum
73	18,96	17,00	20,00

The most appropriate times and days on which the learners would be available were continuously negotiated with the schools. One session was completed after school during the third school term. Two sessions were held when schools were on recess for the third term, and the remaining three were completed on Saturdays during the fourth term.

3.4 Variables

This study aims to investigate the potential relationship between the comprehension of physical science and language proficiency, specifically the use of mother-tongue subtitling in Sesotho as a supportive tool to enhance comprehension (recall and understanding). The dependent variable is the comprehension of physical science. The independent variable is membership to either of the groups: the experimental group watched the videos with Sesotho subtitles and the control group watched the videos without subtitles. The main aim of this study is also related to the ability of the intervention (watching videos with Sesotho subtitles) to improve the comprehension of physical science as a subject.

Obviously, many other variables could influence the participants' scores on physical science tests. An "extraneous variable effect" could occur. This is a phenomenon whereby intervening variables lead to certain explanations and conclusions of a study, where one cannot state with confidence that the effects observed were caused by the interventions studied (Brown, 2002:11). According to Brown (2002:12), extraneous variables can have a negative feedback on research. In the case of this study, it was very important to control for potential extraneous or confounding variables. It is possible that, for example, learners who are more positive towards the use of Sesotho as a language of teaching and learning in physical science would fare better in the physical science test if they formed part of the experimental group. In order to monitor the

influence of potential confounding variables, information on the following aspects were gathered to allow an analysis of their potential effect on the scores in the physical science test:

- Sesotho language proficiency
- English language proficiency
- General academic achievement at school
- Socio-economic status
- Interest in science subjects in general
- General commitment to school.

An important part of the analyses was to determine whether any of the confounding variables controlled for could explain potential differences between scores of participants on the physical science tests. This was done by conducting t-tests.

3.5 Selection and preparation of stimulus material

Questionnaires were used to collect information about the demography of the participants; learners' attitudes towards physical science as a school subject; learners' impressions about the language of learning and teaching that is most appropriate for the teaching of physical science; and learners' attitude towards the academic part of their school work (for copies of all the pre- and post-test instruments, see Appendices A-F). The questionnaire is presented in Appendix D. As explained above, it may, for example, be possible that "attitude towards physical science" as a school subject could explain the differences in the effort learners put into the project and therefore could explain the differences in the scores on the physical science tests. By asking about these potential attitudes, I was at least able to determine whether attitudes were similar or different in the control and experimental groups, and in this way I can "account" for its potential influence on the physical science test scores.

In order to gather relevant information about the language proficiency of the participants in Sesotho and English, I designed an additional English comprehension test which I translated into Sesotho. The topic of the comprehension test was "making money from home". The text was derived from the Internet blog, "make easy money info.blog.com." The readability of this text

was calculated electronically by an “office word” programme which uses the Flesch Reading Ease Test to calculate the readability of the text. The following is a practical way to do this. The Microsoft office button was selected and then the Word Options icon, then Proofing, and then the check grammar with spelling option was selected. The instruction was followed under correcting grammar in a Word document. Lastly the show readability icon was selected for the display of readability. The ease of this text was 69, 6 on the scale and the standard readability of a greater number of people is between 60 and 70.

The aim of this ordinary comprehension test was to provide some additional information about the Sesotho and English proficiency levels of the participants by administering the same comprehension test in both languages. The manner in which the Sesotho and English comprehension tests were distributed helped to divide the learners into two groups. The comprehension test papers were handed out in such a way that every second learner would have a paper in a different language from the learner sitting next to him or her. Unfortunately, there was no time to reverse the process at a later stage so that all the learners could complete both tests. The potential washback effect, especially with a translated test, also did not make this ideal. Washback is the influence of testing on teaching and learning (Brown, 2002:11). Testing before this experiment would mean that our teaching and learning encounter would be influenced.

However, the marks for these tests were correlated with Sesotho or English Grade 12 marks to determine if they were a fair reflection of the learners’ language proficiency, and they provided additional information about the language proficiency of the participants in Sesotho and English.

The physical science tests were designed to evaluate two specific types of knowledge related to the material presented in the videos: the questions were aimed at testing whether the learners could answer “recall” questions better after watching the video or whether they could answer “understanding” or application-type questions better. In this study, “recall questions” are defined as those questions requiring shallow processing, drawing out factual answers, in other words, testing the recall and recognition of facts. “Understanding-type questions” are defined as those questions requiring interpretation, application, analysis, evaluation and synthesis of information.

This is based on the assumption that the basic aim of comprehension strategies is to improve remembering and understanding of a text (Pressley *et al.*, 1998:3) In each physical science test, 10 marks were allocated to typical “recall” questions and 10 marks to typical “understanding type” questions. This design enabled me to ascertain to some degree whether subtitles in the mother tongue support “recall” knowledge or “understanding” knowledge of physical science topics addressed in the videos. Due to the “washback” effect, i.e. the influence of testing on teaching and learning (Pan, 2009:258), I decided not to let the learners write the physical science test before and after watching the video. Conducting the experiment in this way might have added a confounding variable which would make it more difficult to ascertain whether the intervention had an effect on “recall” or “understanding” knowledge of the physical science topics treated in the videos, because differences in scores could have been caused by the “learning effect” or the “washback” effect of taking the physical science test twice in such a short time span.

The sessions during which the control group and the experimental group were first to watch the video alternated. One week it would be the control group that watched the video first, and the subsequent week it was the experimental group. One group would be free while the other group watched the video. Immediately after the first group had watched a video, they would write the physical science test about the video that they had just watched. In the meantime, the next group would watch the relevant video and immediately after the viewing they would also write the physical science test. The physical science teachers at the schools assisted the researcher to invigilate and keep order.

A laptop PC was used to play the videos. A data projector was connected to the laptop to display the videos on a screen. External loud speakers were attached to the laptop to amplify the sound of the videos.

3.6 Information, permission and ethical aspects related to the project

Written permission was sought from the Free State Department of Education to conduct this research at the identified schools. I also had to register the research project at the Free State Department of Basic Education. The Free State Department of Basic Education approached the

identified schools in the relevant district office on behalf of myself, and permission was granted by the Department, district office and school principals for the research project to be conducted. The parents of the learners who took part were requested to sign consent forms for their children to take part in the research. Lastly, the learners were requested to sign letters of assent to indicate that they had been informed about the nature of the product and were willing to participate freely. These letters of assent and consent will be stored for a period of five years after publication of the results and will then be destroyed.

3.7 Pilot study

A pilot study was conducted to check if there would be any hindrances during the intervention and to identify those issues that needed to be tightened up before the investigation was carried out. The pilot study was conducted at a separate school in the same education district as the schools that were identified for the main experimental investigation. This education district is known as the Fezile Dabi Education District and is located in the north-eastern part of the Free State. This school has the same characteristics as the schools where the main research was performed. It is a former Department of Education and Training secondary school. English is the language of learning and teaching and it is offered at a first additional language level. Sesotho is offered at a home language level.

The pilot study included the use of all the instruments that would be used in the final intervention. Four of the six videos and physical science tests were piloted. Parents' consent forms and learners' assent forms were delivered to the school a week before the experiment was conducted. A list of items to check during the pilot study was compiled. This check list included the following items: time taken for each test; checking the effective functioning of the equipment used during the intervention (e.g. computer, data projector, DVDs, screen, speakers, extension cords, adaptors); lighting and subtitles.

Six learners from the piloting school were used in the pilot study, three boys and three girls. Four of the learners were 18 years of age and other two were 19 and 20 years old.

The first event in the pilot was the completion of the questionnaire. This took the learners about 15 minutes. I asked them to indicate difficult questions or words which I was prepared to discuss

and to note the difficulties with a view to adjusting the questionnaire for use in the final intervention. A break of fifteen minutes was given to the learners after they had finished completing the questionnaire.

The learners started to write the ordinary comprehension test after the break. Three wrote the Sesotho test and the other three wrote the English test. The tests were distributed alternately in Sesotho and English according to how the learners were seated. This test took about 20 minutes. The following time distribution for various instruments was observed during the pilot study: it was observed that the average time taken to complete the questionnaire was 15 minutes; the average time taken to do the vocabulary and ordinary comprehension test was 20 minutes; and the average time taken to do a physical science test was 15 minutes.

After the comprehension test, the learners were given another fifteen-minute break, after which they were divided into two groups. They were given numbers to pull from a hat. The learners with the last three consecutive numbers were scheduled to watch a video with subtitles, and those with the first three consecutive numbers were scheduled to watch the video without subtitles. The learners scheduled to watch the DVD with subtitles were the first group to watch it, and the learners scheduled to watch the DVD without subtitles were the last group to watch it.

Arrangements were made for the group scheduled to watch the DVD with subtitles to write the physical science test based on the DVD that they had just watched in another classroom immediately afterwards. They were allocated an invigilator to watch over them as they wrote. They were given permission to leave the room as soon as they were through.

While the group scheduled to watch the DVD with subtitles was busy writing, the group scheduled to watch the DVD without subtitling watched it. They also began to write their physical science test based on the DVD as soon as they had finished watching.

The pilot study was useful because it helped to expose certain shortcomings of the experimental investigation. It revealed minor spelling mistakes in the physical science tests. It also revealed that space was not provided on the test paper to indicate if the answer sheet was for a subtitled or un-subtitled test. This observation helped the researcher to correct the remaining physical science

test papers before they were duplicated. It was also observed from the pilot study that side speakers for bigger venues would be necessary, and speakers were arranged before the main intervention was conducted.

3.8 Data collection procedure

The data were collected over a six-week period. Table 8 below presents information about the dates of the experiment and the number of learners who attended.

Table 8: Date of experiment and number of learners

	Date of event	Description of event	Number of learners participating on that date
1	17/09/2011	Introduction, consent and assent forms	89
2	19/09/2011	Questionnaires	89
3	24/09/2011	Ordinary Sesotho and English comprehension test	44
4	26/09/2011	Physical science Test – Lesson 13(a)	27
5	01/10/2011	Physical Science Test – Lesson 13(b)	57
6	08/10/2011	Physical Science Test – Lesson 14(a)	55
7	15/10/2011	Physical science Test – Lesson 14(b)	35
8	22/10/2011	Physical science Test – Lesson 15	8
9	29/10/2011	Physical science Test – Lesson 16	33

The above table displays dates, events and the number of learners who attended the different sessions. It also indicates how the different instruments were distributed. The first event in which the research was introduced to the learners and the assent and consent forms were distributed was well attended on 17/09/2011. The figures show that 89 learners were present. The distribution and completion of questionnaires were done on 19/09/2011, and again 89 learners were able to attend. The ordinary Sesotho and English comprehension tests were administered on

24/09/2011 and the turnout was 44 learners. The first session of the physical science test was administered on 26/09/2011 and only 27 learners were able to attend. The second session of the physical science test was administered on 01/10/2011 and 57 learners turned up. The third session of the physical science test was administered on 08/10/2011 and 55 learners attended. The fourth session of the physical science test was administered on 15/10/2011 and 33 learners were present. The fifth test was administered on 22/10/2011 and only 8 learners from one school turned up. The sixth and the last test in this series were administered on 29/10/2011 and attendance was 33 learners.

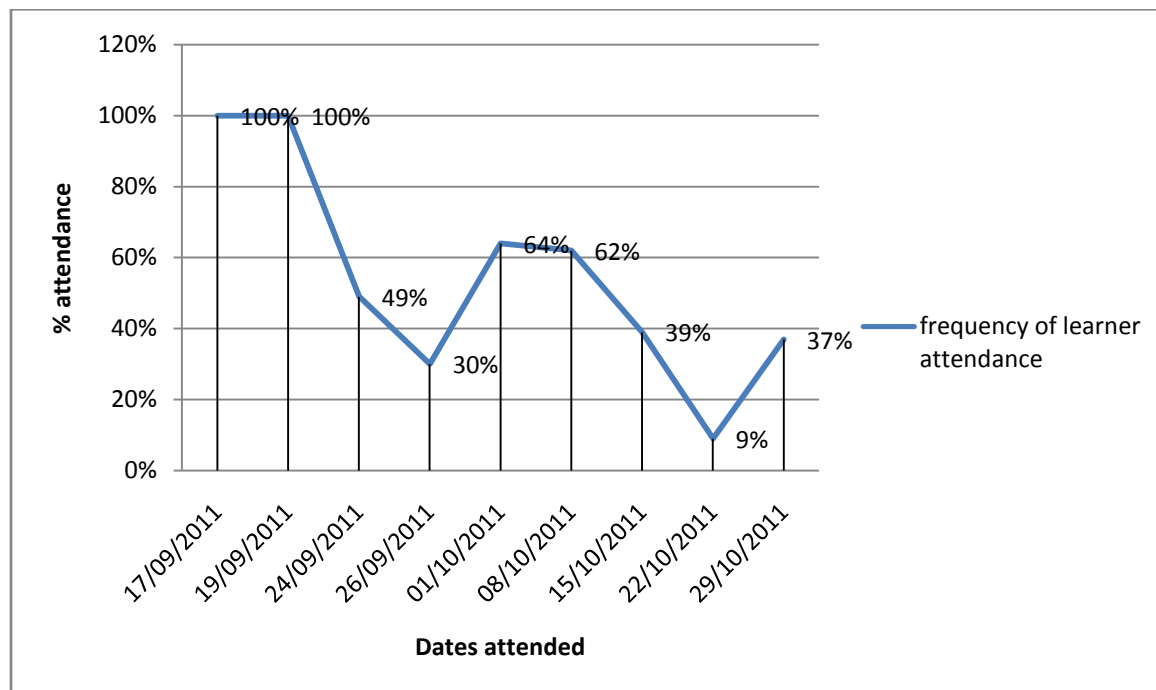


Figure 5: Frequency of learner attendance of research sessions

The whole activity of administering this research was concluded by thanking the members of staff who assisted and the learners for their assistance in taking part in this project.

