Integrating Language Literacy Skills in Teaching Physical Sciences in Riba Cross District, South Africa

by

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ABSTRACT:

Poor performance, by English Language Learners (ELLs), in Science examinations remains a thorny issue in countries where English is not the home language. Research around the world and the Department of Basic Education in South Africa have long recommended the integration of Language Literacy skills in the teaching of Physical Sciences in order to solve this issue. Despite that, learners' poor performance in Physical Sciences examinations has been found to be positively related to low language literacy skills. The questions are: Do Physical Sciences teachers integrate language literacy skills in teaching the subject?; If yes, to what extent is the integration of language literacy skills practiced in Physical Sciences classroom? In an attempt to answer the above questions, a quantitative survey was carried out in Riba Cross District of Sekhukhune Region of Limpopo Province in South Africa. 211 learners and five teachers from selected nine schools took part in the study and questionnaires were used to collect data. Data were analysed using descriptive and inferential statistics and the Statistical Package for the Social Sciences (SPSS) version 22 was used. The results indicate that Language Literacy skills are integrated into the teaching of Physical Sciences in Riba Cross District, despite concerns raised by the teachers. The areas of concern include letting learners to argue using evidences and writing reports. Furthermore, schools with large classes have challenges in integrating Language Literacy Skills in the teaching of Physical Sciences. Therefore, further studies are recommended which should integrate both qualitative and quantitative approaches in school contexts.

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I never thought this journey would ever come to an end. But now it's a huge relief and some sorrows as the long learning roller-coaster has come to its natural end. It is a relief because it took me almost four years when I thought it will only take me two years. But I think it was worth it as, along the way, I have realised there were many things I did not know, that I had to learn before completing my masters journey. The sorrow part will come as I will miss those who were helping me realise the gaps that existed and the gaps that still exist in my learning. That mentoring made me to feel more like we are family, a sort of father to son relationship, than just a mere supervisor to student or lecturer to student relationship.

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DECLARATION

I declare that this dissertation: Integrating Language Literacy Skills in Teaching Physical Sciences in Riba Cross District has not previously been submitted by me for a degree at this or any other university; that it is my own work in design and execution, and that all material contained has been duly acknowledged.

Romulus Asaph Mogofe

Signed…………………………   Date: _____

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CHAPTER 1: INTRODUCTION TO THE STUDY

1.1 BACKGROUND TO THE STUDY

Literacy skills like reading and writing are important in the teaching of Science (Babalola, 2012; Barber, Catz, & Arya, 2006; Broggy & McClelland, 2012; Carrejo & Reinhartz, 2012; Duschl & Osborne, 2002; Mayaba, 2008; National Research Council, 2014; Yore, Bisanz, & Hand, 2003). For example, learners need reading comprehension which enhances instruction comprehension that is important for the smooth flowing of enquiry learning (Taylor, Pearson, Clark, & Walpole, 2000; Rasinski, 2006). In addition, writing in Science classroom can help learners perfect their Science process skills (Villanueva, 2010; National Research Council, 2014). So, language literacy skills are indispensable in Science teaching.

Over the past 25 years Science education scholars have advocated for the incorporation of language literacy in Science classrooms (Wellington & Osborne, 2001; Webb, 2007). This development influenced the Department of Basic Education in South Africa to also recommend the integration of language literacy skills in the teaching of Physical Sciences in addition to the focus on knowledge and skills, problem solving, the application of scientific and technological knowledge, the nature of Science and its relationships to technology, society and the environment (Department of Basic Education (DoBE), 2011c; Department of Education (DoE), 2003). Scientific inquiry involves generating, planning, designing, inventing, hypothesising, critiquing, experimenting, judging, testing, concluding and communicating scientific findings (Cheuk, 2013; DoBE, 2011b; National Academies Press, 2014; Singapore Ministry of Education, 2013; Stage, Asturias, Cheuk, Daro, & B., 2013). All the skills mentioned above need language literacy skills which require proficiency in reading, writing and speaking skills (National Research Council, 2005).

Indeed, language is an important vehicle for teaching and learning of Science and Mathematics (Broggy & McClelland, 2012). It is an instructional tool that determines the outcomes of an education system of a country (Republic of South Africa, 2012; Saeed & Jarwar, 2012). In addition, many scholars argue that there is a strong correlation between the level of literacy in the language of teaching and learning and

the performance of the learners in Science (Nomlomo, 2007; Brock-Utne & Holmarsdottir, 2004; Durano, 2009; Howie, 2003; HSRC, 2012; Kamati, 2011; Manyike, 2007; Monyai, 2010; Sturman, Burge, Cook, & Weaving, 2012; UNESCO, 2012). The strong correlation is because learning is enhanced when it occurs in contexts that are culturally, linguistically, and cognitively meaningful and relevant to learners (Doherty & Pinal, 2002; Estrada & Imhoff, 2001; Hilberg, Tharp, & DeGeest, 2000; Lemke, 2001; Rosebery, Warren, & Conant, 1992). Gulzar and Qadir (2010), Probyn (2005) and Sturman, Burge, Cook and Weaving (2012) argued that learners who use the language of learning and teaching and the language of examination frequently, inside and outside the school premises, have a higher chance of succeeding in Mathematics and Science examinations. That is because speaking is one of basic literacy skills which also needs to be practiced so that learners can communicate their ideas and scientific findings fluently (Nikolajeva, 2010; National Academies Press, 2014). Furthermore, learners perform better in Science and Mathematics if the language of learning and examinations is their native (home) language or mother tongue (Sturman, Burge, Cook, & Weaving, 2012; National Education Evaluation and development Unit, 2013). The listening, speaking, writing and reading level of learners becomes high and if the literacy is high, it becomes very easy for learners to make meaning out of any given task, which enhances performance. However the language of teaching in many SA schools (sample) is English while there are many languages of learning (SePedi, Tsonga,etc) (DoBE, 2010).

Learning Science through the mother tongue which may have higher literacy level than a foreign language seems not possible for larger part of the population in many countries. For example, in the South African context, more than 80% of learners use foreign language to acquire knowledge in Science and other non-language subjects (DoBE, 2010a, 2014). Furthermore, South African learners' reading ability falls below the reading ability of learners from neighbouring states like Botswana, Kenya, Swaziland and Zimbabwe (SACMEQ, 2010). In addition, Limpopo Province learners have the lowest reading ability compared to the reading ability of the learners in the other provinces of South Africa (Moloi & Chetty, 2011). Taking the above argument into account, something needs to be done to close the literacy gap of learners who are learning a foreign language and use it to learn Science in the classroom. Many researchers have found that the language that is used as the language of learning

may not matter in the teaching of Science (Mahlobo, 2011; Gerber, Engelbrecht, Harding, & Rogan, 2005), but how it is used to develop the literacy skills for the learning of Science (Miller, 2006; Wellington & Osborne, 2001). Furthermore, in Singapore there is integration of literacy skills in the teaching of Science which may be one of the reasons why Singapore performs well in Programme for International learner Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) tests (Singapore Ministry of Education, 2013).

Teaching strategies, like enquiry learning, using a word walls, letting the learners read and write about Science, letting the learners talk about Science and dividing learners into groups, which focus on improving the language skills in the language of learning and teaching (LoLT) and the language of Science (LoS) were found to be useful in Thailand (Praputtakun, Dasah, Tambanchong, Praputtakun, & White, 2012) and in Eastern Cape province of South Africa (Mayaba, 2008). When these strategies are applied in Science teaching, LoLT develops together with the LoS (Carrejo & Reinhartz, 2012; Mayaba, 2008); as the LoS cannot exist as a stand-alone entity, separate from the LoLT. That is so because one should be able to read and comprehend in order to examine scientific information, and one should be able to compose in order to communicate scientific findings (Miller, 2006; Pazicni & Pyburn, 2014). Therefore, as learners are assisted in understanding the content of the subject (Physical Sciences), they should also develop their language literacy skills in both the LoLT and LoS.

Science teachers need to reduce the language load of the learners who are learning a language and using it to learn Science and smoothen Science learning by integrating language literacy skills in the teaching of Science the (Dong, 2005; Baker, et al., 2014; Kelley, Lesaux, Kieffer, & Faller, 2010; Butler, Urrutia, Buenger, Gonzalez, Hunt, & Eisenhart, 2010; August, Artzi, & Mazrum, 2010; England & Webb, 2007; Park, Wiseheart, & Ritter, 2014; Douglas, Klentschy, Worth, & Binder, 2006; University of The State of New York, 2014). This does not have to be confused with allocating Science time for teaching the language but teaching Science in a way that will enhance the language development of the learners. That is easily possible because integration of language literacy skills in Science teaching is described as "Natural Fit" (Creech & Hale, 2006). For example, teaching through enquiry and letting the learners write about Science, read about Science, talk about Science,

listen to each other talking about Science would improve their literacy for Science learning (Elliott, 2010).

Science education would prove ineffective if it did not enhance learners' language skills acquisition (Yore, Bisanz, & Hand, 2003), as Science literacy is a meaning-making activity (Von Glasersfeld, 1993). For learners to grasp Science concepts, they should know what it means, believe it is true and that literacy is able to solve practical problems (Hewson, 1981; National Research Council, 2005). Thus, acquisition of scientific knowledge depends mainly on the depth of learners' literacy in the LoS such as words, actions, pictures and graphical representation (National Research Council, 2005).