3.9 Summary

This chapter covered the following: it showed how the tests, questionnaires and stimulus material were generated. It went on to show in detail how all these instruments were administered to make sure that they met the standard of research of this nature. All the variables that needed to

be dealt with were also discussed in this chapter to demonstrate that the testing instruments for the various variables conformed to the necessary standards. All these variables were incorporated into measuring instruments such as questionnaires and tests.

This chapter highlighted all the necessary themes and the scope of this research to ensure that all the necessary areas of research had been covered during the empirical study.

The environment in which the experiment was done was also described. The physical as well as the abstract environments were covered. All the ethical issues were mentioned and the ways in which they were handled were explained.

Lastly, the background and the nature of the participants were described.

Chapter 4: Empirical Research Results

4.1 Introduction

The central theoretical statement of the study was that mother-tongue subtitling would improve comprehension (recall and understanding) of physical science in secondary education in South Africa for learners who use ESL as the LoLT. The results will be presented in two sections. The first section will focus on the data related to the central theoretical statement: t-tests were conducted to determine if there were statistically significant differences between the physical science test scores of the participants in the control and experimental groups. The second section will discuss the influence or lack thereof of potential confounding variables related to the physical science test scores. Based on these results, conclusions about the central theoretical statement will be presented.

4.2 Selection of test scores for the analyses

The experiment involved participation in six interventions over a period of six weeks. However, when the results of the scores of the six physical science tests were analysed, it became clear that results for lessons 15 and 16 were problematic.

Results for lesson 15 were problematic because the number of participating learners was low (see Table 8 in Chapter 3). Only 12 learners turned up for this session. The reason why so few learners turned up was because learners at school B were released early from school that day and had decided to go home instead of travelling to School A where these tests were conducted. Only 12 of the 20 learners who attended these sessions regularly from School A turned up. Some learners from School A decided to leave when they were not sure if the learners from School B would turn up. They thought the tests would not take place if the learners from School B did not turn up. However, the researcher decided to carry on with the tests as there was no guarantee that learner turn-out would increase in the future. The researcher did not want to disappoint the learners who turned up despite the poor attendance. However, it was not feasible and

responsible to do statistical analyses with so few data points. Therefore the results for lesson 15 are not included in the discussion on this study.

Results for lesson 16 were also not considered because the average performance of the learners was exceptionally poor. The average performance of the experimental group was 2.05 out of 20 (which is only 10.25%) and 2.26 out of 20 (which is only 11.3%) for the control group. It is assumed that the performance in this lesson was affected by calculations that formed part of the “understanding” questions of this test. The recall section did not cover a wide scope in this test. If the learners did not comprehend the concept on which questions were based, they got most of the questions wrong. The fact that the total average scores were so low in both groups made the use of these results impossible because of the lack of variation in data points.

The analyses that follow in the rest of this chapter include the results of 22 participants per test for the experimental group and 21 participants per test for the control group. The analyses are therefore done only on the results of those participants who attended four out of the six tests (lessons 13a, 13b, 14a and/or 14b) that formed part of the experiment. By using the data from these participants, I believe that I obtained a true reflection of the potential influence of the Southern Sotho subtitles on the comprehension of physical science material. Obviously, one of the effects of this decision was a drastic decrease in the number of participants in the study. This is common in intervention studies of this nature.

4.3 Results of physical science test scores

Each of the physical science tests counted for 20 marks. Ten marks were allocated to questions that tested “recall”, in other words, memory questions related to the topic of the lesson. The other ten marks were allocated to “understanding” type questions, which required the participants to apply the information from the lesson to answer the question. In other words, the “understanding” type questions focused on calculations or integration of information by the participants. In Table 9 below, the means for the individual test scores are reported as well as the t-tests that investigated the statistical differences or similarities between means for the experimental and control groups.

Table 9: Independent t-tests between differences of scores in physical science tests for the experimental and control groups

Tests	Themes	Mean subtitles Exper.	Std. Dev. Subtitles	Valid N. Subtitles	Mean No subt. Control	Std. Dev. No subt.	Valid N. No subt.	t-value	p
13 (a)	Electromagnetic Spectrum	6.79	4.39`	19	8.29	1.98	14	-1.19	0.245
13 (b)	Electromagnetic Radiation	7.00	3.74	34	5.32	2.69	34	2.12	0.038
14 (a)	Energy and Penetrating Ability	7.82	4.36	34	6.50	3.46	34	1.39	0.170
14 (b)	Transmission and Scattering	5.19	2.44	21	4.55	2.44	22	0.87	0.392

Key to table: Statistical significance indicated by: * $p < 0.05$, ** $p < 0.01$

From Table 9 it is clear that the overall performance of the participants was low. The total mean scores indicate that the participants never achieved above 50% as an average score in these tests. This finding is similar to their physical science marks achieved in Grades 11 and 12 in the participating schools. This trend is also observed by various other educationists (Reddy *et al.*, 2003) in the context of other science tests. The low performance of the participants in the physical science tests that formed part of this intervention is represented in Figure 6.

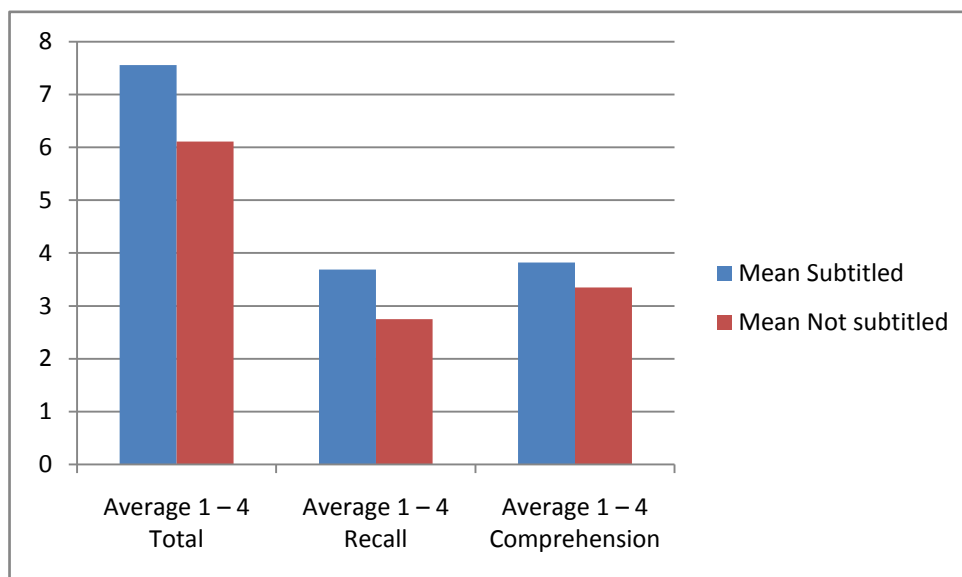


Figure 6: Means for physical science tests (out of 20%)

The averages for physical science marks in the participating schools are reported in Table 10 below.

Table 10: Averages for physical science scores in the participating schools – Grade 11 (in 2010) and Grade 12 (in 2011)

School A		School B	
Grade 11 (2010)	Grade 12 (2011)	Grade 11 (2010)	Grade 12 (2011)
19.2%	34.6%	34.6%	37.8%

An independent t-test analysis enables us to compare statistically whether there is a difference between the means achieved by the experimental and the control group. A statistically significant difference would indicate that the intervention influenced physical science test scores, or that there was no influence. The means for the scores of the experimental group all exceeded the means for the scores of the control group, except for one test, that is test 13 (a). The mean for the score for test 13(b) is 7.00 for the experimental group and 5.32 for the score of the control group; the mean for the score for test 14 (a) is 7.82 for the experimental group and 6.50 for the score for the control group; and the means for the score for test 14(b) is 5.19 and 4.55 for the score for the experimental and control group respectively. The means for test 13 (a), which is the only test in which the score for the control group is higher than for the experimental group, are 6.79 for the experimental group and 8.29 for the control group. The t-tests indicate that there is only one statistically significant difference between the means on the four physical science tests: the ‘p’ value for test 13(b) indicates that it is the only test which has a score which is statistically significant in this experiment.

This finding indicates that when considered as independent tests, the only “trend” that is observable is that:

- In three of the four physical science tests taken into account in the analysis of this study, the experimental group performed better than the control group; but
- The differences between means are statistically significant in the case of only one test (13b) where the experimental group performed better than the control group.

The variance in number of participants from session to session makes it difficult to do straightforward comparisons of performance on the physical science tests between sessions. The small number of participants in lesson 13a, in particular, leads us to distrust the difference in mean as indicative of any difference in the performance in the physical science test of the two groups

In an attempt to minimise such sampling effects evident in experiments of this nature where there is usually great variance in participation, the mean scores on the physical science tests of those participants who attended at least three out of the four sessions, were calculated and t-tests were conducted on these numbers. The independent t-test results displaying the mean scores of participants who took part in three out of the four sessions that were included in the analysis of this study are presented in Table 11 below. This analysis via t-tests helps us to view the overall effect of the tests on our participants as we try to manage the effect of smaller sample sizes.

Table 11: Results of independent t-tests to determine if the means for the subtitled (experimental) and not subtitled (control) groups are similar for the physical science test scores

	Mean (subtitled group)	Std. Dev. (subtitled group)	Valid n (subtitled group)	Mean (not subtitled)	Std. Dev. (not subtitled)	Valid n (not subtitled)	t-value
Mean scores of tests 1 - 4: Total	7.56	2.50	22.00	6.11	1.69	21.00	2.22*
Mean scores of tests 1 - 4: Recall	3.69	1.53	22.00	2.75	1.00	21.00	2.35*
Mean scores of tests 1 - 4: Understanding	3.82	1.52	22.00	3.35	1.27	21.00	1.08

Key to table: Statistical significance indicated by: * $p < 0.05$, ** $p < 0.01$

From this analysis, it is clear that there is a statistically significant difference between the mean scores for participants who took part in three out of the four sessions: the participants in the experimental group performed statistically significantly better than the control group. This is particularly true for the “recall” type of comprehension questions in the physical science test. This is the main finding of the study and it will be interpreted in the next chapter.

4.4 Confounding variables and results

In an experimental study, one needs to assess whether confounding variables (e.g. attitude towards a subject) has influenced the final results of the experiment. In the case of this study, we controlled for the following confounding variables:

- Gender
- Highest qualification of parents (as an indicator of socio-economic status)
- Grade 12 marks for physical science
- Grade 12 marks for English and Sesotho
- Self-designed comprehension tests for English and Sesotho proficiency
- Interest in science subjects in general
- General commitment to the academic part of school
- Experience of and attitudes towards subtitles.

The t-test results for all of these variables indicate that none of the confounding variables explain the statistically significant difference between the performance of the experimental and control groups when the means of the participants who attended three of the four sessions taken into account in this study are considered. The t-test results for each of the potential confounding variables are reported in the rest of this section.

4.4.1 Gender as a potential confounding variable

Gender is one of the many biographical variables that is traditionally included as a variable of interest in educational research (Grant & Sleeter, 1986:195). In 1986, Grant and Sleeter conducted a survey to determine which biological and social variables had been included most often in educational studies for the previous ten years. It was found out that out of the 71 articles surveyed, only 18 focused on gender alone as a variable and only five articles focused equally on either social class and gender (Grant & Sleeter, 1986:197). This study simply shows that gender

alone as a variable is always included, but gender with other variables is included to a lesser extent, and the rest of the articles focus on variables other than gender. In the context of gender as a confounding variable in second or foreign language learning, there is a long history of research that indicates that females are better at foreign language learning than males (Kobayashi, 2002:182). Conversely, there is some evidence that females are less successful in subjects such as mathematics and science (O’Brian, Martinez-Pons & Kopala, 1999:231). Based on these gender issues, this study therefore needed to monitor whether there was a statistically significant difference between the means achieved by participating females and males. Table 12 below contains the results that tested the potential influence of gender among the participants in this study.

Table 12: ANOVA results for gender as a confounding variable on total average scores of physical science tests 1-4

	Df	F	p
Gender	1,34	0,737	Not significant

Key to table: df = degrees of freedom; F = F-ratio

From the ANOVA results in Table 12 it is clear that there is no statistically significant difference between the scores achieved for the physical science tests by females or males in the experimental or control groups.

4.4.2 Highest qualification of parents (as indicator of socio-economic status)

Parents’ qualifications usually indicate their socio-economic status in South Africa (Van der Berg & Burger, 2003:498). Usually the higher the education of the parents, the better the socio-economic status of such parents, and the higher the socio-economic status of parents, the higher the learner educational attainment (Van der Berg & Burger, 2003:503). Socio-economic status has been indicated as a contributing causal variable in the educational attainment of learners under certain circumstances in many studies over a long period of time. Sewell and Shah (1967:23), for example, have observed results similar to those of Eckland (1967) in terms of socio-economic status and educational attainment. These two studies found that the socio-

economic status of parents is a contributing causal variable that affects higher educational attainment by learners.