Generally, learners in South Africa do not perform well in Science international examinations (HSRC, 2012; SACMEQ, 2010) and local Physical Sciences examinations (DoE, 2010a, 2011c, 2012, 2013, 2014a). Locally, in Grade 12 Physical Sciences examinations, low language literacy level in the language of Science (LoS) and the language of teaching and learning (LoLT) were found to be among the reasons why learners are not doing well in Physical Sciences examinations (DoE, 2012, 2013, 2014a). For example, the 2012 National Diagnostic Report of learner performance reports that:

> *Many candidates performed poorly in questions included as level 1 and 2 questions due to lack of knowledge. Many did not know basic definitions…. For many candidates, language and terminology deficiencies are barriers to understanding and expression. Misinterpretation of questions was often evident (DoE, 2012, p. 180).*

These findings suggest that learners lack language literacy skills in both the LoLT and LoS. In addressing the language literacy issue, studies recommend the integration of language literacy skills in the teaching of Sciences (Center on Education Policy, 2010; August, Artzi, & Mazrum, 2010; August, Carlo, Dressler, & Snow, 2005; Comber & Barnett, 2003; Lyon, 2013; Moje, Sutherland, Cleveland, & Heitzman, 2006; Carrier, 2011; Cervetti, Pearson, Bravo, & Barber, 2006; Short & Fitzsimmons, 2007). The Department of Basic Education has also made a recommendation for the teachers to integrate language literacy skills in the teaching of Sciences (DoBE, 2011b). The recommendation also appears in DoBE's National

Diagnostic Report (2012, 2013, 2014a). The way learners struggle in both LoLT and LoS when writing the final Physical Sciences examinations, as reported in the diagnostic reports, may suggest that some teachers are not doing enough in developing their LoLT and LoS through integration of language literacy skills in the teaching of Physical Sciences, which were found to be working by Barber, Catz and Arya (2006), Praputtakun et al. (2012), Thier (2002) and Mayaba (2008). The challenge for Science teachers is meeting the linguistic needs of English language learners while also meeting their content needs in Science lessons (Daughenbaugh, Shaw, & Burch, 2013). One of the main challenges is that many Science teachers may not know how to assist language learners to acquire literacy skills for the learning of Science and if asked to do so, they become confused (Lee, Quinn, & Valdés, 2013). The extent to which teachers integrate literacy needed to be investigated so that teachers who still cannot find ways to assist Science learners to acquire language literacy skills for the learning of Physical Sciences can be assisted (Echevarria & Hasbrouck, 2009). The teaching of literacy skills cannot be left for language teachers only (Lee, Quinn, & Valdés, 2013; Wellington & Osborne, 2001). Furthermore, with English learners, it is imperative to consider whether current classroom instruction reflects best practices for their specialised needs (Echevarria & Hasbrouck, 2009). This study investigated the extent to which language literacy skills are integrated into the teaching of Physical Sciences in Riba Cross District of Sekhukhune region, Limpopo Province of South Africa.

1.2 STATEMENT OF THE PROBLEM

South African learners do not perform well in international Science examinations (HSRC, 2012) and in Grade 12 local examinations (DoBE, 2010a, 2011b, 2012, 2013). Locally, there seemed to be an improvement in Grade 12 Physical Sciences examinations, from 2010 to 2013, but the pass rate at 40% or above was still far below 50% (DoBE, 2013) and dropped to below 40 % in 2014 (Department of Basic Education, 2014a). This is worrying because 40% does not even meet the requirements for entry into the university to do Science related courses which are scarce in South Africa. The following table summarises the overall achievement rates in Physical Sciences National Senior Certificate (NSC) examinations over the period of 5 years by the Grade 12 learners in South Africa:

Table 1: Overall achievement rates 1 (DoBE, 2013, p.173, 2014, p. 142)

Year	No of learners	No. achieved at 30% and above (from 30% to 100 %%)	% achieved at 30% and above (from 30% to 100%)	No. achieved at 40% and above (from 40% to 100%)	% achieved at 40% and above
2010	205 364	98 260	47.8%	60 917	29.7%
2011	180 585	96 441	53.4%	61 109	33.8%
2012	179 194	109 918	61.3%	70 076	39.1%
2013	184 383	124 206	67.4%	78 677	42.7%
2014	167 997	103 348	61.5 %	62 032	36.9%

The percentage of learners passing Physical Sciences at 40% and above was 39.1% in 2012, 42,7% in 2013 and 36,9% in 2014, which must be a major concern for National Department of Basic Education and Science education communities in South Africa (DoBE, 2012, 2013, 2014a). Inability to read and comprehend instructions and lack of understanding of the language of Science are among the major contributing factors (DoBE, 2013; Mayaba, Otterup, & Webb, 2013; Baker, et al., 2014; Center on Education Policy, 2010; Wellington & Osborne, 2001; Webb, Lepota, & Ramagoshi, 2004; Lee, Avalos, & Avalos, 2002; Lee, Quinn, & Valdés, 2013; Pazicni & Pyburn, 2014). These contributing factors also appear in National Department of Basic Education 2013 and 2014 diagnostic reports (DoBE, 2013, 2014). The problem of South African learners' inability to read and comprehend information is also reflected in SACMEQ 2010 report. To try and solve this problem, the Department of Basic Education has reiterated a recommendation, made by many studies, for teachers to integrate language literacy skills into Physical Sciences teaching (Himmel, Short, Richards, & Echevarria, 2009; Faria, Freire, Galvão, Reis, & Baptista, 2012; Atasoy, 2013; Ferreira, 2011; Bicer, Capraro, & Capraro, 2013; Lawrence, White, & Snow, 2011; Gonyea & Anderson, 2009; Lee, Quinn, & Valdés, 2013; Shatz & wilkinson, 2010; DoBE, 2012, 2014a). The recommendation also appears in Physical Sciences Curriculum and Assessment Policy Statement (CAPS):

Teachers of Physical Sciences should be aware that they are also engaged in teaching language across the curriculum. This is particularly important for learners for whom the Language of Learning and Teaching (LoLT) is not their home language. It is important to provide learners with opportunities to develop and improve their language skills in the context of learning Physical

Sciences. It will therefore be critical to afford learners opportunities to read scientific texts, to write reports, paragraphs and short essays as part of the assessment, especially (but not only) in the informal assessments for learning (DoBE, 2011c, p. 14).

In addition, the recommendation to integrate literacy skills in the teaching of Physical Sciences is also indirectly outlined in the 2012 National department of Basic Education's Diagnostic report (Department of Basic Education, 2012). "*Teachers are advised to put some visually stimulating material such as articles from newspapers, or words and concepts that are problematic to their learners, on the walls of classrooms*" (DoE, 2012, p.182). With English learners, it must be clear whether the current classroom practice is at par with their language need so that they are not marginalised when coming to Science learning (Echevarria & Hasbrouck, 2009). This study investigated the extent to which language literacy skills are integrated in the teaching of Physical Sciences so that teachers can be assisted where there may be a gap.

1.3 AIM OF THE STUDY

The aim of this study was to investigate the extent to which language literacy skills are integrated in the teaching of Physical Sciences in Riba Cross District of Limpopo Province, South Africa.

1.4 OBJECTIVES

The objectives of the study were:
- To identify the extent to which language skills are integrated in the teaching of Physical Sciences in the classroom.
- To establish whether the current Science teachers' practices in helping the learners to acquire language skills in the language of Science and the language of teaching and learning are in line with recommendations by studies and the Department of Basic Education.

1.5 SIGNIFICANCE OF THE STUDY

The Department of Basic Education together with many researchers recommend that Physical Sciences teachers must also assist learners, who are learning foreign

language and at the same time using it to learn Physical Sciences, to acquire language skills (Almelhi, 2014; Blanchard, Masserot, & Holbrook, 2014; DoE, 2003, DoBE, 2011b, 2012, 2013; Himmel, Short, Richards, & Echevarria, 2009; Faria, Freire, Galvão, Reis, & Baptista, 2012; Atasoy, 2013; Ferreira, 2011; Bicer, Capraro, & Capraro, 2013; Lawrence, White, & Snow, 2011; Gonyea & Anderson, 2009; Shatz & wilkinson, 2010). It was found that, in 2012 and 2013 National Senior Certificate examinations, language literacy skills were still a problem (DoBE, 2012, 2013). For example, in an attempt to answer examination questions, it was found that learners:

- could not comprehend the questions,
- could not express themselves in the language of teaching and learning (the language of examination) and;
- seemed not to know some scientific terms and did not comprehend the questions.

With recommendations by the Department of Basic Education in every Science teacher's file: a recommendation to integrate language literacy skills in the teaching of Science; it remains poorly known whether Physical Sciences teachers are helping English language learners acquire English language skills in learning Physical Sciences. The study is aimed at identifying practice gaps in terms of integration of language literacy skills in Science teaching, hence its significance.

1.6 THE FEASIBILITY OF THE STUDY

The study's feasibility is that:
- The study was conducted in Riba Cross district, as it is accessible to the researcher,
- The study is relevant to the current trends in learner performance in the Riba Cross District and hence it will provide the results of the extent to which language literacy skills are integrated in the teaching of Physical Sciences in Riba Cross District.
- Although it should be acknowledged that this study cannot be aimed at addressing all the factors affecting poor performance in Physical Sciences, it should be viewed as one of the many studies that will help to solve the problem.

CHAPTER 2: LITERATURE REVIEW

Research indicates that more than 80 % of schooling population in South Africa uses neither English nor Afrikaans as their home language (DoE, 2010, 2014). Conversely, the two languages are the only available languages of teaching and learning (LoLT) non-language subjects from Grade 4 to Grade 12 in the South African schools. Conclusively, 80 % of South African learners learn Science through a language other than their home language and mostly English. This group of learners is mostly marginalised when coming to content area learning (Buell, Burns, Casbergue, & Love, 2011; Ackerman & Tazi, 2015). The language literacy level of these learners, who may be referred to as English language learners (ELLs), is low in most cases (Center on Education Policy, 2010; Turkan & Schramm-Possinger, 2014) and very low in South African Context (SACMEQ, 2010). If not taken care of, it may affect the learning process in the classroom and validity of the tests and the reliability of the test scores during assessments (Center on Education Policy, 2010; Baker, et al., 2014). That is because for ELLs, each Science test or examination assesses both their Science knowledge and English language. So, learners need to develop a reading fluency as it is a strong predictor of reading comprehension (Park, Wiseheart, & Ritter, 2014; Pazicni & Pyburn, 2014). Furthermore, it is reading comprehension that influences how learners interpret questions and as a result their answering (August, Carlo, Dressler, & Snow, 2005; Pazicni & Pyburn, 2014). In contrast, teachers have been found not to assist learners in this regard in some parts of the world (Meidl, 2011). Meidl has found that the teachers involve learners in little meaningful conversations which does no good to the pivotal literacy development of the learners. According to Department of Education and Training, Northern Territory Government (DETENTG) (2010) teachers should have proper knowledge of strategies that can be used to enhance the language literacy level of English language learners (ELLs); who are learners "whose English language proficiency is insufficient to meet the standards in classrooms where English is the primary language" (Turkan & Schramm-Possinger, 2014, p. 1). Seemingly, the issue of language literacy is overlooked by most Science teacher educators (Lyon, 2013). It must be born in mind that with English learners, it must be known if the strategies teachers are using to teach Science are viable in developing their language literacy skills while learning Science (Echevarria & Hasbrouck, 2009)

The literature review discusses literacy and language; the link between language literacy and Science learning; research on the integration of language literacy in to the teaching of Science; ways to integrate language literacy in the teaching of Science and theoretical framework underpinning this research.

2.1 LITERACY AND LANGUAGE

Language Literacy is "the ability to use language and images in rich and varied forms to read, write, listen, speak, view, represent, and think critically about ideas" (Science Co-ordinators and Consultants Association of Ontario; The Science Teachers' Association of Ontario, 2004, p. 1). In general terms, literacy refers to reading, writing, speaking, viewing, and listening effectively in a range of contexts (Australian Government; Northern Territory Government, 2010). In addition to the above definition of literacy, some researchers have looked beyond just reading, writing, speaking, viewing and listening. For example, READ (2014) defines literacy as "the ability to comprehend, interpret, analyse, respond and interact with a growing variety of complex sources of information" (READ, 2014, p. 10). Furthermore, Shanahan and Shanahan (2008) indicate that there are three types of literacies: Basic Literacy, Intermediate Literacy and Disciplinary Literacy. According to Shanahan and Shanahan Basic Literacy includes "skills such as decoding and knowledge of high-frequency words that underlie virtually all reading tasks"; Intermediate Literacy includes "skills common to many tasks, including generic comprehension strategies, common word meanings, and basic fluency" and Disciplinary Literacy includes "skills specialized to history, Science, mathematics, literature, or other subject matter" (Shanahan & Shanahan, 2008, p.44). Scientific Literacy falls under Disciplinary Literacy on Shanahan and Shanahan's pyramid of literacies, because it includes scientific knowledge and use of that knowledge to identify questions, to acquire new knowledge, to explain scientific phenomena, and to draw evidence-based conclusions about Science-related issues (OECD, 2013).

Disciplinary
Literacy

Intermediate Literacy
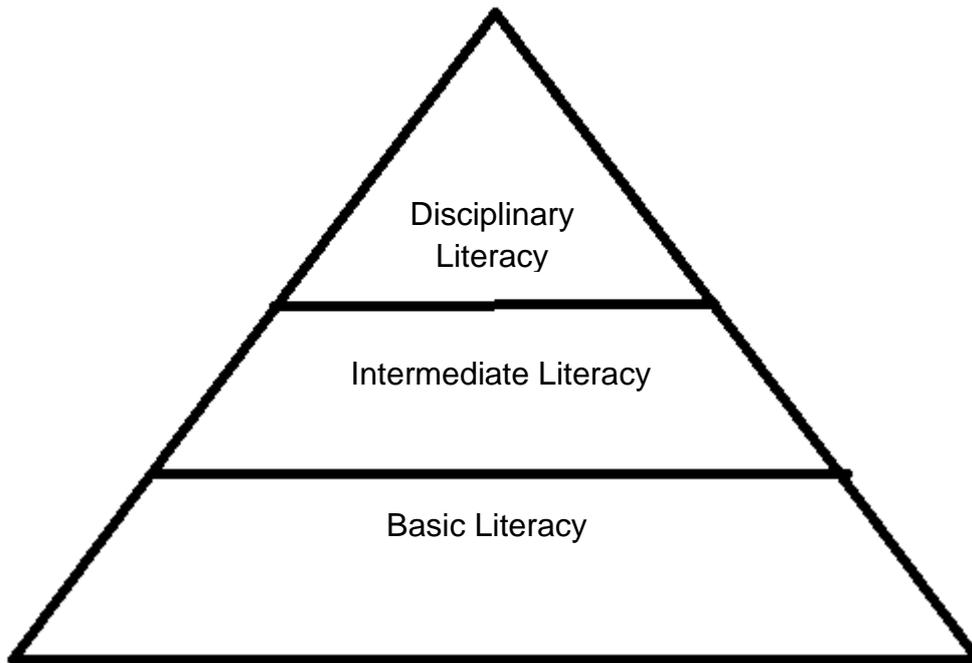
Basic Literacy

Figure 1: Increasing Specialization of Literacy (Shanahan & Shanahan, 2008, p.44)

The pyramid also indicates that one cannot have Scientific Literacy if one has not acquired basic literacy skills and it is basic literacy skills that are making learners to fail to interpret examination questions correctly, which leads them to losing marks during examinations (DoE, 2012, 2013). So the main focus should be on building the basic language literacy skills before even thinking about Scientific Literacy. Science teachers cannot leave the enhancement of basic language literacy skills to language teachers, as this will result in fruitless Science teaching (Wellington & Osborne, 2001).

One cannot separate literacy skills, like reading, writing, listening and speaking from language (National Research Council, 2000; Australian Government; Northern Territory Government, 2010). Scholars define language in different ways and the attempt to define language dates back to 1921 when Sapir (1921) defined language as purely human and non-instinctive method of communicating ideas, emotions and desire by means of voluntarily produced symbols. In addition, Bloch and Trager (1942) define language as a system of arbitrary vocal symbols by means of which a social group communicates. Chomsky (1957) also defines language as a set of finite number sentences, each finite in length and constructed out of a finite set of elements. Ergin (1990) defines language as a natural means to enable

communication among people, a living entity that has its own peculiar laws, by means of which it alone can develop, a system of contracts whose foundation was laid in times unknown, and a social institution interwoven with sounds. Halliday (2003) defines language as a system of meaning or a semiotic system. All the definitions above give one an idea of the importance of language in Science and any form of education, but for this study Ergin's definition will be adopted because it is at least recent and fits well into social constructivists' and Vygotsky (1962)'s theories of learning which form the basis for this research.

Generally, it is hard to imagine meaningful Science learning where there is low level of language literacy in the language of learning and teaching (which can be accepted to be English in the South Africa context) unless Science teachers try out something to pick up the level of language literacy skill of the learners in the science classroom (Broggy & McClelland, 2012). In addition, Comber and Barnett (2003) argued that language is the most important part of the learning process. They further pointed out that oral language has a key role to play in classroom teaching and learning (Comber & Barnett, 2003). That is so because interaction and communication with others is fundamental for effective learning (Doherty & Pinal, 2002; Estrada & Imhoff, 2001; Hilberg, Tharp, & DeGeest, 2000; Lemke, 2001; Rosebery, Warren, & Conant, 1992; Comber & Barnett, 2003; Blanchard, Masserot, & Holbrook, 2014). Therefore, speaking and listening should be given priority when language literacy skills are taught in a classroom.

2.2 THE LINK BETWEEN LANGUAGE LITERACY SKILLS AND SCIENCE LEARNING

Almelhi (2014), Blanchard, Masserot and Holbrook (2014), Dong (2005); and Turkan and Schramm-Possinger (2014) propose that the teaching of language literacy skills has to be integrated into the teaching of Science. That is because integration of language literacy skills into the Science does not only help in enhancing the language literacy but can also help deepen concepts understanding for English language learners (ELLs) (Dong, 2005; Baker, et al., 2014; Kelley, Lesaux, Kieffer, & Faller, 2010; Butler, Urrutia, Buenger, Gonzalez, Hunt, & Eisenhart, 2010; August, Artzi, & Mazrum, 2010; Hapgood & Palincsar, 2007). This does not call for Science teachers to allocate time for teaching grammar and other genres of language during

Science lessons, but for Science teachers to teach Science in a manner that would enhance literacy development; teach Science in a way that even learners with low language literacy level will follow (Dong, 2005; National Research Council, 2014).