These results have been repeated in more recent studies. Ermisch and Francesconi (2012:139), for example, argue that the qualifications of parents are known to have an impact on learner educational attainment. Learner educational attainment is known to be higher where the parents' educational qualifications are high. This is based on the assumption that 'highly educated parents may provide a better environment (e.g. books around the house) for producing human capital in their children' (Ermisch & Francesconi, 2012:139). A better learning environment and better human capital engender good educational attainment.

Parents' contribution towards learner attainment can be divided into the contribution that is brought about by the father and the contribution that is brought about by the mother. Each parent's contribution is different in the manner in which it affects a child's educational attainment. In a study analysing impact of family background, Ermisch and Francesconi (2012:146), for instance, found that a mother's education has a stronger association with her child's educational attainments than the education of the father. It was estimated in that study that the reason for that state of affairs was caused by the human capital investment which educated mothers put into the education of their children.

For the above-mentioned reasons, I monitored the potential influence of the qualifications of the parents of the participants as indicators of their socio-economic status on their scores for the physical science tests used in this study. No statistically significant correlation was found in this study for this variable. This implies that the mean difference between the experimental group and the control group was not found to be statistically significant as displayed in the ANOVA tables (Tables 13 and 14) below.

Table 13: ANOVA results for highest qualification of father as a confounding variable on total average scores of physical science tests 1-4

	df	F	P
Highest qualification of father	3,27	0,493	Not significant

Key to table: df = degrees of freedom; F=F-ratio

From the results in Table 13 above, it is clear that there is no statistically significant difference between the scores achieved and the qualifications of the fathers of the participants on the total average scores of physical science tests 1-4. From the results in Table 14 below it is clear that there is no statistically significant difference between the total average scores for physical science tests 1-4 achieved by the participants and the qualifications of the mothers.

Table 14: ANOVA results for highest qualification of mother as a confounding variable on total average scores of physical science tests 1-4

	df	F	P
Highest qualification of mother	3,30	0,889	Not significant

Key to table; df=degrees of freedom; F=F-ratio

4.4.3 English and Sesotho proficiency

It was argued in the previous chapter that the language proficiency of the participants could have an influence on the results of the educational tests, especially where the LoLT is an additional language and not the mother tongue of the learners. Participants with better English proficiency, for instance, could have an added advantage over other participants in both the control and experimental groups, while participants with better Sesotho proficiency would have an added advantage in the experimental group.

To try and monitor the potential influence of this variable, Grade 12 English as a first additional language and Sesotho Home Language examination results of the participants were analysed for both groups to evaluate the impact of English and Sesotho proficiency of each participant. In addition to this, self-designed English and Sesotho proficiency tests were also incorporated in the analysis of the experimental results.

The results from independent t-test analysis did not indicate any statistically significant differences in the means of scores for Grade 12 English and Sesotho final examination scores for the participants in either the experimental or in the control groups, as shown in Table 15 below. The learners in the experimental and control groups had comparable language scores for English and Southern Sotho based on their Grade 12 national examination scores in these subjects. Differences between their scores on the physical science tests used in this study can therefore not be explained by possible differences in language proficiency in English and Sesotho.

Table 15: Results of independent t-test to determine the means for the Grade 12 English and Sesotho scores for the control and experimental groups

	Mean Subtitled group	Std. Dev.	Valid n	Mean Not-subtitled group	Std. Dev.	Valid n	t-value
Grade 12 English	51.94	7.94	18.00	48.94	7.40	18.00	1.17
Grade 12 Southern Sotho	62.28	6.95	18.00	61.78	6.17	18.00	0.23

Key to table: Statistical significance indicated by: * p<0.05, ** p<0.01

The results from independent t-test analysis did not indicate any statistically significant differences in the means of scores for English and Sesotho based on the self-designed proficiency test scores either, as indicated in Table 16 below.

Table 16: Results of independent t-test to determine if the means for the subtitled self-designed proficiency scores and not-subtitled self-designed proficiency scores are statistically significantly different

	Mean Subtitled group	Std. Dev.	Valid n	Mean Not-subtitled group	Std. Dev.	Valid n	t-value
Self-designed Sesotho test TOTAL	5.29	3.30	7.00	2.89	2.42	9.00	1.68
Self-designed English test TOTAL	4.71	4.35	7.00	3.88	1.96	8.00	0.49

Key to table: Statistical significance indicated by: * p<0.05, ** p<0.01

Differences between results in the physical science test scores of participants in this study could therefore not be related to differences in proficiency in Sesotho or in English because, based on the two measures of language proficiency used in this study, it is clear that the participants had similar proficiency levels.

4.4.4 Interest in science as a subject as a potential explanation for differences in test scores

It is clear that interest in science as a subject could explain the differences in the physical science test scores of the participants. Several studies indicate that attitude towards subjects such as Mathematics and Science influence the effort students are prepared to put in to the learning of these subjects (Kim & Song, 2009:115).

If students in the experimental group liked science better as a subject, they could be more committed to the project and therefore do better. Attitudes towards physical science as a subject were measured in Section B of the questionnaire (see Appendix D). In Table 17 below, the independent t-test results indicate that there was no difference between the groups if one looks at the results for attitudes towards science as a subject.

Table 17: Results of independent t-test to determine if the means for the subtitled and not-subtitled groups concerning attitudes towards science as a subject are different

Questions	Mean Subtitled group	Std. Dev.	Valid n	Mean Not-subtitled group	Std. Dev.	Valid n	t-value
Q1	4.10	0.85	20	3.71	1.14	14	1.13
Q2	3.00	1.26	20	2.79	1.05	14	0.52
Q3	4.40	0.82	20	4.50	0.65	14	-0.38
Q4	3.11	1.23	18	2.62	0.87	13	1.24
Q5	4.45	1.00	20	4.86	0.36	14	-1.45
Q6	3.40	1.31	20	3.14	1.29	14	0.57
Q7	3.47	1.26	19	3.29	1.14	14	0.44
Q8	4.00	1.03	20	3.93	1.27	14	0.18
Q9	4.05	1.00	20	3.93	1.14	14	0.33
Q10	4.55	0.60	20	4.14	0.86	14	1.62
Q11	3.60	0.99	20	3.85	0.80	13	-0.75
Q12	4.20	0.70	20	4.07	0.92	14	0.47
Q13	4.00	0.97	20	4.00	0.88	14	0.00
Q14	2.85	1.35	20	2.93	0.73	14	-0.20
Q15	3.35	1.09	20	3.46	0.97	13	-0.30
Q16	3.05	1.39	20	3.14	1.03	14	-0.21
Q17	3.79	1.08	19	3.85	0.69	13	-0.17
Q18	2.75	1.07	20	3.00	1.04	14	-0.68
Q19	3.75	0.79	20	3.79	0.80	14	-0.13
Q20	4.65	0.49	20	4.79	0.43	14	-0.84
Q21	4.20	0.95	20	4.07	1.00	14	0.38
Q22	3.84	0.96	19	3.79	0.43	14	0.21
Q23	4.68	0.48	19	4.64	0.50	14	0.24
Q24	4.45	0.76	20	4.36	0.93	14	0.32
Q25	3.20	0.95	20	3.79	0.80	14	-1.88
Q26	4.11	0.94	19	4.14	0.77	14	-0.12
Q27	2.85	1.04	20	3.29	1.07	14	-1.19
Q28	4.10	0.85	20	4.07	0.83	14	0.10
Q29	3.42	1.17	19	3.86	1.03	14	-1.11
Average Section B	3.77	0.41	20	3.78	0.37	14	-0.08

Key to table: Statistical significance indicated by: * p<0.05, ** p<0.01

None of the t-test results were statistically significant, and this indicates that the attitudes towards science as a subject were the same for learners in the experimental and control groups. Differences in the physical science test scores used in the experiment can therefore not be explained by a potential difference in attitudes towards science as a subject.

4.4.5 Attitudes to and experience of subtitled material

If members of the experimental group were more experienced and/or positive towards the use of subtitles, it could possibly explain their superior achievement in the recall questions reported in this study. Attitudes towards and experience of the use of subtitles were measured in Section C of the questionnaire (see Appendix D). In Table 18 below, the independent t-test results indicate that there was no difference between the groups if one looks at the results for attitudes and experience of the use of subtitles.

Table 18: Results of independent t-test to determine if the means for the subtitled and not-subtitled groups concerning attitudes and experience towards the use of subtitles are different

Questions	Mean subtitled group	Std. Dev.	Valid n	Mean not-subtitled group	Std. Dev.	Valid n	t-value
C1	2.50	0.94	14.00	2.44	0.98	18.00	0.16
C2	2.29	1.07	14.00	1.94	0.93	16.00	0.96
C3	3.07	0.92	14.00	3.29	0.85	17.00	-0.70
C4	1.93	0.92	14.00	2.25	0.93	16.00	-0.95
C5	3.08	1.04	13.00	3.35	0.86	17.00	-0.80
C6	2.31	1.18	13.00	2.76	0.97	17.00	-1.16
C7	3.23	0.73	13.00	3.06	0.93	16.00	0.53
C8	3.14	0.95	14.00	2.94	0.83	17.00	0.63
C9	3.07	1.00	14.00	3.24	0.90	17.00	-0.48
C10	2.15	1.28	13.00	2.07	1.22	15.00	0.18
C11	2.36	1.08	14.00	2.35	1.11	17.00	0.01
C12	2.43	1.02	14.00	2.41	1.00	17.00	0.05
C13	2.93	0.92	14.00	3.29	1.10	17.00	-0.99
C14	3.29	0.83	14.00	3.35	0.61	17.00	-0.26

Key to table: Statistical significance indicated by: * p<0.05, ** p<0.01

No statistically significant differences were observed for experience of and attitudes towards subtitles between the experimental and control groups in the study.

4.4.6 Attitude towards the academic part of school

We have seen above that a good attitude towards certain subjects may influence learner academic attainment. From that premise it can be argued that a positive attitude towards schooling could influence learner achievement. Studies which looked at school as a whole indicate that a positive attitude to the academic part of school could potentially influence learner achievement. Some studies such as that of Mickelson (1970) even analysed different aspects of attitudes that have a direct influence on improved academic achievement, confirming that positive attitudes towards school contribute towards improved academic achievement by learners.

When data from the attitude of learners from both the control and the experimental groups were analysed to determine if any of the groups displayed a more positive attitude towards school and the academic part of school in general, it was found that there were no statistically significant differences in the attitudes of participants in the experimental and control groups. Table 19 indicates the results of the analysis of both groups in terms of their attitude towards school.

Table 19: Results of independent t-test to determine if the means for the subtitled and not-subtitled groups concerning attitudes towards the academic part of schools are different

Questions	Mean Subtitled group	Std. Dev.	Valid n	Mean Not-subtitled group	Std. Dev.	Valid n	t-value
D1	3.50	0.80	12.00	3.33	1.05	15.00	0.46
D2(NEG)	2.75	0.87	12.00	2.33	1.23	15.00	0.99
D3	2.50	1.24	12.00	2.50	1.29	14.00	0.00
D4(NEG)	1.75	1.36	12.00	1.87	1.30	15.00	-0.23
D5(NEG)	2.33	1.15	12.00	2.53	0.83	15.00	-0.52
D6	3.33	0.65	12.00	2.80	0.77	15.00	1.90
D7	3.67	0.49	12.00	3.54	0.52	13.00	0.63

Key to table: Statistical significance indicated by: * $p < 0.05$, ** $p < 0.01$

Based on the data presented in Table 19, it is clear that the participants displayed the same attitudes towards the academic part of school.

4.5 Conclusion and summary

The analysis of the results of this study can be divided into two categories in terms of variables that were measured: the relationship between the dependent and independent variables; and the analysis of results related to potential confounding variables. The analysis of the physical science results may in turn be divided into the recall and understanding parts of comprehension measured by the physical science tests.

There were statistically significant differences between the results for the physical science tests used in this study when the mean scores of the experimental and control groups were compared for those participants who attended the three out of the four sessions taken into account in this study. The experimental group performed statistically significantly better on the physical science test in terms of the total scores as well as the scores achieved for the recall questions. There was no statistically significant difference between the scores achieved on the understanding questions by the experimental and control groups who participated in three out of the four sessions in the study, although the experimental group achieved higher means (see Table 11). An analysis of the results that monitored the potential influence of confounding variables (gender, socio-economic status, proficiency in English and Sesotho, attitudes towards physical science as a subject, attitudes towards the academic part of school in general, attitudes towards and experience with subtitles) indicate that none of these variables could explain the differences in scores achieved for the total and recall questions in the experiment, because the participants displayed similar proficiencies and attitudes.

Based on the analysis of the results of all the above-mentioned variables, it could be said that the central theoretical statement of this study (mother-tongue subtitling will improve comprehension of physical science as a Grade 12 subject) is supported for the recall part of the physical science tests conducted. This result will be interpreted in the next chapter. The implications of this result for the use of mother-tongue subtitling in physical science subjects in secondary school education will also be discussed.

Chapter 5: Discussion and Interpretation

5.1 Introduction

In this chapter the results reported in Chapter 4 will be discussed and interpreted. The results of physical science test scores, t-tests, and the results related to confounding variables, will be interpreted and discussed. The conclusion and implications of these results will be given in Chapter 6.