In addition, Australian Government; Northern Territory Government (AGNTG) (2010) reckoned that there is a need for teacher development so that they can effectively help learners with low language literacy skills to acquire scientific knowledge swiftly. This can also be more beneficial to teachers who are still at the universities. They need to be helped to connect theory and practice in language acquisition for Science learning and assessment (Lyon, 2013). However, the integration of Science contents and literacy practices in classrooms poses a challenge to Science teachers and teacher educators (Moje, Sutherland, Cleveland, & Heitzman, 2006). Furthermore, Lyon (2013) found that this issue is mostly underrated as teachers are trained for ideal situations and Science teacher think their job is only to teach the Science content even if it does not make sense to the learners and the performance is not acceptable.

Science Education is itself regarded as a pathway to teaching language literacy (Rodriguez, 2010). In addition, Shanahan and Shanahan (2008) argued that high-quality Science instruction requires that learners learn to read and write like scientists. So, integrating Science and literacy learning can motivate children to learn to read as well as accelerating the learning of Science concepts (Douglas, Worth, & Binder, 2006; Guthrie, Barbosa, Perencevich, Taboada, & Davis, 2004). More so, integrating literacy skills was found to be a useful tool in the learning of mathematics (Bicer, Capraro, & Capraro, 2013). Integrating writing into mathematics writing improves problem solving, which may also help teachers to easily identify learners' understanding and misconceptions. That is so because once teachers analyse each learner's written response carefully, they can see how learners' ideas need to be developed or changed (Bicer, Capraro, & Capraro, 2013). As a result, remedial activities and differentiated instructions can be planned and be given to the learners.

Integration of language literacy should not be seen as a new burden for the teachers as the teaching of Science and the teaching of language have many commonalities (Creech & Hale, 2006). Consequently, the integration will prove more effective in both language and Science learning (Cervetti, Pearson, Bravo, & Barber, 2006). For

example, Science learning and literacy learning both use inquiry and comprehension strategies such as activating prior knowledge, establishing goals, making predictions, drawing inferences, and recognizing relationships (Cervetti, Pearson, Bravo, & Barber, 2006). Integration can reduce the task-load that has to be carried by English language learners who are to learn English and use it to learn Science content (Short & Fitzsimmons, 2007). Short and Fitzsimmons (2000) found that adolescent English Language Learners, who must simultaneously learn English and grade-appropriate Science, perform double the task of their native language peers because they are held to the same grade-level standards for academic. As a result, the integration of Science and language teaching is critical for this kind of learners to develop the language literacy skills necessary to be successful in meeting high standards in Science examinations and tests (Almelhi, 2014; Echevarría, 2012). Furthermore, Echevarría (2012) recommends that the teaching of Science must be adapted by integrating language literacy skills in the teaching of Science for these learners. Integration of language literacy skills in the teaching of Science improves the school performance of English language learners (Echevarría, 2012). In addition, Integration of language literacy skills should be practiced by all subject teachers (Echevarría & Short, 2011; Ferreira, 2011).

Learners benefit more from Science teachers who make Science concepts accessible by integrating language literacy skills in the teaching of Science (Brisk, 2010; National Science Teachers Association, 2009; Almelhi, 2014). That is why the integration of language literacy skills pedagogy into Science teaching is regarded as a powerful tool for improving ELL achievement (Stoddart, Solis, Tolbert, & Bravo, 2010). That is because literacy cannot be achieved through literature alone (Science Co-ordinators' and Consultants' Association of Ontario and The Science Teachers' Association of Ontario, 2005). Seemingly, learners have to be involved in more writing in their Science classroom as it engages learners in deep learning not surface learning that may take place in classrooms where little writing takes place (Gonyea & Anderson, 2009). In addition, Moje et al. (2006) recommended that teachers should incorporate reading and writing into their content area classrooms. However, integrating literacy strategies may need more time of planning the lessons. But for the sake of the learners, it needs to be practiced in science classrooms.

In fact, in Science classroom, learners do not just acquire scientific knowledge but also a way of verifying it (Science Co-ordinators' and Consultants' Association of Ontario & The Science Teachers' Association of Ontario (SCCAO & STAO), 2005). As a result, the tasks that would provide learners with an opportunity to investigate scientific phenomena improve learners' language and Science literacies. According to SCCAO and STAO (2005), the tasks given to the learners in this regard should prompt learners to use a range of skills like:

- *Using of prior knowledge.*
- *Understanding and development of specialized vocabulary, units and symbols.*
- *Interpreting diagrams, data tables, charts, graphs, and other graphic tools· using inference and reasoning.*
  Recognizing concept flow and connection between concepts, evaluating, comparing, identifying patterns, summarizing and forming conclusions · navigating a variety of texts (e.g., websites, signs, labels, manuals, textbooks) and structures (e.g., table of contents, index, multi-format pages) (SCCAO & STAO, 2005, p. 5).

This means scientific inquiry and reading in Science should be interdependent. Similarly, in the South African context, there are connections in the specific aims for the learning of Science and English as an Additional language and the language of learning and teaching (LoLT). According to Department of Basic Education (2011), learning a First Additional Language should enable learners to:

- *acquire the language skills necessary to communicate accurately and appropriately taking into account audience, purpose and context;*
- *use their English for academic learning across the curriculum;*
- *listen, speak, read/view and write/present the language with confidence and enjoyment. These skills and attitudes form the basis for lifelong learning;*
- *express and justify, orally and in writing, their own ideas, views and emotions confidently in order to become independent and analytical thinkers; use their Additional Language and their imagination to find out more about themselves and the world around them. This will enable them to express their experiences and findings about the world orally and in writing;*

- *use English to access and manage information for learning across the curriculum and in a wide range of other contexts. Information literacy is a vital skill in the 'information age' and forms the basis for lifelong learning;*
- *use English as a means of critical and creative thinking: for expressing their opinions on ethical issues and values; for interacting critically with a wide range of texts; for challenging the perspectives, values and power relations embedded in texts; and for reading texts for various purposes, such as enjoyment, research, critique* (Department of Basic Education, 2011a, p. 9).

On the other hand Science is aimed at equipping learners with investigative skills which involve classifying, communicating, measuring, designing an investigation, drawing and evaluating conclusions, formulating models, hypothesising, identifying and controlling variables, inferring, observing and comparing, interpreting, predicting, problem-solving and reflective skills (Department of Basic Education, 2011c; Rhodes & Feder, 2014). This requires learners to communicate among themselves and to communicate their findings which correlate with one or more of the aims of learning English as an additional language and LoLT (National Academies Press, 2014). So, integrating language literacy skills into Science teaching is not only good for Science learning, but also for the learning of LoLT itself.

It cannot be denied that integrated strategies can help to close the achievement gap between girls and boys in Sciences as it helps to improve the achievement level of the girls (Astrom, 2008; Kelley, Lesaux, Kieffer, & Faller, 2010; Rutter, et al., 2004; Ontario, 2009; ESTEYN, 2008; Watson, Kehler, & Martino, 2010; Cavas, Ozdem, Cavas, Cakiroglu, & Ertepinar, 2013). It must also be stated that the issue of boys underachieving when it comes to literacy than girls is contestable (White, 2007). But, more evidence supports the notion that girls are better in literacy than boys. Mayaba, Otterup, and Webb (2013) relate the problem of poor performance in mathenatics and Science with language deficiencies which include writing skills. That is because deficient language skills limit opportunity to learn Science (Lee, Avalos, & Avalos, 2002). As a result, learners with low reading proficiency encounter challenges when learning Science (Fang, 2006). Therefore, teachers should integrate language literacy skills when teaching Science so as to cover all the learners in the classroom, including ELLs (Lee, Avalos, & Avalos, 2002). It should be known that teaching strategies focusing on language literacy skills are effective in improving learner

performance in mathematics and Science (Amaral, Garrison, & Klentschy, 2002). As a result integrating language literacy in the teaching of Physical Sciences will improve performance and achievement levels in tests and examinations.

Consequently, effective Science teachers incorporate reading and writing strategies in their instruction to promote both Science learning and literacy development for all learners (Douglas, Klentschy, Worth, & Binder, 2006). Integration of literacy skills into the teaching of Science was found to be working in Thailand (Praputtakun, Dasah, Tambanchong, Praputtakun, & White, 2012). Mayaba (2008), in South Africa, also found that the integration of literacy skills improves the language literacy level in the language of Science and the language of learning and the performance in Science examinations. As a result, this calls for Science teachers to also be language teachers (& Osborne, 2001; Powers & Stansfield, 2009); because the learning of the language of Science is a major part of Science education and literacy skills are prerequisite to Science literacy (Shanahan & Shanahan, 2008). This means every Science lesson is a lesson of both the language of learning and the language of Science (Wellington & Osborne, 2001). In this way, if teachers use literacy strategies in the content area, learners increase reading levels and significantly improve performance on content area standardised testing (Sessoms, 2012).

Reading and writing are essential activities that all the learners of Science need to engage in to completely focus on their scientific understanding (Wallace, Hand, & Prain, 2004; van Zee, Jansen, Winograd, Crowl, & Devitt, 2013). More so that Science understanding cannot be attained without the ability to read and comprehend textual information and write competently about the subject under study (Norris & Phillips, 2003). In addition, literacy enhancing skills were also found to be useful in promoting the performance of learners studying computer Science in Nigeria (Babalola, 2012). That is so because integration of language literacy skills improves their meaning making which is the ability to understand and compose meaningful written, visual, spoken, digital and multimodal texts (New South Wales Department of Education and Training, 2009). Therefore, for ELLs to succeed in learning Science, Science instruction should be coupled with language and study skills (Hernández, 2003).

2.3 RESEARCH ON INTEGRATION OF LANGUAGE LITERACY SKILLS IN THE TEACHING OF CONTENT

Historically, research on ELLs has been dominated by debates on the language of teaching and learning (LoLT) of Science (Appalachia Regional Comprehensive Center, 2009). Little attention was given to the development of the language literacy skills in the language that is used to teach and learn Science, which is mostly English in the South African context. But recently, around the world, studies are giving attention to the issue of language literacy skills for effective learning of Science (Ferreira, 2011; Atasoy, 2013; Bicer, Capraro, & Capraro, 2013; Cook, 2011; Faria, Freire, Galvão, Reis, & Baptista, 2012; Chabalengula & Mumba, 2012; Lawrence, White, & Snow, 2011; August, Artzi, & Mazrum, 2010; Gonyea & Anderson, 2009).

Many researchers have found out that integration of Language literacy skills in the teaching of Science helps to improve learner performance in tests and examinations. For example, Atasoy (2013) found that there was a significant difference between the levels of improvement of conceptual understanding in groups where integration of literacy skills was taking place than for those that did not experience the integration. In addition, integrating writing into mathematics classroom also improved problem solving skills of mathematics learners (Bicer, Capraro, & Capraro, 2013). Integrating language literacy skills in content area helps learners to develop personal meaning and this also help learners to develop eagerness to go extra miles on their own (Faria, Freire, Galvão, Reis, & Baptista, 2012; August, Artzi, & Mazrum, 2010; Liao, Chiang, Chang, & Liao, 2015).

Evidently, some teachers seem to have a challenge when it comes to assisting ELLs. For instance, in Zambia, pre-service Science teachers were found to have a biased meaning of scientific enquiry (Chabalengula & Mumba, 2012). This was as a result of teachers' failure to create a link between literacy skills and Science teaching. Furthermore, teachers' views of what is scientific enquiry excluded the writing and discussion part of scientific enquiry which form pivotal part in developing literacy skills in language and Science (Chabalengula & Mumba, 2012). Teachers' behaviour as reported by Chabalengula and Mumba is in contrast to a study by Lawrence, White and Snow (2011) who confirmed that integration of language literacy skill helps in improving performance of ELLs (Lawrence, White, & Snow, 2011). These

overwhelming benefits seem to be overlooked by most Science teachers as they prepare to teach Science to ELLs.

Integrating Science and literacy learning can motivate children to learn to read as well as deepen their understanding of scientific knowledge (Douglas, Worth, & Binder, 2006; Guthrie, Barbosa, Perencevich, Taboada, & Davis, 2004; Coyne, McCoach, & Kapp, 2007). In addition, August, Artzi and Mazrum (2010) found that combining good Science teaching with scaffolding that focuses on language literacy development is also an effective method for helping English language learners in Science classrooms. Furthermore, Himmel et al. (2009) concluded that integration of language literacy skills in the teaching of Science is a helpful way of enhancing ELLs' performance in Science. So, integrating language skills in the teaching of Science can help learners develop academic language literacy and support learner's self-reliance in Science.

There are many more studies emphasizing the integration of language literacy skills into the teaching of Science. For example, Gonyea and Anderson (2009) and Shatz and Wilkinson (2010) concluded that writing becomes useful when it engages learners in deep learning as measured by higher order, integrative, and reflective learning activities. Ferreira (2011), after conducting an investigation with Life Sciences teachers in Gauteng Province of South Africa, recommended that teachers should be able to integrate language and Life Sciences content, creating authentic contexts for language learning. The integration of writing and inquiry strategies in Science classroom also improves procedural understanding (Villanueva, 2010; Greenleaf & Hanson, 2010). This means integration of literacy skills can cement learners' Science process skills which include writing the investigative question, writing the procedure, discussing the results and writing the conclusion (Rhodes & Feder, 2014). In addition, Amaral et al. (2002) found that teaching strategies focusing on language literacy skills improve performance in mathematics and Science. But the findings by Cook (2011) indicate that course content, learner characteristics, and resource availability affect how teachers select and use graphics in their Science courses.

Despite all the evidence supporting the integration of language literacy skills in Science lessons, a little seems to be done to help learners in this regard. For

example, literacy was found to be a challenge by Moje et al. (2006). Moje et al recommended that teachers should integrate reading and writing into their content area classrooms. Integration of language literacy skills in Science classroom would help to lighten the language load the ELLs have to carry in learning Science while they are having language difficulties (Greene, 2013; Short & Fitzsimmons, 2007).

The performance of ELLs is far below that of other learners, by a margin from 20% and 30% points (Abedi & Dietel, 2004; National Academies Press, 2010). According to Abedi and Dietel testing ELLs in Science is not only testing their Science achievement but also their language ability. Abedi and Dietel (2004) recommended that the focus in Science teaching should also be on reading. Lyon (2013) reckoned that teachers also need to be helped to connect theory and practice in language acquisition to Science learning as it was found that the language issue is not given attention. Bravo et al. (2011) also found that prospective Science teachers do not bother to help their learners to acquire language literacy skills in their class irrespective of the rich opportunity available in Science class to do so. This means teachers entering the profession require additional attention on how to make Science more accessible to ELLs. There is a need for the integration of ELL Pedagogy in the training of Science teacher, which is not practiced or practiced to a limited extent (Bravo, Solís, & Mosqueda, 2011).

South African Science learners, especially those who are learning a language (for example English) and using it to learn Science, encounter four language obstacles: home language, school academic language, English as the language of learning and teaching, and Science specific language (Webb, 2007). This group of learners form more than 80% of the schooling population in South Africa (DoE, 2010, 2014). As recommended by Elliott (2010), teachers need to try to reduce the load learners need to carry in the learning of Science by trying out strategies that would enhance the development of the language literacy skills. That is because the integration of ELL teaching strategies into Science teaching is a powerful model for improving ELL achievement (Stoddart, Solis, Tolbert, & Bravo, 2010).

There is generally little information about the extent to which teachers use strategies known to enhance learners' mastery of the literacy skills for the learning of Science in South Africa. The reason for that could be that many researchers who are involved in

studying the language in Science education concentrate mostly on the foreign language versus the home language of the learners as the language of learning and teaching (LoLT) Sciences (Brock-Utne & Holmarsdottir, 2004; Chivhanga, 2012; Gulzar & Qadir , 2010; Jekwa, 2012; Kamati, 2011; Manyike, 2007; Mngqibisa, 2002; Monyai, 2010; Moodley & Nkonko, 2004; Msimanga, 2012; Nomlomo, 2007; Olugbara, 2008; Reyes, 2004; Sturman et al., 2012; Uys et al., 2007; Yafele, 2009; Yamat, Maaro, Maasum, Zakaria, & Zainuddin, 2011). Little is done and said about basic literacies that would enable the learners to swiftly acquire the scientific knowledge and process skill, which contributes toward improving language literacy skills. The Department of Basic Education in South Africa calls for Science teachers to assist their learners to acquire the language literacy skills as scientific understanding requires them (DoE, 2003; DoBE, 2011c, 2012). It remains to be seen whether teachers heeded to that call and if they did, the extent is poorly known, hence this study.

2.4 WAYS TO INTEGRATE LANGUAGE LITERACY SKILLS IN THE TEACHING OF SCIENCE

Many researchers believe the home language of the learners should be involved in teaching the learners non-language subjects including Science (Chivhanga, 2012; Li, 2008; Mitchell, 2012; Monyai, 2010; Moodley & Nkonko, 2004; Nomlomo, 2007; Olugbara, 2008; Sturman et al, 2012; Yafele, 2009; Yamat et al, 2011). As a result, most studies recommended the use of code switching, which is "the use of two languages varieties in the same conversation" (Myers-Scotton, 2006, p. 239). Code switching would pose challenges if allowed. For example, if code switching is to be used as the medium of instruction, learners should be allowed to switch codes in their attempts to answer examination and test question papers of which it cannot be accepted (UNESCO, 2012). Furthermore, research indicates that, when code switching is used, most teachers find it hard to draw the limits (Gulzar & Qadir , 2010), which leads to some applying code mixing and full translation (Brock-Utne & Holmarsdottir, 2004). As a result, the use of code switching hampers the development of the language of learning and examination which as a result leads to poor Science performance (Gulzar & Qadir , 2010). So, something, besides code switching, needs to be tried to increase language literacy in Science classroom while teaching the Science content.