5.2 The physical science test scores

It was observed in Chapter 4 that the average performance of the participants on all the tests conducted after watching the videos and included in the analysis was low. The participants in this study achieved an average of less than 50% for the physical science test which included recall and understanding type questions in the test that formed part of this intervention. This is not surprising if one looks at the average national performance of Grade 12 learners in physical science over the past three years (2009-2011) (DBE, 2010, 2011). The results for Grade 12 performance in national physical science examinations for 2009-2011 were as follows: 36.8% of pupils in 2009 achieved above 30%, 47.8% of pupils achieved above 30% in 2010, and 53.4% achieved above 30% in 2011. Pupils struggle with science and therefore we need to explore ways of assisting them.

Another crucial factor to consider in this study is the potential role played by lack of reading skills in Sesotho. In a study where the ability to read in the home language (Afrikaans and Sesotho) and an additional language (English) was measured, Hefer (2011:187) argues that: "Afrikaans speakers generally do much more L1 reading than Sesotho speakers for whom little Sesotho material is available". This is an important element to add to the discussion of the results of this study. It is possible that the lack of experience in reading Sesotho texts in general influenced the results because one can assume that competent reading skills in Sesotho are necessary for the reading of Sesotho subtitles. It is, however, very encouraging to note that Hefer (2011:213) also discovered that her participants' comprehension in Sesotho subtitles is better than in English L2. The findings from the current study and that of Hefer are encouraging as

indicators that mother-tongue subtitling can assist learners who are studying in English second language.

5.3 T-test results

There is a statistically significant difference between performances (total averages achieved and averages achieved for recall questions in particular) in the mean test scores of the experimental and control groups that participated in three out of the four sessions in the study. If one compares the means of the control group for each test with the means of the experimental group for each of the four tests that were taken into account in the analysis, one realises that the means for the experimental groups in each instance are higher than those of the control group except for one as indicated above. The difference that we see between the means for the average physical science test scores for recall questions is statistically significant, although the difference between the averages achieved might seem to be numerically low.

The main finding of the study is therefore that mother-tongue subtitling improves comprehension of physical science as a Grade 12 subject in general, and specifically in as far as recall is concerned. This is an important general finding, because it implies that the addition of mother-tongue subtitling to physical science content videos would be a powerful media support instrument if used in a teaching and learning situation. Overall, this finding indicates that the hypothesis of this study has been confirmed by the results: mother-tongue subtitling improves comprehension in physical science as a Grade 12 content subject in secondary education for the participating learners, especially for recall-type of comprehension.

Comprehension was split into recall and understanding categories in this study. It emerged in the test results that the category in which improvement occurred was the recall category. The recall category according to Bloom's revised taxonomy deals with objectives requiring only recognition of information in the knowledge category (Kathwohl, 2002) and we know from the original taxonomy that this category entails shallow processing of information. This observation indicates the level of learner cognitive development of the participants in this study. Their overall scores were low, both in their school grades and the scores of this experiment. Their best

performance was in the recall domain of their tests. This means that their best performances originated from shallow processing of information.

Considering the above-mentioned observation in the light of an observation that was made by Reynolds (2012), an assumption may be made that the multimedia learning effect is greater for learners with a lower knowledge of physical science than for those learners with a higher knowledge (Reynolds, 2012:74). Low scores obtained by all the learners in this study as evidenced by both their Grade 11 and Grade 12 final results are a clear indication that participants in this study had a low knowledge of physical science.

In a study to determine “The Effect of Bimodal, Standard, and Reversed Subtitling on L2 Vocabulary Recognition and Recall” by Zarei (2009), it was found that standard subtitling was significantly more effective than reversed subtitling in vocabulary recall. This study therefore confirms the findings of Zarei by showing that, as in the case of vocabulary recall, information recall benefits from exposure to translated subtitles.

5.4 The confounding variables

None of the potentially confounding variables in this study related statistically significantly to the physical science test scores, i.e. none of them could explain the differences between physical science test scores for the experimental and control groups. This is a very important finding, because it strengthens the conclusions made in this study. A discussion and interpretation follows of each confounding variable that was tested.

Gender. The absence of any statistically significant difference that was mentioned in Chapter 4 between the control group and the experimental group has certain repercussions for this study. It implies that the female and male learners were equally strong. It also implies that any academic performance difference between the two groups should not be inferred to emanate from their gender differences.

Highest qualification of parents as indicators of socio-economic status. This potentially confounding variable was found, as in the gender category above, to have no statistically

significant relationship with the scores. Figure 7 below is a pie chart displaying learner responses regarding their parents' qualifications, taking both fathers and mothers together. As can be seen from this graph, 35% of the learners did not have information about their parents' qualifications, 16.0% of the learners indicated that their parents had done Grade 7, 31.0% had done Grade 12, and 17% had done a post-school qualification.

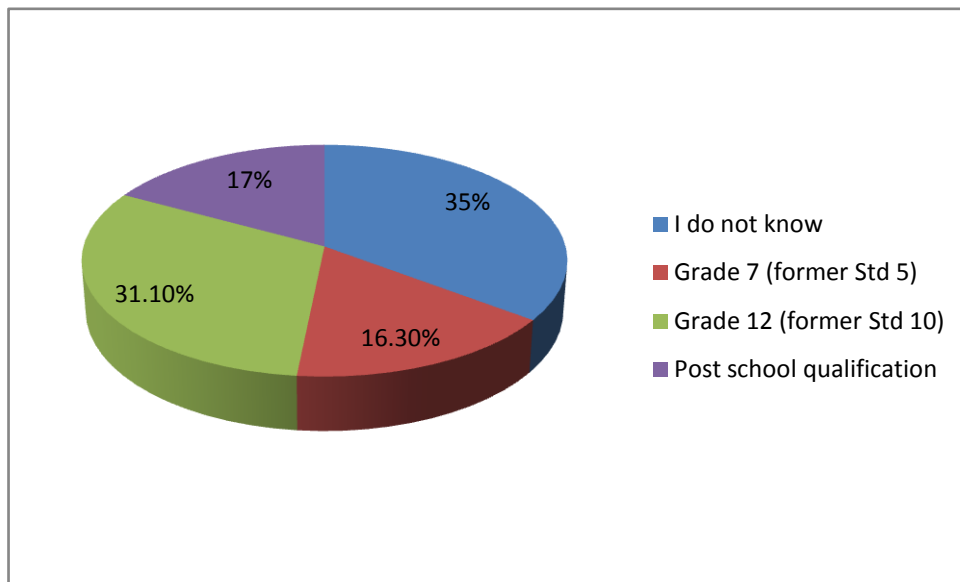


Figure 7: Highest qualifications of parents

Figures relating to participants' parents' qualifications reflect the socio-economic status of this population. It can be surmised from these figures that the majority of learners from the participating schools come from single-parent families and/or broken homes, as well as homes that lacked effective communication. This is derived from the fact that the majority of learners did not know their fathers' and/or mothers' qualifications. When 16% of the learners whose parents only passed Grade 7 is added to the 35% of learners who did not have information about their parents' qualifications, we realise that the majority of participants are educationally as well as socio-economically disadvantaged. The combined percentage of these two groups is 51%. The combined percentage of learners whose parents had done Grade 12 and post-school qualifications was 48%. This situation has implications for our study. The implications will be discussed in detail in the next chapter on conclusions and recommendations.

Experience and attitudes towards subtitles. This variable was covered in Section C of the questionnaire. The participants were required to indicate their experience of and attitudes towards subtitling in English and the mother tongue on a scale by ticking the most applicable response, where 1 = rarely, 2 = sometimes, 3 = frequently, 4 = generally and 5 = always. See Table 18 for the means.

The results of the participants' responses to these questions are presented in Figure 8. The differences between the means of the experimental and control groups were not statistically significant and this indicates that the attitudes towards and experiences of subtitles were the same for the participants in both groups.

What is important to highlight is the general negative attitude reported by participants in both groups towards the use of Sesotho subtitles for physical science teaching and learning (questions 4, 6 and 13). Even the learners in the experimental group believed that Sesotho subtitles should rather NOT be used in physical science classrooms.

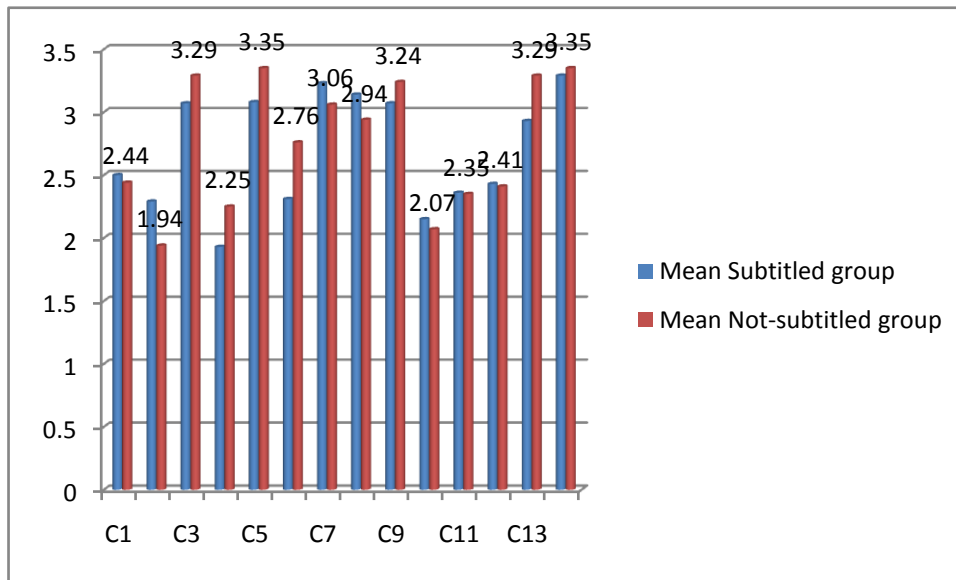


Figure 8: Mean differences in experience and attitude towards subtitles

These results were confirmed verbally when the participants expressed a negative attitude towards subtitles and specifically subtitles in Sesotho to the researcher during the intervention. Despite these negative attitudes towards subtitling in general and the use of Sesotho subtitling in

physical science teaching and learning specifically, the participants in the experimental group achieved statistically significantly higher recall scores.

Other confounding variables. The other confounding variables were adequately covered in the previous chapter, and particularly because they do not relate to differences between the two groups, they do not need any further elaboration here.

5.5 Conclusions

This study has shown through classical empirical research methodology that mother-tongue subtitling could be an important tool in enhancing achievement in physical science education. It has been shown that mother-tongue subtitling can be used as an additional comprehension tool to help learners who are struggling with second language proficiency in English (the LoLT in secondary education in South Africa) to understand physical science better. The statistically significant different physical science test scores (as evidenced by independent t-test results) indicated conclusively that the learners who viewed the videos with Sesotho subtitles performed better specifically on recall questions in this intervention. None of the potentially confounding variables were distributed differently in the two groups and therefore none of the confounding variables could explain the difference in physical science scores achieved in this study. It is important to note that both groups held negative attitudes towards the use of Sesotho subtitles in physical science education and that the advanced scores of the experimental group could not be explained by a more positive attitude towards Sesotho subtitles.

Chapter 6: Conclusions and recommendations

6.1 Main conclusions

This study found that Sesotho subtitles improved the recall component of physical science comprehension for Grade 12 learners in two secondary schools. This hypothesis was prompted by theoretical information derived from the literature, which asserts that the benefits of mother tongue education. Literature reviews concerning captioning and subtitling also indicated that subtitling could assist with educational achievement. Another part of this study was an attempt to determine whether comprehension theories and psycholinguistic theories support the feasibility of such a study. It was discovered from the literature survey that these two concepts support the paradigm of this hypothesis to a large extent. Furthermore, the study aimed to review the present situation regarding the stipulations of the South African LiEP, and aimed to explore how mother-tongue subtitling could practically support the multilingual LiEP. It was subsequently discovered from the literature survey regarding this policy matter that the findings from this study could actually provide direction that could assist South Africa to progress towards implementation of the country's liberal and multilingual language policy in order to support successful learning. The study was finally able to position itself as an intervention strategy for children who struggle with comprehension of physical science as a secondary school subject in two schools in South Africa. By so doing it was able to address the challenges noted in comprehension and psycholinguistic theories, provide some direction in the struggle to implement the LiEP in South Africa, and address the ramifications of multilingualism in South African education.

The main findings of the study are the following:

- Overall, there was a statistically significant difference between the physical science test scores of the experimental group who watched the video material with Sesotho subtitles and the control group.
- Specifically, there was a statistically significant difference between the physical science test scores for the recall questions achieved by the experimental group and those of the control group.

- The attitudes towards and experience of Sesotho subtitles of the participating learners in this project were negative. They did not believe that Sesotho subtitles could improve their understanding of physical science as a subject.
- Despite the negative attitudes towards Sesotho subtitles as a supporting mechanism to improve physical science comprehension, the results of this empirical study indicate that the recall marks of the experimental group (who watched the Sesotho subtitled video) were statistically significantly better than the marks achieved by the control group. This informs us that subtitling of learning material in the mother tongue improves the comprehension of learners at least in the recall domain.
- The findings of this study support the hypothesis stated initially. It also concurs with the theoretical premise upon which the hypothesis of this study is based, as evidenced from the literature surveys of both comprehension and psycholinguistic theories. This finding reinforces the notion that was raised at the beginning of this study, namely that mother-tongue subtitling can be used to support multilingualism and enhance effective learning by improving the comprehension of learners of physical science as a content subject in secondary education.
- Other theoretical information obtained from different captioning and subtitling studies have been confirmed by this study.

6.2 Recommendations

Based on the findings of this study, there are three types of recommendations to make: LiEP recommendations, research methodology recommendations, and technical/industry recommendations related to subtitling.

It is not necessarily imperative to use mother-tongue subtitling in every learning and teaching activity in South African secondary schools. However, it is maintained in this study that mother-tongue subtitling can be used as a remedial or support strategy to improve the comprehension (at least at recall level) for more taught via English as a medium of instruction in South African secondary schools.

It was obvious from the literature review on South African language policies that the South African LiEP is prone to different interpretations and implementations. The reason for this was found to be its extensive democratic nature which refrains from being prescriptive. The South African LiEP has been exploited by different stakeholders, some well meaning and some not so well meaning, for unproductive reasons. Ultimately, the vague policy statement has so far resulted in a lack of implementation of multilingual strategies (especially those related to the use of African languages in education at all levels). This trend has been observed by many scholars in South Africa (Beukes, 2009; Webb, 1991; Du Plessis, 2000; Heugh, 2002).

The very noticeable lack of implementation of the LiEP in South Africa is due primarily to the tendency of former DET schools to use mother tongue learning for only the first three years of school, and to use second language learning (in this instance English as the second language) for the remaining years of schooling as the medium of instruction. It is necessary to describe the language arrangements in both the former DET schools and the former Model C schools in full here. All South African schools are required by the new curriculum statement to offer a minimum of at least two official languages (DBE, 2008). A practical application of this policy by former DET schools translated into these schools ironically offering English First Additional language as a LoLT and any of the African languages as Home language.

The LiEP unnecessarily “subscribes to a monolingual conception of language whereby learners need to develop an additional language in domains that would normally be reserved for Home or Community language usage” (Van der Walt *et al.*, 2011:333). Based on this technical information about the conception of the new South African curriculum statement, it is obvious that more work needs to be done on the curriculum statement itself to ensure a viable arrangement for the learning of languages that will be used as media of instruction.

It is convincingly argued by Brock-Utne and Holmarsdottir (2003:6) that the language policies of South African education reflect the actual 1979 apartheid language policy. Secondly, ex-Model C schools are divided into those that use Afrikaans as the language of learning and teaching for the rest of the school years and English as the first additional language and do not offer any options for taking a third language; those that use English as Home language and Afrikaans as

first additional language; and lastly those that use both English and Afrikaans as parallel media of instruction in the same school – classes that use English as Home language use Afrikaans as first additional language and those that use Afrikaans as Home language use English as first additional language. Eighteen years post-1994, there is no evidence that African languages are used productively in secondary schools as media of instruction to improve access to learning for African language home language users.

These trends in the application of the LiEP in South African schools are due to the language policy itself. In short, the complex language situation in South Africa will always require creative solutions such as the use of mother-tongue subtitling. Mother-tongue subtitling can be used to support learners who find themselves in any of the above-mentioned school arrangements. Mother-tongue subtitling can be used to enhance comprehension in each of these situations. As South Africa is a diverse and multilingual country, a situation will always exist where a learner in a school situation will need mother tongue support and mother-tongue subtitling, and this will serve as a coping or support strategy in such a situation.

It was observed during the administering of the physical science tests that there were instances where it is impractical to use subtitles when conducting a lesson. Such instances are when narrators on the screen need to illustrate a point on the board on the screen. Normally such illustrations are written scripts themselves. It is possible that they could interfere with subtitles and hence it is not advisable to mix the two on the screen. Another instance where it is not advisable to use subtitling is when certain illustrations on the screen require the complete absence of any other interference. It was observed that in certain instances narrators themselves disappeared from the screen so that certain processes or procedures were practically presented without any other source. Subtitles can be hindrances if shown at the same time as such procedures are taking place; they can interfere and get in the way of visual presentations of experiments. We already know from the cognitive load theory that instructional control should be consciously exercised when designing a multimedia learning activity like this. Care should be taken not to overload a presentation with extraneous or ineffective material (Paas *et al.*, 2004). Nevertheless, more studies are required to evaluate subtitling against this information.

It was observed during the course of the design of this study that a lot of specialised contributions by experts from other disciplines would be required regarding instruments needed for the experiment. In Chapter 3, the subtitling used in the videos for this intervention was done at the Language Laboratory of the School of Languages at the Vaal Triangle Campus of the North-West University. The translation was done by the researcher himself and the back translations by colleagues. It should also be pointed out that the physical science tests were moderated by physical science specialised teachers at the schools where the experiment was done. All this information serves as a recommendation that a team of professionals should be utilised for any specialised instruments and material for the research, as this is important for the validity of the study. It is hoped that material of this nature will also become more widely available as the use of subtitling in South Africa is set to increase with the switch to digital broadcasting.

As the production and supply of Learning and Teaching Support Material (LTSM) is the prerogative of outside suppliers at schools, it is wise to bring the results of studies like these to the attention of the suppliers. There is a potential market for the production and supply of this kind of LTSM to schools. Suppliers whose major trade is to produce audiovisual material for schools are the main targets of this exploration. These suppliers could be encouraged to make subtitled material of this nature available as part of their stock. Publishers of physical science textbooks could explore the possibility of incorporating subtitled videos as support instruments with their books. These do not have to be compulsory, but like dictionaries, they could be used as additional learning enhancing strategies. With the increasing availability of online resources, this is becoming an even bigger reality.

The empirical research project as a whole has highlighted the need to include as many opportunities and tests as possible in an intervention study, as this gives the researcher sufficient data to work with if some of the data have to be discarded (as was the case in this study). Furthermore, all efforts should be made to ensure that a sufficiently large number of groups participate in as many of the events as possible that are planned for the intervention. It was also observed that some students lose interest as the study progresses, and it is therefore necessary to include as many participants as possible in a study of this nature so that the final results are still

valid even if some of the participants drop out due to tiredness, boredom or for any other reason. This was a minor problem for this study because for some sessions the sample sizes became too small to be used for individual analysis. It was fortunate that this study used the current part of the physical science syllabus; otherwise learner participation would have been even more adversely affected, as evidenced in lesson 15. The learners continued to attend later because they felt they were gaining knowledge of a part of the syllabus that they were to be examined on at the end of the year. This is a good example for future researchers to consider if they are interested in doing similar studies.

Care should be taken to distribute the difficulty level of the tests evenly throughout the intervention. This will ensure that the results of the study are spread evenly across all sessions. The study should not be too difficult or too easy for the learners, because then the test scores show little variance. It is therefore essential to establish test reliability and test validity using recognised methods.

The support of teachers, especially in the discipline on which the research is being conducted, is important for empirical studies of this sort. Educators at different participating schools know the learners, and their support of the study can be useful to enable sustained participation. They can advise the researchers about the best ways to handle learners so that they participate optimally in the intervention. In view of this, it is clear that it is challenging to conduct experimental research with learners at school level. The general view of school principals and provincial departments is that research experiments conducted by outside researchers disrupt learning and teaching. Education officials prefer that such research be conducted during school holidays or in the afternoon after classes. Unfortunately, since most township schools are still not performing well, teachers are forced to teach during school holidays, and afternoon classes are offered throughout the year in many cases. The Department of Basic Education has programmes in place for such schools which must be carried out during school holidays and during the afternoons. Teachers at such schools do not take kindly to intruders coming to do their business during this time. It needed some convincing from the researcher conducting this study to persuade the provincial Department of Basic Education, district departments and school principals as well as governing bodies to give permission for this research. They were convinced because the material for the

experiment was taken from the Grade 12 syllabus, so it was possible that it would contribute to the national examination performance of the learners. It is important also to point out that this state of affairs in township schools denies outside researchers the opportunity to explore situations and find solutions that could improve the quality of learning and teaching in these schools.

As situations and attitudes of learners change, even more information will emerge. It might be that the reading competency of learners who were used in this study was not as good as it would be if mother tongue teaching in the other African languages was to be implemented in South Africa, but the difference is already obvious. One can just imagine how much more significant the difference would be if learners started to gain better reading skills in their mother tongue. This could only happen if the policy allowed indigenous African languages to be used as languages of learning and teaching. The moment that this is implemented, many other positive results will emerge. More books will be printed in indigenous African languages, and indigenous African languages will be used more frequently in classes. Teachers will also be better empowered to use indigenous African languages effectively. If learners in South Africa get used to using their mother tongue as the language of teaching and learning for longer periods of time, the language situation will change even at secondary school level. One of the effects of the changed situation will be changed attitudes of learners and consequently, it is hoped, the attitude of parents will change as well.

If the situation changes towards the use of the mother tongue in education, interventions such as this study will have a more profound and better application in education. It was shown in a comparative study on the effects of bimodal, standard and reversed subtitling that: "... as to vocabulary recall, it can be concluded that bimodal subtitling is significantly better than standard subtitling, which, in turn, is significantly better than reversed subtitling" (Zarei, 2008:82). Bimodal subtitling could benefit learners who are at present forced to use standard subtitling if the policy were to change. This does not, however, imply that there would be no place for standard subtitling if the situation changes. It has already been pointed out that a multilingual environment which requires standard subtitling will always prevail in South African education.

As mother-tongue subtitling improves comprehension of physical science as a Grade 12 subject (specifically for recall questions), many opportunities are open for further use of subtitling other than the ones mentioned above. These results are particularly important because learners were negative at the beginning of the experiment; they never thought that Sesotho subtitling would help them with the comprehension of physical science. This study adds to the ever-growing number of schools of thought that mother tongue teaching in South African schools is practical and could be beneficial. An even wider scope for intervention studies of this nature should be explored where mother-tongue subtitling for other secondary education is also implemented and evaluated. Physical Science is widely acknowledged to be difficult for secondary school learners in South Africa, as evidenced by the poor national results discussed elsewhere in this dissertation. The improvement of recall comprehension in this traditionally difficult subject is encouraging. It is possible that comprehension gains in other subjects might be even greater. This potentially positive effect of mother-tongue subtitling on comprehension should be explored with more secondary school subjects.

Heugh (2000:5-6) stated:

The intention [in the paper] is not to suggest that language is everything. I should like to predict, though, that should the role of language [with reference to the mother tongue] continue to be shrouded in a confusion of ill-informed myths, it would eventually become the most important factor, which determines the failure of the majority and success for a tiny minority. It will certainly increase the gulf between those who have and those who do not.

I agree with Heugh, that if left unattended, the language situation in South African education will become the most important issue that determines the academic success or failure of learners at school. It is argued in this dissertation that the use of mother-tongue subtitling as a supportive instrument to improve comprehension in secondary schools in South Africa deserves further exploration – this indicates that we have heeded the warning sounded by Heugh and others. For example, Jansen (2010:200) correctly states that “every single case of education policymaking

demonstrates, in different ways, the preoccupation of the state with settling policy struggles in the political domain rather in the realm of practice”. I would therefore add my voice and say that mother-tongue subtitling is a practical and powerful solution to the implementation problems related to the education of multilingual learners in classrooms across South Africa. Mother-tongue subtitling could provide a first step towards using African languages effectively to enhance teaching and learning in the South African context where there is a struggle to understand how to use the mother tongue in education.

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APPENDIX A: Parent consent form



PO Box 1174, Vanderbijlpark South Africa, 1900
Tel: (016) 910-3475 Fax: (016) 910-3116
e-mail Johannes.mahlasela@nwu.ac.za

TO WHOM IT MAY CONCERN

Dear Sir/Madam

RE: PARENT/GUADIAN – REQUEST FOR PERMISSION TO CONDUCT RESEARCH

Request is hereby made to conduct research on your child as part of the school population. This research is about the ability of Grade 12 learners to comprehend physical science content when subtitled in the mother tongue. The aim of this research is to determine if mother tongue subtitling could improve learners' comprehension. It will be based purely on school assessment procedure and no physical tests will be conducted upon the children.

Your child's participation in this research is voluntary and may choose to withdraw from this process at any time. If a child chooses to participate or withdraw from the research process, there will be no penalty for doing so. Written consent will be obtained from your child.

For the purposes of anonymity and confidentiality, the names of the school and your child will not be mentioned throughout the data and findings of the research.

Should you have any questions or enquiries about this research, please do not hesitate to contact me or my supervisor.

Thanking you in advance

Your faithfully

Johannes Tsietsi Mahlasela

(016) 910 3475

Signature:.....Date:.....

I.....(full names of parent/guardian) hereby confirm that I understand that my child is involved in research by Mr J.T. Mahlasela and hereby give permission for my child to take part in this research.

Signature of parent/guardian

date

APPENDIX B: Learner assent form



**NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
INSTITUTIONAL OFFICE**

Learner number: _____

Name of School: _____

Date: _____

Information and assent

I, (PLEASE WRITE OUT YOUR FULL NAMES AND SURNAME)

GIVE PERMISSION TO THE RESEARCHER, MR JT MAHLASELA AND MEMBERS OF HIS RESEARCH TEAM, TO REPORT THE DATA GATHERED IN THIS QUESTIONNAIRE IN MY MASTER'S DEGREE, BOOKS, ACADEMIC JOURNALS, ACADEMIC CONFERENCES AND INSTITUTIONAL REPORTS AT THE NWU.