Many researchers believe the teaching of language skills can be effectively integrated into Science teaching (Mercuri, 2010; National Research Council, 2014; Creech & Hale, 2006; Creech & Hale, 2006). The question is: How to integrate literacy skills in Physical Sciences classroom? Seemingly, the main thing is to give learners themselves enough space to contribute; that would make Science learning to flow smoothly (Rissanen, 2014). For instance, emphasising key vocabulary, creating opportunities for learner-to-learner interaction, and reminding learners of the lesson objectives are some of the many ways that can help learners develop academic language literacy skills and support learner autonomy in Physical Sciences (Himmel, Short, Richards, & Echevarria, 2009).

Many studies have outlined practical ways to integrate literacy teaching into the teaching of Science. For example, Meltzer and Hermann (2005) outlined eight instructional practices that can be used to help ELL to swiftly acquire language literacy in LoLT while learning the subject area content. The strategies are:

> *teacher modelling, strategy instruction, and using multiple forms of assessment; emphasis on reading and writing; emphasis on speaking and listening/viewing; emphasis on thinking; creating a learner-centred classroom; recognising and analysing content-area discourse features; understanding text structures within the content areas; and vocabulary development* (Meltzer & Hamann, 2005, p. 10).

Similarly, Baker et al. (2014) recommended four ways to assist ELLs acquire literacy skills while learning the Science. The recommendations are that teachers should:

> Teach a set of academic vocabulary words intensively across several days using a variety of instructional activities; integrate oral and written English language instruction into content-area teaching; provide regular, structured opportunities to develop written language skills and provide small-group instructional intervention to learners struggling in areas of literacy and English language development (Baker et al., 2014, p. 6).

There are many studies supporting these recommendations (Butler, Urrutia, Buenger, Gonzalez, Hunt, & Eisenhart, 2010). These are not the only practical ways that teachers can use to assist ELLs to improve their language literacy level while learning Science.

Wellington and Osborne (2001) reckoned that there are many ways to help the learners to improve their literacy level and how to teach depends mostly on how artistic the teacher is, as teaching is itself an art. Whatever strategy a teacher employs, in order for it to bear positive fruits, it should involve a range of modes of communication and should put the learner in the centre of learning (Wellington & Osborne, 2001). For example: the spoken and written word; visual representation; images, diagrams, tables, charts, models and graphs; movement and animation of physical models; practical work (learners must feel, touch, smell and hear sounds); and use mathematical symbols either as shorthand or in the form of equations to convey a connection. So, teachers need to be aware of this range of modes and how to utilise them in developing learners' basic literacies and later enhance performance. Science teachers need to be innovative and look for materials to bring to classroom to encourage learners to read. Consequently, trying out the strategies mentioned above would enrich learners' Science vocabulary and also the vocabulary in the LoLT and this can lead to better Science performance. That is because "Once learners understand how things are said, they can better understand what is being said, and only then do they have a chance to know why it is said" (Jamison, 2000, p. 45).

Generally, many studies recommend that the following activities should take place inside the Physical Sciences classroom in order to develop the LoLT and learning, the language of Science and scientific knowledge mastery: Teachers must take time over Science words; The use of Word walls; Talking about Science; Reading about Science and Writing about Science (Elliott, 2010; Gibbons, 2002; Jamison, 2000; DoBE, 2011; New South Wales Department of Education and Training, 2009; Yore, Bisanz, & Hand, 2003; Rasinski, 2006; Pikulski & Chard, 2005; Taylor, Pearson, Clark, & Walpole, 2000; Nagy, 2003). So, each of the methods mentioned above will be discussed as a subheading. The subheadings will also include the use of technology as recommended by others.

2.4.1 TEACHERS MUST TAKE TIME OVER SCIENCE WORDS
According to research, in order to help learners develop language literacy, new vocabulary should be identified and carefully explored (Elliott, 2010). Learners need a chance to say words aloud before learning spelling (New South Wales Department of Education and Training, 2009; Elliott, 2010; Silverman & Hines, 2009; Center,

2005; Nash & Snowling, 2006). In addition, where appropriate, the morphemic structure and meaning of roots and stems should be explored. Center (2005) also recommended that phonics should be taught to ELLs to assist them become more proficient faster. Center further argues that learners who learn phonics master the sound code that enables them to read and spell. Mastering phonics, or the alphabetic principle, will make recognition of familiar and new words involuntary (Center, 2005; IMPACT, 2013; Nichols, Rupley, & Rickelman, 2004). The other way to help learners to master new scientific and English words is to use word games (Carrier, 2011). According to Carrier, traditional word games can be modified to suit the context and background of the learners so that they can assist them to experience the language of Science in their familiar context. This requires the choice of games to be at least democratised so that learners can introduce their own games. Examples of the word games that can be modified and used are Odd One Out, Bingo, Breaking words down into smaller words (Biology: Bio-logy), etc.

2.4.2 WORD WALLS

Word walls are places where new words can be displayed (Elliott, 2010). The walls of the Science classrooms can be used for this purpose. As a matter of principle, no particular word should stay on the word wall for a long time; words should be removed as learners are used to them and be replaced by the new problematic words (Carrier, 2011). According to Carrier, one of the golden rule is that learners should be given freedom to put words that they feel are difficult on the wall and a teacher should make known the number of words that should be on the wall at a go. That will help in making the word wall more effective. This will also help to encourage learners to use the word wall as Carrier recommends that learners should be continuously encouraged to use the word walls.

2.4.3 TALKING ABOUT SCIENCE

Seemingly, learners discourse is central to the development of language literacy skills (National Research Council, 2014). That is so because learner discourse facilitates the exploration of unfamiliar ideas and concepts and enables the construction of understanding (Carrier, 2011). When coming to talking, more specifically, arguing from evidence, even antagonizing philosophies of Kuhn and Popper believe it is the basis for science learning (Kuhn, 1962; Popper, 1959). Scientific knowledge emerges from constructive argument from sources and

experimentation. Furthermore, learners who argue scientifically in their classroom perform better than their counterparts who argue by accident (Demirbag & Gunel, 2014; Cavagnetto & Hand, 2012; Rhodes & Feder, 2014). Argument should be the centre of effective Science learning (Cavagnetto & Hand, 2012). As a result, in the Science classroom, learners should talk about Science (National Research Council, 2014). It is easy to involve learners in Science talks if a teacher is prepared to go extra miles. To facilitate the Science talks, teachers can use strategies like numbered hats together, jig-saw and pairs so that learners can communicate among themselves. These strategies, when employed properly, reinforce Vygotsky (1962, 1992)'s notion that learning is a social endeavour as they improve the mastery of Science concepts (Doherty & Pinal, 2002; Estrada & Imhoff, 2001; Hilberg, Tharp, & DeGeest, 2000; Lemke, 2001; Rosebery, Warren, & Conant, 1992). Furthermore, it is important to promote learners' dialogue as they have instructional conversations (Carrier, 2011). This means that a teacher needs to provide a meaningful context and reason for investigation so that the discussions among the learners are authentic and motivating. In Science, arguments that make claims should be based on evidence (Kuhn, 1962; Popper, 1959; Lakatos, 1970). First, it should be the claim, followed by evidence and last a reason explaining how the evidence supports the claim. In that way learners will be deepening their scientific understanding while improving literacy skills in the language of teaching and learning. According to Carrier (2011), a teacher should prohibit learners from communicating in their home language if their home language is not the LoLT (English). It is also a teacher's role to group the learners and encourage them to talk.

2.4.4 READING ABOUT SCIENCE

Ideally, Science lesson should be introduced by letting the learners read (National Research Council, 2014). A teacher need to have a clear purpose of what that particular reading need to achieve as reading in Science classroom can serve to achieve three purposes (Spencer, 2014). According to Spencer, there can be direct reading instruction, vocabulary builders, and concept organizers. Teachers should bring to class Science related texts that use correct scientific terms and which are related to the topic that is to be taught (Elliott, 2010; National Research Council, 2012). In the South African context that cannot be seen as a burden as the law requires that 60 % of the school budget should be spent on items that will help the classroom teaching and learning (Limpopo Department of Education, 2011). So if

there is material that would need a teacher to use money, schools should supply the funds so that teaching and learning should proceed without hindrances. So, a Science teacher should make sure that learners read almost every day. When learners are reading, a teacher should make sure that words are pronounced correctly as it helps learners to become proficient readers (Coltheart, 2005). According to Coltheart (2005) reading texts involves recognising words automatically, reading in a phrased and fluent way and navigating texts to create meaning. Research by Pikulski and Chard (2005) demonstrates that there is a positive correlation between reading fluency and comprehension. So if learners can read fluently, their level of comprehension would be higher. Comprehension involves responding to, interpreting, analysing and evaluating texts. Furthermore, research indicates that instruction comprehension, which needs reading comprehension, is prerequisite to enquiry learning (Taylor, Pearson, Clark, & Walpole, 2000; Rhodes & Feder, 2014; Cartwright, 2006). Nagy (2003) has also found that there is a connection between a strong vocabulary and comprehension. So, the more the learners read, the more their vocabulary increases, which improves reading and instructions comprehension, that leads to better Science performance.