SIGNATURE

DATE

Ref no: 16/4/1/.....-.....

FS460C

APPENDIX C: Application to conduct a research project

FREE STATE PROVINCE



APPLICATION FORM TO REGISTER RESEARCH PROJECTS IN THE FREE STATE DEPARTMENT OF EDUCATION

- ❖ Please complete all the sections of this form that are applicable to you. If any section is not applicable please indicate this by writing N/A.
- ❖ If there are too few lines in any of the sections please attach the additional information as an addendum.
- ❖ Attach all the required documentation so that your application can be processed.

Send the application to:

Director: Quality Assurance

Room 401

Syfreets Building

Free State Department of Education

Private Bag X20565

Bloemfontein 9300

Tel: 4048750/4048658

Fax: 447 7318

1 **Title** (e.g. Mr, Ms, Dr, Prof.):

M	R		
---	---	--	--

2 **Initials and surname:**

J	T		M	A	H	L	A	S	E	L	A				
---	---	--	---	---	---	---	---	---	---	---	---	--	--	--	--

3 **Telephone: Home:**

N	A		-										
---	---	--	---	--	--	--	--	--	--	--	--	--	--

Work:

0	1	6	-	9	1	0	3	4	8	6		
---	---	---	---	---	---	---	---	---	---	---	--	--

Cell:

0	8	2	-	3	6	1	7	9	3	2		
---	---	---	---	---	---	---	---	---	---	---	--	--

Fax:

0	8	6	-	2	7	4	9	5	1	9		
---	---	---	---	---	---	---	---	---	---	---	--	--

E-mail

J	O	H	A	N	N	E	S	.	M	A	H	L	A	S	E	L	A	@	N	W	U	.	A	C	.	Z	A
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

4 Home Address:

P	O	B	O	X	2	8	4	2	9						
S	O	N	L	A	N	D	P	A	R	K					
												1	9	3	9

5 Postal Address:

P	O	B	O	X	2	8	4	2	9						
S	O	N	L	A	N	D	P	A	R	K					
												1	9	3	9

6.1 Name of tertiary institution/research institute

North West University

6.2 Occupation: Lecturer

6.3 Place of employment: Vanderbijlpark

7 **Name of course:** MA (Language Practice)

8 **Name of supervisor/promoter:** Prof. Susan Coetzee-Van Rooy

Please attach a **letter from your supervisor** confirming that you have registered for the course you are following.

9 **Title of research project:**

Improving comprehension in science through mother tongue subtitling in secondary education

10 **Concise explanation of the research topic:**

The study seeks to test the possibility of using mother tongue subtitling in former DET schools in science to improve the comprehension of learners. The study uses videotaped lessons to achieve this objective.

11 **Application value that the research may have for the Free State Education Department:**

As schools already use videotaped lessons such as the learning channel and other independent companies, it is anticipated that video tapes subtitled into the mother tongue can help improve the comprehension of learners in science. This is in line with the objective of the policy of multilingualism in schools as well as the LiEP.

12.1 **Full particulars of the group with whom the research is to be undertaken:**

Grade 12 learners whose mother tongue is South Sotho and who do science in the additional language of English.

12.2 **List of schools/Directorates in the Department/officials:**

Phiritona Secondary School and Sedibathuto Secondary School, both at Heilbron, as well as Cedar Secondary School at Sasolburg.

12.3 Grades:

Grade 12

12.4 Age and gender groups:

Mixed genders of Grade 12 learners aged between 17 and 21 years.

12.5 Language groups:

South Sotho home language as well as English First Additional Language doing Learners.

12.6 Numbers to be involved in the research project:

106 learners.

13 Full particulars of how information will be obtained, e.g. questionnaires, interviews, standardised tests. **Please include copies of questionnaires, questions that will be asked during interviews, tests that will be completed or any other relevant documents regarding the acquisition of information.**

Questionnaires and standardised test included herewith.

14 The **starting and completion dates of the research project (Please bear in mind that research is usually not allowed to be conducted in the schools during the fourth term).**

19 September 2011 – 21 October 2011

15 Will the research be conducted **during or after school hours?**

After school hours.

16 If it is necessary to use school hours for the research project, **how much time will be needed?**

N/A

17 **How much time will be spent on the research project by individual educators and/or learners?**

20 minutes watching unsubtitled video by group A. 30 minutes answering a test by the same group. 20 minutes watching a subtitled video by group A. 30 minutes answering a test by group A.

20 minutes watching a subtitled video by group B. 30 minutes answering a test by group B.

15 minutes filling in a questionnaire by both groups.

Total Time spent = 6 x 2 Hours.

18 Have you included:

- | | | |
|------|--|--------|
| 18.1 | A letter from your ⁴ supervisor confirming your registration for the course you are following? | Yes/No |
| 18.2 | A draft of the letter that will be sent to the principals requesting permission to conduct research in their schools? | Yes/No |
| 18.3 | A draft of the letter that will be sent to parents requesting permission for their children to participate in the research project?..(If applicable) | Yes/No |
| 18.4 | Copies of questionnaires that you wish to distribute? | Yes/No |
| 18.5 | A list of questions that will be asked during the interviews? | Yes/No |

I confirm that all the information given on this form is correct.


SIGNATURE

14.02.2011
DATE

APPENDIX D: Questionnaire



NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
VAAL TRIANGLE CAMPUS

Questionnaire: Grade 12 Physical Science Education

Background information: Thank you for agreeing to participate in this project in which we are trying to learn more about Grade 12 science and language. I appreciate that you signed the assent form.

Instructions:

We hope that you are comfortable and not anxious about participation. Remember: your participation will not influence your marks. You are helping us to understand how to improve the teaching of Grade 12 physical science. There are no wrong answers in this questionnaire, because we are interested in your opinion. Remember that you do not need to write down your name, because we will use the number allocated to you for this project to ensure confidentiality.

SECTION A: BIOGRAPHICAL INFORMATION: Please put a tick (✓) or a (x) at the relevant answers below:

1. Name of your school	Phiritona Secondary School	1
	Sedibathuto Secondary School	2
2. Learner number allocated to you by the researcher for participation in this project		
3. Age of the learner in years (today)	16 years or younger	1

	17 years	2
	18 years	3
	19 years	4
	20+ years	5
4. Gender of the learner (Female / Male)	Female	1
	Male	2
5. Race of the learner (Black, Coloured, Indian, White, other)	Black	1
	Coloured	2
	Indian	3
	White	4
	Other	5
6. Subjects taken by the learner in Grade 12. Please mark all the subjects you take	Sesotho Home Language	1
	IsiZulu Home Language	2
	English first additional language	3
	Physical Science	4
	Mathematics	5
	Mathematics Literacy	6
	Life Skills	7
	Other subjects? Please write them down in the space below	8

7. What is the highest educational level completed by your father?

I do not know	1
My father completed primary school (Grade 7 / former Standard 5)	2
My father completed secondary school (Grade 12 / former Standard 10)	3
My father completed a qualification/s at University / College	4

8. What is the highest educational level completed by your mother?

I do not know	1
My mother completed primary school (Grade 7 / former Standard 5)	2
My mother completed secondary school (Grade 12 / former Standard 10)	3
My mother completed a qualification/s at University / College	4

9. Please look at the following grid with languages. Please mark the ONE language you use at HOME most of the time.

Afrikaans	1	Shona	12
Dutch	2	Southern Sotho	13
English	3	Spanish	14
French	4	Swati	15
German	5	Tsonga / Shangaan	16
Hebrew	6	Tswana	17
Italian	7	Venda	18
Ndebele	8	Xhosa	19
Ndonga	9	Zulu	20
Northern Sotho	10	Other (specify below):	
Portuguese	11		

10. Please mark ALL the languages you know in the grid below.

Afrikaans	1	Shona	12
Dutch	2	Southern Sotho	13
English	3	Spanish	14
French	4	Swati	15
German	5	Tsonga / Shangaan	16
Hebrew	6	Tswana	17
Italian	7	Venda	18
Ndebele	8	Xhosa	19
Ndonga	9	Zulu	20
Northern Sotho	10	Other (specify below):	
Portuguese	11		

11. Which language or languages would you prefer to be used to teach Physical Science in Grade 12? Please motivate your answer.

a) Write down the name of the language / languages that should be used for teaching Grade 12 physical science:

b) Motivation of my answer at 11(a): I think this language / these languages should be used to teach Grade 12 Physical Science because ...

SECTION B : Attitudes towards physical science as a school subject

INSTRUCTIONS: *For each of the following statements, mark the rating category (x) that most indicates how you currently feel about the statement. Please respond to all of the items.*

1. I feel that physical science will be useful to me in my job in the future.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

2. The thought of being enrolled in physical science as a subject makes me nervous.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

3. A good learner must have training in physical science.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

4. Physical science seems very mysterious to me.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

5. Most people would benefit from taking a physical science course.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

6. I have difficulty seeing how physical science relates to my field of study.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

7. I see being enrolled in a physical science course as a very unpleasant experience.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

8. I would like to continue my physical science training after school.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

9. Physical science will be useful to me in comparing the relative merits of different objects, methods, programs, etc.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

10. Physical science is not really very useful because it tells us what we already know anyway.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

11. Physical science training is relevant to my performance in my field of study.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

12. I wish that I could have avoided taking physical science as a subject.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

13. Physical science is a worthwhile part of my future job training.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

14. Physical science is too maths oriented to be of much use to me in the future.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

15. I get upset at the thought of enrolling in another physical science course in future.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

16. Physical science is best left to the "experts" and should not be part of taking chances.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

17. Physical science is an inseparable aspect of scientific research.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

18. I feel intimidated when I have to deal with scientific formulas.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

19. I am excited at the prospect of actually using physical science in my future job.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

20. Studying physical science is a waste of time.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

21. My physical science training will help me better understand the research being done in my field of study.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

22. One becomes a more effective "consumer" of research findings if one has some training in physical science.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

23. Training in physical science opens up opportunities in future jobs.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

24. Physical science thinking can play a useful role in everyday life.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

25. Dealing with numbers makes me uneasy.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

26. I feel that physical science should be required early in one's school career.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

27. Physical science is too complicated for me to use effectively.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

28. Physical science training is not really useful for most future jobs.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

29. Physical science thinking will one day be as necessary for efficient citizenship as the ability to read and write.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
----------------	-------	---------	----------	-------------------

Note: Section B was adapted for Physical Science as a school subject in South Africa by making adjustments to WISE, S.L. 1985. The development and validation of a scale measuring attitudes towards statistics. *Educational and Psychological Measurement*, 45:401-405. The questionnaire is in the academic public domain and no additional permission was solicited.

SECTION C: Physical science content subject and language

Rate each of the following statements by ticking (x) the most applicable answer from the given scale below where 1=never, 2=seldom, 3=sometimes, 4=often

	Never	Seldom	Sometimes	Often
1. I have watched science videos before	1	2	3	4
2. I have watched subtitled science videos before.	1	2	3	4
3. Only English should be used in Physical Science lessons.	1	2	3	4
4. Only Sesotho should be used in Physical Science lessons.	1	2	3	4
5. Both English and Sesotho should be used in Physical Science lessons.	1	2	3	4
6. I recommend mother tongue subtitling for physical science content subject.	1	2	3	4
7. I watch TV every day.	1	2	3	4
8. The programmes I watch contain subtitles.	1	2	3	4
9. Subtitles help me follow TV programmes I watch.	1	2	3	4

10. Subtitles irritate me.	1	2	3	4
11. I have watched subtitled educational programmes before.	1	2	3	4
12. I have watched subtitled science education programmes before.	1	2	3	4
13. I think science TV programmes with Sesotho subtitles would be beneficial.	1	2	3	4
14. I think science TV programmes with English subtitles would be beneficial.	1	2	3	4

SECTION D: Attitude towards the academic part of your school work.

Rate each of the following statements by ticking (x) the most applicable answer from the given scale below where 1=never, 2=seldom, 3=sometimes, 4=often.

	Never	Seldom	Sometimes	Often
1. I have a place to study after school.	1	2	3	4
2. When I study at home, I am interrupted.	1	2	3	4
3. I do not like all my subjects at school, but I still work hard.	1	2	3	4
4. I do not work hard at my school work because I dislike certain teachers.	1	2	3	4
5. I get nervous when taking a test.	1	2	3	4
6. When I have trouble with my school work I try to talk with the teacher.	1	2	3	4
7. My marks in my school subjects show what I can do.	1	2	3	4

END OF THE QUESTIONNAIRE - Thank you for your time!

APPENDIX E: Physical Science Tests



NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
VAAL TRIANGLE CAMPUS

RESEARCH TITLE: IMPROVING COMPREHENSION IN PHYSICAL SCIENCE

Use this paper to answer your questions:

Learner Number.....

Name of School:.....

Subtitled		Not Subtitled	
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COMPREHENSION TEST

LESSON 13 (A)

TIME ALLOCATION: 30 MINUTES

The following questions are based on the video that you have just watched, entitled **ELECROMAGNETIC WAVES – dispersion of light**. Please try to answer as many questions as you can.