2.4.5 WRITING ABOUT SCIENCE

One way to help ELLs improve their language literacy skills in science classroom is to let them write about Science (National Research Council, 2014; Demirdag, 2014). Writing, when coupled with enquiry-based learning can enhance language literacy skills and science learning (Moskovitz & Kellogg, 2011). Writing in the Science classroom can be in the form of journals, diaries, graphic organizers, poems laboratory reports and other creative writing (Elliott, 2010). Writing also involves using spelling, handwriting and design features to create texts for specific purposes (Carrier, 2011). Teachers should involve learners in writing because it helps learners to cement their Science process skills. Winch et al. (2001) reckoned that writing is not a tool for learning but learning in itself. Writing helps learners to be accurate. Teachers should try out different ways of involving learners in writing so as to improve their writing skills (Science Co-ordinators' and Consultants' Association of Ontario & The Science Teachers' Association of Ontario, 2005). For example:

- use of pre-writing activities aligned to specific methods of inquiry and to learning styles

- continued and expanded use of direct instruction of informational text forms (e.g., expository writing, reports, letters, opinion paragraphs)
- classroom environments that prominently display "reading, writing, and vocabulary resources [such as] key words, graphic organizers, examples of informational paragraphs … and general connectives
- writing assignments that provide assessment opportunities for other curriculum areas in addition to Science
- use of non-traditional writing activities to communicate learner knowledge and Understanding (Science Co-ordinators' and Consultants' Association of Ontario & The Science Teachers' Association of Ontario, 2005, p. 5)

According to Baker et al. (2014)'s recommendation 3, learners should be given *regular, structured opportunities to develop written language skills. This can be achieved when learners write* assignments related to Physical Sciences and also focusing on developing their language literacy together with writing skills (Baker, et al., 2014). Baker et al. further recommended that for this activity to assist learners there should be a constant and frequent assessment.

2.4.6 INTEGRATION OF TECHNOLOGY INTO SCIENCE INSTRUCTION

It is very important to integrate technology in the teaching of Science to improve language and Science literacies (Carrier, 2011; Lys, 2013; de Oliveira, 2011; Sawmiller, 2010; Cyparsade, Auckloo, Belath, Dookhee, & Hurreeram, 2013; Brick & Cervi-Wilson, 2015; Smith, 2014; Singh & Chan, 2014). According to Carrier (2011) the use of technology can help to reinforce word meanings and provide learners with multi-sensory connections. Furthermore the use of Information and Communication Technology (ICT) can help the learners to learn Science by giving access to information and ways to measure and analyse variables (Telima & Arokoyu, 2012; Chen, Chen, & Ma, 2014). This includes computers and cell phones. The current challenge in the use of ICT in South African Schools and Africa in general is lack of ICT infrastructure (Gillwald, Moyo, & Stork, 2012; Buabeng-Andoh, 2012). Even teachers in the schools with proper infrastructure do not integrate ICT in their classroom teaching (Chigona, Chigona, Kayongo, & Kausa, 2010; Assan & Thomas,

2012; Buabeng-Andoh, 2012). Lack of proper skills is among the reasons why teachers fail to integrate ICT in the teaching of Science. Regarding the cell phone, there is still a debate whether they should be allowed into schools or not. Some schools in South Africa forbid the use of cell phones by the learners in school campuses. So, we are still some steps away before we could start talking about using ICT in our classrooms in South Africa. Maybe there should be intense training for teachers to be able to use ICT confidently in the classroom and the provision of ICT infrastructure.

2.5 THEORETICAL FRAMEWORK

One of the pioneers of learning from a sociocultural perspective is a Russian psychologist, educator, philosopher and art critic Lev Vygotsky (1896-1934) (Vygotsky, 1962). Vygotsky believed that there must be language development before effective learning can take place and that social interaction is the basis of learning and development. In addition many studies reaffirm that learning is enhanced when it occurs in contexts that are culturally, linguistically, and cognitively meaningful and relevant to learners (Doherty & Pinal, 2002; Estrada & Imhoff, 2001; Hilberg, Tharp, & DeGeest, 2000; Lemke, 2001; Rosebery, Warren, & Conant, 1992). Language and thought are related and they develop together (Vygotsky, 1992). Children develop basic interpersonal communicative skills and learn to communicate in their home language (Cummins, 1981; Rosenthal, 1996). When new concepts are constructed, word sense plays an important role. Word sense is understood to be all that a word arouses in one's consciousness and all the different nuances of the meaning of a word in different contexts (Vygotsky, 1962). The Network Theory of Learning stresses the importance of connecting new knowledge into networks of existing knowledge in order for conceptualisation to occur (Shunk, 1996). Instruction that scaffolds literacy skills in language learners in Science classroom helps them master scientific knowledge as much as learners who are learning Science in their home language (Walqui, 2006; Babalola, 2012; Gibbons, 2002). Integration of literacy skills in Science teaching compensates for any language gap (Walqui, 2006; Nikolajeva, 2010; Scarcella, 2003; Schleppegrell, 2004; Lee, Quinn, & Valdés, 2013; Shanahan & Shanahan, 2008; Bicer, Capraro, & Capraro, 2013; United Nations Educanional, Scientific and Cultural Organisation (UNESCO), 2009). Learning of

Science and development of literacy and numeracy reinforce one another. (Lee, Quinn, & Valdés, 2013).

Also, Sapir-Whorf Hypothesis relates thought and language (Kay & Empton, 1984; Perlovsky, 2009; Whorf, 1956; Sapir, 1985); which explains why Science needs language. According to Sapir-Whorf's hypothesis, the more sophisticated and subtle words learners have in a language, the more learners think intelligently in that particular language. This means the more learners increase their knowledge of English words, the more learning Science in English becomes smooth. In addition, social interaction is the basis of learning and development (Vygotsky, 1962; Comber & Barnett, 2003). Social interaction may be limited where some elements of language literacy are not fully developed which may also limit the learning process. Learners must be able to read texts, graphs and pictures in order to comprehend scientific information; and they must be able to write and speak in order to communicate scientific information (Klentschy & Molina-De La Torre, 2004; Villanueva-Hay & Webb, 2005; National Academies Press, 2014). That is why it is recommended that Science teachers must not leave the teaching of literacy skills to the language teachers (Brisk, 2010; Barber, Catz, & Arya, 2006; Bicer, Capraro, & Capraro, 2013; Appalachia Regional Comprehensive Center, 2009; Atasoy, 2013; Carrejo & Reinhartz, 2012; Echevarría & Short, 2011; Moje, Sutherland, Cleveland, & Heitzman, 2006). Learners struggling to learn Science in a second language lose at least 20% of their capacity to reason and understand in the process (Johnstone & Selepeng, 2001). Integrating reading, writing, and oral language into Science instruction could help the learners to effectively acquire scientific knowledge and practice language literacy skills simultaneously (Hapgood & Palincsar, 2007). Even the opposing philosophies of Popper (1959) and Kuhn (1962) encourage learners to talk in science classroom. Popper and Kuhn believed that learners build their scientific knowledge as they argue scientifically (from evidence).

The theories discussed in the theoretical framework can be summarised as social constructivist theory of learning and the network theory of learning. These theories are relevant to this study as language development is the key to effective learning in any science subject.

2.6 CONCLUSION OF THE LITERATURE REVIEW

Previously, studies on English Language Learners (ELLs) in Science have been dominated by debates on the language of learning and teaching (LoLT) (Appalachia Regional Comprehensive Center, 2009). There is also a need to integrate Language literacy skills in teaching English Language Learners the contents of Science as instructing English language learners in content areas continues to pose demands and challenges to the teachers and the learners themselves (Hernández, 2003). With English learners, it is proper to continuously evaluate if the current practice accommodates their specialised language need (Echevarria & Hasbrouck, 2009).

CHAPTER 3: RESEARCH METHODOLOGY

This study employed quantitative research approach, because it was aimed at description of social reality.

> Quantitative research is a process that is systematic and objective in its way of using numerical data from only a selected subgroup of a universe to generalize the findings to the universe that is being studied (Pieterson & Maree, 2007, p. 145).

Quantitative research is useful to quantify opinions, attitudes and behaviours (Cohen, Manion, & Morrison, 2007; McMillan & Schumacher, 2001, 2006).

3.1 DESIGN OF THE STUDY

The study employed a survey design. Groves, Fowler, Couper, Lepkowski, Singer and Tourangeau (2004, p. 2) defined a survey as "…a systematic method for gathering information from entities for the purpose of constructing quantitative descriptors of the attributes of the larger population of which the entities are members…" A survey is a comprehensive method that would help a researcher to describe, compare or explain knowledge, attitude behaviour and practices (Cohen, Manion, & Morrison, 2007). It uses scientific sampling and questionnaire design to measure characteristics of the population with statistical precision. It seeks to provide answers to such questions as "…How often do people do certain behaviour…?" (Sukamolson, 2007, p. 4).

3.2 POPULATION

Population is defined by Cohen et al. (2007), McMillan and Schumacher (2001, 2006) and Richards (2006) as a group of elements or cases, whether individual objects or events that conform to a criteria and to which we intend to generalize the results of the study. In this study, the population was all Grades 10 Physical Sciences learners and all the science teachers in the Secondary schools of Riba Cross District of Limpopo Province in South Africa. Limpopo Province is amongst the lowest as far as pass rate in Science subjects is concerned in secondary school exit grade in South Africa, that is National Senior Certificate (NSC) examinations (DoE, 2010a, 2011b)

and the lowest in international Mathematics, Literacy and Science tests (HSRC, 2012; SACMEQ, 2010). Riba Cross is part of Sekhukhune Region which was the lowest performing region, in Grade 12 examinations, of all the districts in Limpopo province in 2012 (DoE, 2012).