1. Mention one easily available concrete object that one may use to conduct the experiment that was conducted in the video.
Piece of glass
2. Define 'dispersion of light' in your own words.
Spreading of light
3. Explain the difference between a 'dense medium' and a 'vacuum'.
Dense medium – medium in which it is difficult for light to travel because of the composition thereof. Vacuum – No obstruction like air.
4. In which type of medium is light likely to travel faster, in a 'dense medium' or 'vacuum'? Choose.
Vacuum
5. Arrange the following colours of the spectrum of light according to their speed from the fastest to the slowest.

Green Orange Violet Yellow Blue Indigo Red

1.red
2.orange
3.yellow

4.green
5.blue
6.indigo
7.violet

6. White light may be defined in terms of two characteristics, name them.

Different frequencies
Different wavelengths

7. Give the equation for the speed of light.

Speed = frequency X wavelength

8. Give two examples of shorter wave length and two examples of longer wave length.

SHORTER WAVE LENGTH	1. <u>ultraviolet</u>	LONGER WAVE LENGTH	1. <u>microwaves</u>
	2. <u>X-rays</u>		3. <u>Infrared</u>

9. Describe where invisible spectrum may be found.

Anything beyond invisible spectrum/ anything shorter / much higher wavelength/ much smaller wavelength.

10. Fill in:

Electromagnetic radiation occurs within the: much higher wavelength and lower/ smaller wavelength

One mark each:

TOTAL = 20 Marks



NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
VAAL TRIANGLE CAMPUS
THAK YOU VERY MUCH

Research Project Title: Improving comprehension in physical science .

Use this paper to answer your questions:

Learner Number.....

Name of School:.....

Subtitled		Not Subtitled	
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Post Test:

LESSON 13 (B)

TIME ALLOCATION: 30 MINUTES

The following questions are based on the video that you have just watched, entitled **ELECROMAGNETIC WAVES - frequencies**. Please try to answer as many questions as you can.

1. Give two examples of ultraviolet rays.

x-rays
gamma-rays

2. What is the product of radioactive decay of isotopes?

x-rays & gamma-rays

3. Mention the type of radiation that we get from the sun.

Gamma radiation

4. Choose the range of wavelength of ultraviolet rays from the given ones.

- A. 720 nm – 1 000 nm
B. 1 000 nm – 720 nm
C. 520 nm – 720 nm
D. 320 nm – 400 nm

5. Fill in:

5.1 The frequency of shorter wavelengths is higher higher/lower(choose).

5.2 The damage caused by shorter wavelengths in humans results into cancer / tumours

6. The deficiency in proteins caused by shorter wavelengths in humans occurs on one of the following molecules:

- A. RNA
- B. DNA
- C. CHN
- D. DNO

7. Identify the vitamin that is produced by the UV B from the sun, from the given ones.

- A. Vitamin B
- B. Vitamin D
- C. Vitamin E
- D. Vitamin C

8. Mention two chemicals from which sunscreens are produced.

Titanium Oxide
Zinc Oxide

9. Explain in your own words one way in which sunscreens work to protect the skins of humans.

Block out ultraviolet
Absorb the ultraviolet

10. In your own words explain the disadvantage of using creams that make skin light by black people.

Removes substance of the skin that blocks ultraviolet rays.

11. In your own words, how would you define magnetic radiation in simple terms?

Interaction of electric field and magnetic field. / Changing magnetic field

12. What is the result around the conductor if carrying current?

Magnetic radiation / field

13. What is the result of a constantly changing magnetic field inside the conductor?

Electric conduction / electric current

14. For us to induce electric field as well as magnetic field they must both stand at right angles to each other. (fill in) (1)r

R	C	TOTAL

Thank you very much



NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
VAAL TRIANGLE CAMPUS

Research Project Title: Improving comprehension in physical science .

Use this paper to answer your questions:

Learner Number.....

Name of School:.....

Post test:

LESSON 14 (A)

TIME ALLOCATION: 30 MINUTES

The following questions are based on the video that you have just watched, entitled **ELECTROMAGNETIC RADIATION – radioactive decay**. Please try to answer as many questions as you can.

1. Give two views about the nature of light.

light is a wave
light is a particle

2. Give two views about the nature of matter.

Matter is associated with waves
Matter is a particle

3. Define current according to how you understand it in your own words.

Current is moving charges

4. Define acceleration in the context of the accelerating particle in your own words.

Accelerating particles behave like a wave

5. Supply the formula for the speed of a wave.

$C = f\lambda$

6. Supply the formula for frequency.

$F = c/\lambda$

7. Supply the formula for energy.

$$E = hf$$

$$E = hc/\lambda$$

8. Consider the following information:

Radio waves: $\lambda_1 = 3 \text{ m}$

Gamma rays: $\lambda_2 = 0,03 \times 10^{-9} \text{ m}$

- 8.1 Calculate the frequency of each of the above waves. (3)

$$\begin{aligned} F_1 &= c/\lambda \\ &= 3 \times 10^8 \\ &= 1,0 \times 10^8 \text{ Hz} \end{aligned}$$

$$\begin{aligned} F_2 &= c/\lambda \\ &= 3 \times 10^8 \\ &= 0,03 \times 10^{-2} \\ &= 1,0 \times 10^{-19} \text{ Hz} \end{aligned}$$

- 8.2 Determine the amount of energy that photons of radio waves and gamma rays have. (3)c

$$\begin{aligned} E_1 &= h.f \\ &= 6,63 \times 10^{-34} \times 1,0 \times 10^8 \\ &= 6,63 \times 10^{-26} \text{ J} \end{aligned}$$

$$\begin{aligned} E_2 &= h.f. \\ &= 6,63 \times 10^{-34} \times 1,0 \times 10^{19} \\ &= 6,63 \times 10^{15} \text{ J} \end{aligned}$$

- 8.3 What can be deduced about the frequency and energy of certain types of waves? (2)c

The smaller the frequency of the waves, the less the energy they have. Gamma rays have the highest frequency and therefore the most energy.

Total Marks = 20

R	C	TOTAL

Thank you very much



Research Project Title: Improving comprehension in physical science .

Use this paper to answer your questions:

Learner Number.....

Name of School:.....

Subtitled	Not Subtitled
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Post test:

LESSON 15

TIME ALLOCATION: 30 MINUTES

The following questions are based on the video that you have just watched, entitled **TRANSMISSION OF ELECTROMAGNETIC RADIATION AND PHOTOELECTRIC EFFECT**. Please try to answer as many questions as you can.

1. $9,5 \times 10^{-20}$ J energy is required to remove an electron from calcium metal. Blue light ($\lambda = 500 \times 10^{-2}$) is shone onto the piece of metal.

1.1 What name is given to the process mentioned above? (2)r

Photoelectric effect

1.2 Will the blue light be able to remove an electron from this piece of metal? (4)c

Yes, it has enough energy to remove it

$$c = f \cdot \lambda$$

$$f = c/\lambda$$

$$\frac{3 \times 10^8}{500 \times 10^{-2}}$$

$$= 6,0 \times 10^{14} \text{ Hz}$$

$$= 6,0 \times 10^{14} \text{ Hz}$$

$$E = hf$$

$$= 6,63 \times 10^{-34} \times 6,0 \times 10^{14}$$

$$= 3,978 \times 10^{-19} \text{ J}$$

2. If the energy of visible light increases, the following will occur: Draw a cross(x) over the correct letter.
- A. Wavelength decreases; frequency increases; colour shift to the blue side of the spectrum.
 - B. Wavelength increases; frequency increases ; colour shift to the red side of the spectrum
 - C. Wavelength decreases; frequency decreases; colour shift to the blue side of the spectrum
 - D. Wavelength decreases; frequency increases; colour shift to the red side of the spectrum (2)c

3. The behaviour of light when it hits an object depends on (Mark with a cross (x) over the correct letter):
- A. The speed of light
 - B. The wavelength of light
 - C. The energy of light
 - D. The size of the object (2)r
4. The minimum frequency of a photon that is required to release an electron from a metal is known as (Mark with a cross (x)):
- A. Quantum of light
 - B. Work function
 - C. Threshold frequency
 - D. Photon energy (2)r
5. An electron that receives energy from a light photon can jump to a higher energy level, only if the:
- A. Energy difference between the levels is greater than the energy of the photon
 - B. Energy difference between the levels is smaller than the energy of the photon
 - C. Energy difference between the levels is equal to the energy of the photon
 - D. Electron has absorbed half of the photon energy (2)r
6. Study each of the following cases:
- A. – light that travels through glass
 - B. – orange and pink colours during sunrise and sunset
 - C. - Ultraviolet light shines through glass and warms it slightly c

Explain what happens in each case and also give the appropriate term for each of the processes that occur. (6)

- A. Transmission – light passes through glass
 - : Is not absorbed
 - : Light moves slower
 - : Light moves in the same direction
- B. Scattering – light moves slower
 - : Violet – blue part of light is absorbed
 - : Red light is let through
- C. Absorption / Reflection
Chlorophyll pigment absorbs most of the frequency of visible light except for green.
Green is reflected to our eyes.

Total marks = 20

R	C	total

Thank you very much



RESEARCH TITLE: IMPROVING COMPREHENSION IN PHYSICAL SCIENCE

Use this paper to answer your questions:

Learner Number.....

Name of School:.....

Subtitled		Not subtitled	
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COMPREHENSION TEST

LESSON 16

TIME ALLOCATION: 30 MINUTES

The following questions are based on the video that you have just watched, entitled **ELECTROMAGNETIC RADIATION – lasers and spectra**. Please try to answer as many questions as you can.

- Make use of the following formula alongside and explain what you can deduce about the “fall” of an electron between energy levels of violet and the red light, respectively.

h & c are constants. red . violet (red light has the longest λ and violet light the shortest. $(E_1 - E_2)$ red < $(E_1 - E_2)$ violet. A constant divided by a smaller denominator $(E_1 - E_2)$ gives a larger answer (i.e. results in a larger λ , & vice versa. $E_1 - E_2$ is the energy Jump of the electron from a higher level to a lower energy level. The size of the jump determines the colour (frequency) of the light that is radiated. The jump is much larger for violet than red light. Violet: $5 - n = 2$, red $3 - n = 2$.

(4)
- What does the abbreviation ‘laser’ stand for?

Light amplification by stimulated emission of radiation(2)
- Briefly explain how a laser works.

Movement of electrons from the stage of high energy to a stage of low energy in the atom.-(2)
- How does laser differ from normal light that is emitted from a bulb?

Laser is monochromatic: one wavelength and one colour coherent in phase. Directional: moves as a thin beam.(2)
- Give three properties of lasers.

 - : Focus on a very small spot.
 - : Contains a lot of energy.
 - : Can be used to transfer information

- Three-D pictures-(3)
6. Give three applications of lasers.
Bar codes in shops
Communication
Medical lasers
Printers(3)
7. Give the reason why the intensity of light diminishes as one moves away from its source.
Light energy is spread in all direction – less intensity-(2)
8. Define the following two terms: Polychromatic light and
Monochromatic light
Poly – different colours / out of phase/chaotic/ distractive interference
Mono – one-(2)

TOTAL = 20marks
THANK YOU VERY MUCH

APPENDIX F: Sesotho and English Comprehension Tests

Make Money From Home

Starting a home business is an appealing idea. Earning some extra money for a bit of work is an honest exchange that has the possibility of turning into a lucrative endeavour. Everyone wants to be their own boss and be able to work as they see fit.

And there are a lot of people out there who are willing to sell or share ideas to get you rich quick. Some of them are worthwhile, others not so much. The trick is in navigating the minefield of false or fraudulent opportunities.

There's no way to be sure you won't get taken in one of the many home business opportunity scams as nobody is immune, but there are a few things you can do to limit your exposure to online business scams and do your best to avoid losing money and time.

The number one red flag is when the offer requires you to put up money in order to learn the secret to success. There are companies that expect you to buy in, but they will give you plenty of information and time so that you can make an informed decision.

One popular form of business that requires start up money is buying into a franchise. Fast food chains and other chain business do require you to put capital into the business. But not until they have given you data about the company and answered all of your questions. If someone wants money first, stay away.

The second thing to watch out for is a company that wants you to work for almost nothing, paying you much less than what your work should be worth. These jobs promise big money, but you have to work endless hours to see anything. Businesses like these often ask you to "stuff envelopes" or pay you to read email and click links. You should be selling advertising, not just reading it.

If you are tempted by a home business, first determine exactly what it is that you will be doing, and then estimate the number of hours it would take to complete each specific task. Figure out how much you will be making per hour, and then ask yourself if it is really worth it. If you're looking at minimum wage or below, it's not going to be worth starting your own business.

Finally, don't be tempted by the promise of fast, big money. Almost everyone who promises you that you will become rich on little or no work is just selling you a line. The world just doesn't work that way. Do your homework, put in the work necessary to make your business successful, and you can keep from being scammed.

Answer the following questions in clear and understandable language:

1. Explain the theme of this text. (2)

Do not be caught up by business scams

2. Give two major characteristics of money scams mentioned in the above text. (2)

They need money up front

They promise big money for little work

3. Answer with a TRUE or FALSE and give reasons for your answers:

3.1. All the people who are selling or sharing ideas about getting rich quickly are not crooks.(2)

False – some are crooks

3.2. All the people are immune to business opportunity scams. (2)

False – no one is immune

4. Why is the author using the phrase “navigating the minefield” to explain the activity of finding one’s own way around. (2)

Because finding a legitimate business is tricky/dangerous

5. Why is the author using the phrase “one red flag” to describe a certain specific offer made by people to scam others? (2)

A red flag is a sign of danger

6. Identify the red flag in the above sentence and write it down. (1)

Scam – when money is required up front.

7. Define franchise. (1)

A brand that conducts business which needs a certain amount of money to start doing business.

8. Give two businesses that would require you to pay money up front before you can start a business. (2)

Franchise

A scam

9. Explain why the author thinks that it is not worth starting a business if one is looking at a minimum wage or below. (2)

One is going to work hard for nothing

10. Explain “selling a line”. (2)

Duping/Scamming

Total = 20 marks

Visit today <http://makeeasymoneyinfo.blogspot.com/>

Etsa Tjhelete o le lapeng

Ho qala kwebo ya lapeng ke mohopolo o ipiletsang. Ho fumana tjhelete e eketsehileng bakeng sa mosebetsinyana ke phapanyetsano e tshepahalang e nang le kgonahalo ya ho fetoha boiteko bo kenyang tjhelete e ngata.

Mme ho na le batho ba bangata kante kamoo ba ikemiseditseng ho rekisa kapa ho fapanyetsana mehopollo ho o etsa hore o ruwe kapele. E meng ya yona e metle, empa e meng ha e jwalo. Leqheka ke ho tswa hara tshimo ya maraba a fatshe a menyetla ya bohata le boqhekanyetsi.

Ha ho kamoo o ka kgodisehang hore o ke ke wa tshwarwa ke bo bong ba boqhekanyetsi ba menyetla ya kgwebo kaha ha ho ya sa tshwaetsweng, empa ho na le dintho tse mmalwa tseo o ka di etsang ho fokotsa boqhekanyetsi ba kgwebo ya mehala mme wa etsa sohle seo o ka se kgonang hore o se ke wa lahlehelwa ke tjhelete le nako.

Folakga ya pele e kgubedu ke ha seo o se fuwang se o hloka hore o kenye tjhelete hore o tsebe lekunutu la katleho. Ho na le dikgwebo tse ka ratang hore o kenye ho hong, feela di tla o fa boitsebiso bo bongata le nako hore o ka etsa qeto e nang le boitsebiso.

E nngwe ya dikgwebo tse ratwang tse hlokang hore o be le tjhelete ya ho qadisa ke di-franchise. Dikgwebo tsa dijo tsa kapele le tse ding di o hloka hore o kenye kapitale kgwebong. Empa e seng ho fihlela ba o file boitsebiso ka kgwebo le ho araba dipotso tsohle tsa hao. Ha e mong a qala ka ho batla tjhelete pele, sutha.

Ntho ya bobedi eo o lokelang ho e ela hloko ke dikgwebo tse batlang hore o batle o sebeletsa mahala, tse o lefang hanyenyane ho feta kamoo mosebetsi wa hao o hlokang kateng. Mosebetsi ena e tshepisa tjhelete e ngata, empa o lokela ho sebetsa dihora tse sa kgaotseng ho fumana ho hong. Dikgwebo tse tjena di atisa ho o kopa hore o tlatse dienfelopo kapa o bale e-mail e be o tobetsa kgokahanyo. O lokela o be o rekisa papatso, e seng ho bala feela.

Haeba o lekeha ke kgwebo ya lapeng, fumana pele hore na o tla be o etsang, e be o hakanya palo ya dihora tseo o tla di hloka hore o ka qeta mosebetsi o itseng. Fumana hore na o tla be o fumana

bokae ka hora, mme o ipotse hore na e hlile o hloka seo.Haeba o batla moputso o monyenyanane kapa ka tlase ho moo, ha ho hloka hore o qale kgwebo ya hao.

Qetellong, o se ke wa lekeha ke tshepiso ya tjhelete ya kapele le e ngata. Hoo e batlang e le e mong le e mong ya o tshepising hore o tla rua ka mosebetsi o monyenyanane kapa o siyo o o tshwarisa mamphela ka sekotlo. Lefatshe ha le sebetse jwalo. Etsa mosebetsi wa hao wa hae, Etsa mosebetsi o hlokaalang ho etsa hore kgwebo ya hao e atlehe, mme o ka kgona hore o se ke wa qhekanyetswa.

Etela kajeno <http://makeeasymoneyinfo.blogspot.com/>

Araba dipotso tse latelang ka Sesotho se hlakileng le se utlwahalang:

1. Hlalosa mokotaba wa sengodilweng sena. (2)

[O se ke wa qhekanyetswa hore o qale kgwebo](#)

2. Fana ka ditshobotsi tse pedi tse hlaleletseng tsa boqhekanyetsi ba ditjhelete bo boletsweng kahodimo. (2)

[-Di hloka hore o lefe pele](#)

[- Di tshepisa tjhelete e ngata bakeng sa mosebetsi o monyenyanane](#)

3. Araba ka NNETE kappa LESHANO mme o fane ka mabaka karabong tsa hao:

- 3.1.Batho bohle ba rekisang kappa ho fana ka boitsebiso ka tsela ya ho rua kapele ke baqhekanyetsi. (2)

[Leshano – Ba bang ha se baqhekanyetsi.](#)

- 3.2. Batho bohle ha ba tshwaetswe ke boqhekanyetsi ba dikgwebo.

[Leshano – Ba bang bay a qhekanyetsa](#)

4. Hobaneg ha mongodi a sebedisa polelwana “ho tswa hara tshimo ya maraba a fatshe” ho hlalosa tsela ya ho fumana tsela?(2)

Hobane ho fumana tsela e tshepahalang ha ho bonolo/ ho kotsi

5. Hobaneng ha mongodi a sebedisa polelwana “folkga e kgubedu” ho qaqisa mpho e itseng e etswang ke baqhekanyetsi? (2)

Folakga e kgubedu ke letshwao la kotsi

6. Qolla folakga e kgubedu eo ho buuwang ka yona ka hodimo e be o a e ngola. (1)

Baqhekanyetsi

7. Hlalosa franchise. (1)

Kgwebo e tsebahalang e hlokang hore motho a be le tjehele hore a e qadise.

8. Bolela dikgwebo tse pedi tse ka o hlokang hore o romele tjehele pele. (2)

Franchise

Boqhekanyetsi

9. Hlalosa hore ke hobaneng ha mongodi a nahan hore ha ho molemo ho qala kgwebo haeba motho a batla tjehele e nyenyane kapa e ka tlaase ho moo.(2)

O tla sebetsa ka thata bakeng sa phaello e nyenyane.

10. Hlaosa “ho tshwarisa motho mamphole ka sekotlo”. (2)

Ho dihela motho

Kakaretso= matshwao a 20

Appendix G: Registration of Research Project

26/09/2011 10:46

0514049249

DEP PRP&PPP

PAGE 02/02



education

Department of
Education
FREE STATE PROVINCE

Enquiries: LV Alexander
Reference: 16/4/130 - 2011

Tel: 051 404 9275
Fax: 085 6878 678
E-mail: rosesearch@edu.fs.gov.za

2011 – 09 – 20

MR J. T. MAHLASELA
P. O. Box 28429
SONLAND PARK
1939

Dear Mr Mahlasela

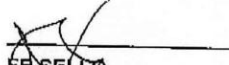
REGISTRATION OF RESEARCH PROJECT

1. This letter is in reply to your application for the registration of your research project.
2. Research topic: **Improving comprehension in science content subject through mother tongue subtitling in secondary education.**
3. Your research project has been registered with the Free State Education Department.
4. Approval is granted under the following conditions:-
 - 4.1 The name of participants involved remains confidential.
 - 4.2 The questionnaires are completed and the **interviews are conducted outside normal tuition time.**
 - 4.3 This letter is shown to all participating persons.
 - 4.4 A bound copy of the report and a summary on a computer disc on this study is donated to the Free State Department of Education.
 - 4.5 Findings and recommendations are presented to relevant officials in the Department.
5. The costs relating to all the conditions mentioned above are your own responsibility.
6. **You are requested to confirm acceptance of the above conditions in writing to:**

**DIRECTOR: STRATEGIC PLANNING, POLICY AND RESEARCH,
CNA Building, Maitland Street - Private Bag X20565, BLOEMFONTEIN, 9301**

We wish you every success with your research.

Yours sincerely


FR SELLO

DIRECTOR: STRATEGIC PLANNING, POLICY AND RESEARCH

Directorate: Strategic Planning, Policy & Research – Private Bag X20565, Bloemfontein, 9300 - Room 301, Old CNA building,
Maitland Street, Bloemfontein 9300 – Tel: 051 404 9287/ Fax: 051 4049274 E-mail: quality@edu.fs.gov.za

Appendix H: Notification to the District

26/09/2011 10:46 0514049249

DEP PRP&PPP

PAGE 01/02



education
Department of
Education
FREE STATE PROVINCE

Enquiries: LV Alexander
Reference no.: 16/4/1/36-2011

tel: 051 404 0203
Fax: 086 6678 678
Email: research@edu.fs.gov.za

2011-09-20

Ms L.J. Mabote
Director: Fezile Dabi Education District
Private Bag X2007
SASOLBURG
9570

Dear Ms Mabote

NOTIFICATION OF A RESEARCH PROJECT IN YOUR DISTRICT

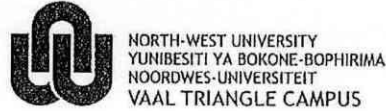
Please find attached copy of the letter giving **Mr Mahlasela** permission to conduct research in sampled schools in the Fezile Dabi Education District. Mr Mahlasela is a lecturer at Vaderbijlpark and is studying for Masters Degree with the University of North West.

Yours sincerely

FR SELLO
DIRECTOR: STRATEGIC PLANNING, POLICY AND RESEARCH

Directorate: Strategic Planning, Policy & Research; Old CNA Building, Maitland Street, Private Bag X20565,
Bloemfontein, 9300 – Tel: 051 404 9287 / 9275; Fax: 051 404 9274 – E-mail: research@edu.fs.gov.za

Appendix I: Request to conduct research at Phiritona Secondary School



PO Box 1174, Vanderbijlpark
South Africa, 1900

Tel: (016) 910-3486
Web: <http://www.nwu.ac.za>

Phiritona Secondary School
P.O.Box 365
HEILBRON
9650

TO WHOM IT MAY CONCERN

Dear Sir/madam

A request is hereby made to the SGB and the principal of the above mentioned school to allow the person mentioned underneath to conduct a research at your school. This research is aimed at grade twelve learners who are doing physical science as a subject. The topic of this research is, "Improving comprehension in science content subjects through mother tongue subtitling in secondary education". As you can realize from the topic of this research, this research is aimed at improving the performance of learners in schools.

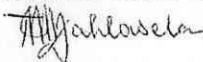
The intention is to conduct it during the third term of 2011. Permission has been sought from the provincial education department to do so. It is estimated that the duration of this research would be at most seven hours and the conductor is intending to use time after hours to conduct this research.

Consent letters would be issued to learners and parents of these learners to give permission for their children to take part in this research. Participation in this research is voluntary and no learner would be forced to take part against his/her will.

Hope that everything has been properly done.

Your's Faithfully

Johannes Tsietsi Mahlasela (Lecturer at North West University)



Appendix J: Permission to conduct research at Phiritona Secondary School



26 September 2011

North West University
Vaal Triangle Campus
Po.Box 1174
Vanderbijlpark
South Africa
1900

TO WHOM IT MAY CONCERN

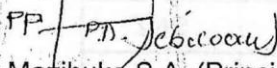
Dear Sir/Madam

The SGB of the above mentioned institution hereby grant permission to Johannes Tsietsi Mahlasela to conduct a research at its school as per his request. The school will avail grade 12 science learners to be part of Mr. Mahlasela's research.

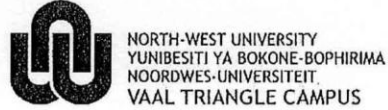
The SGB also acknowledges the fact that the school won't be involved in arranging and consulting learners and parents on behalf of Mr. Mahlasela as he has indicated on his request. The SGB further accepts that participation would be on voluntary basis and no learner will be compelled to take part against his/her will.

Hope you find this in order

Yours faithfully


Mazibuko S.A. (Principal)

Appendix K: Request to conduct research At Sedibathuto Secondary School



PO Box 1174, Vanderbijlpark
South Africa, 1900

Tel: (016) 910-3486

Web: <http://www.nwu.ac.za>

E-mail: Johannes.mahlasela@nwu.ac.za

Sedibathuto Secondary School

HEILBRON

9650

TO WHOM IT MAY CONCERN

Dear Sir/madam

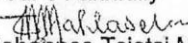
A request is hereby made to the SGB and the principal of the above mentioned school to allow the person mentioned underneath to conduct a research at your school. This research is aimed at grade twelve learners who are doing physical science as a subject. The topic of this research is, "Improving comprehension in science content subjects through mother tongue subtitling in secondary education". As you can realize from the topic of this research, this research is aimed at improving the performance of learners in schools.

The intention is to conduct it during the third term of 2011. Permission has been sought from the provincial education department to do so. It is estimated that the duration of this research would be at most seven hours and the conductor is intending to use time after hours to conduct this research.

Consent letters would be issued to learners and parents of these learners to give permission for their children to take part in this research. Participation in this research is voluntary and no learner would be forced to take part against his/her will.

Hope that everything has been properly done.

Your's Faithfully


Johannes Tsietsi Mahlasela (Lecturer at North West University)
Cell Number: 082 361 7932
Direct Line (016) 910 3486