3.3 SAMPLE

According to McMillan and Schumacher (2001, 2006) and Richards (2006), a sample can be a selected larger group of persons identified as population or it can simply refer to the group of subjects from whom data is collected. For this study, the sample consisted of 5 teachers teaching Science in Grade 10; and 211 Grade 10 learners from 9 Secondary Schools offering Physical Sciences in Riba Cross District. It must be noted that the intended population was 10 teachers and 300 learners from 10 schools, but due to the fact that some schools are no longer offering Physical Sciences, it was impossible for me to obtain the targeted sample size. Another reason why the targeted sample size was not reached is that learners are not taking Physical Sciences in grade 10. For example, I came across a school with more than 60 learners in grade 10 with only 8 learners in Science stream and more than 50 in the alternative stream. For teachers, out of nine teachers who signed the consent form, only 5 managed to answer the questionnaire. 4 teachers returned the questionnaire unanswered. The study focused on Grade 10 because that is where learners start to do Physical Sciences as a separate subject from other Sciences called Natural Science in Grade 9. Sampling was done in two stages for both learners and teachers. In the first stage, purposive sampling took place, where the lists of all the schools offering Physical Sciences in Grades 10 to 12 in the district (Riba Cross) was produced, and simple random sampling was employed to select the schools that took part and to increase generalizability (Cohen, Manion, & Morrison, 2007; McMillan & Schumacher, 2001, 2006).

3.4 INSTRUMENTS

Data was collected using a researcher designed Language Literacy Skills Usage Survey Questionnaire (LSUSQ) for teachers and learners. Using questionnaires as the main research technique is suitable for research that requires several types of information as in this study (Wray & Bloomer, 2006). The questionnaire (for both

teachers and learners) consisted of two sections (A and B). The first section (A) collected teachers/learners' biographic information and the second one asked closed questions that helped in achieving the research objectives. Section B employed a Likert scale with 5 possible responses per item (Maree & Pieterson, 2007). The possible responses on the questionnaire were strongly disagree, disagree, unsure, agree and strongly agree. Teachers' questionnaire had 17 items, whereas the learners' questionnaire had 16 items.

3.5 VALIDITY AND RELIABILITY
3.5.1 VALIDITY

McMillan and Schumacher (2006) and Wells and Wollack (2003) define validity of the questionnaire as the degree of congruence between the explanations of the phenomena and the realities of the world. Furthermore, validity refers to the fact that the instrument measures what it is supposed to measure. To ensure the validity of the questionnaire, five Science experts were consulted when a questionnaire was designed. The two experts helped me to restructure my questionnaire. Initially, the questionnaire for the teachers had 11 items and the one for the learners had 10 items; and the response categories were according to a four point scale. After consultations with the two experts, the number of items on the teachers' questionnaire was increased to 18 and on the learners' questionnaire to 16; and the scale was increased to a five point scale. It included the response category "unsure". The other three experts were asked to judge if each item on the questionnaires was relevant. Table 2 (Appendix H) indicates the results for both the learners' and teachers' questionnaires.

From the results of Table 2 in (Appendix H), the content validity index (CVI) was computed using the following formula:

$$Content\ Validity\ Index\ (CVI) = \frac{Total\ number\ of\ items\ in\ the\ questionnire\ declared\ valid\ be\ all\ the\ four\ raters}{The\ total\ number\ of\ items\ in\ the\ questionnaire}$$

$$CVI = \frac{15}{18} = 0,83$$

For teachers' questionnaire, CVI was found to be 0.83 which is greater than the acceptable value of 0.7 (Cohen, Manion, & Morrison, 2007; McMillan & Schumacher, 2001, 2006). Table 3 (see appendix H) indicates the judgements for learners'

questionnaire. The content validity index (CVI) was therefore computed using the following formula:

$$Content\ Validity\ Index\ (CVI) = \frac{Total\ number\ of\ items\ in\ the\ questionnire\ declared\ valid\ be\ all\ the\ four\ raters}{The\ total\ number\ of\ items\ in\ the\ questionnaire}$$

$$CVI = \frac{14}{16} = 0,88$$

For learners' questionnaire, CVI was found to be 0.88 which is greater than the acceptable value of 0.7. These mean both questionnaires are valid to be used in the study.

3.5.2 RELIABILITY

Reliability of an instrument refers to consistency or stability of the test/measured score (Cohen, Manion, & Morrison, 2007; Pieterson & Maree, 2007). It "is the extent to which a measuring instrument is repeatable and consistent" (Pieterson & Maree, 2007, p. 215). There are different types of reliability according to Pieterson and Maree (2007). For example, test-retest reliability, equivalent form reliability, split-half reliability and internal reliability. This study ensured the internal reliability of the two questionnaires, which is the "measure of the degree of the similarity between the items" of the questionnaires (Pieterson & Maree, 2007, p. 216). To ensure the internal reliability, a Cronbach's Alpha test was carried out. In order to carry out a Cronbach's Alpha test, a teachers' questionnaire was administered to 6 teachers and a learner's questionnaire to 15 learners after which the respective Cronbach's alpha values were calculated using IBM SPSS pack version 22 (Wells & Wollack, 2003; Pieterson & Maree, 2007). For teachers' questionnaire, no item was removed and an alpha value of 0.85, which indicates moderate reliability and it is greater than the minimum acceptable value of 0.7 (see the table below), was obtained.

Table 2: Reliability Statistics for Teachers' questionnaire

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.852	.854	18

This indicates that the teachers' questionnaire was reliable. For learners' questionnaire, no item was automatically removed by SPSS, as there were no items

with similar responses. The Alpha value of the questionnaire was found to be 0.73, which is above the acceptable value of 0.7 (see the table below).

Table 3: Reliability statistics for learners' questionnaire

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.725	.721	16

Although the value shows low reliability, it can be used as it is above 0.7.

3.6 DATA COLLECTION

Data was collected by the researcher using Language Literacy Skills Usage Survey questionnaire (LSUSQ) for both teachers and learners. The researcher visited the teachers and the learners at the sites and data collection did not hamper the normal running of the schools that were visited. Data was collected over a period of two weeks, from 15 September 2014 to 26 September 2014, after a provisional clearance certificate was issued by the University's research ethics committee.

3.7 DATA ANALYSIS

Descriptive statistics were used to analyse the results from the questionnaires (Gall, Gall & Borg, 2007; Lodico, Spaulding & Voegtle, 2006). Percentages, means and modes were used to indicate the frequency of various responses expressed by the respondents. The researcher also arranged the quantitative research data into tables, histograms and bar graphs in order to present the key features of the research data in a more interpretable manner (Johnson and Christensen, 2008). In carrying out the analysis, the researcher used IBM SPSS pack version 22 To increase the generalizability of the findings , means and standard deviations were used as in case of box and whiskers plots (Urdan, 2005). Gaussian distribution curves, which estimate the exact binomial distribution of events, were used to infer the generalizability of the findings (Urdan, 2005).

3.8 LIMITATIONS AND DELIMITATIONS

Surveys often have a shortfall of driving a respondent into a particular response category, thereby limiting the range of responses (Delva, Kirby, Knapper, & Birtwhistle, 2002). Furthermore, with descriptive statistics, one cannot generalise the results of the sample to the whole population unless one uses some inferential statistics that show that the results can be generalised (Urdan, 2005). This study was also limited to secondary schools offering Science from Grade 10 to Grade 12 in Sekhukhune district of Limpopo Province. The study was aimed at learners who are enrolled in a Science classroom where English is the medium of instruction and teachers who are teaching them Physical Sciences. All these were taken into account when data was collected and analysed. Hawthorne effect was also taken into account: the researcher was aware that subjects who know they are being observed as part of an experiment often change the way they act in a ploy to improve the way they are viewed by outsiders or even the insiders (Broches, 2008). It is also known through the theory of rationalisation that when people are asked about their practice, they will say what they think is acceptable than what they are actually doing (Cherepanov, Feddersen, & Sandroni, 2009; Ambur, 2002). To negate the Hawthorne Effect and the effects outlined by rationalisation theory, the questionnaires was given to teachers and learners so that the information could be triangulated.

3.9 ETHICAL CONSIDERATION

Permission to conduct the study was sought from the University research management team, District offices of the Department of Education, the school principals, the learners, parents and the School Governing Boards (SGB's). The recruitment of the learners and the teachers who were the main participants in the research was conducted in an open and democratic way. In addition, Section 71 of National Health Act (NHA) of 2012 guided the recruitment of the learners who were still minors, in Grade 10 (South African Department of Health, 2012). Furthermore, ethical issues namely: informed consent, confidentiality, respect, anonymity and discontinuance were also observed.

9.1 INFORMED CONSENT

The principle of informed consent arises from the subject's right to freedom and self-determination. Being free is a condition of living in a democracy, and when restrictions and limitations are placed on that freedom they must be justified and consented to, as in research (Cohen, Manion, & Morrison, 2007; McMillan & Schumacher, 2001, 2006). Consent thus protects and respects the right of self-determination and places some of the responsibility on the participant should anything go wrong in the research. As part of the right to self-determination, participants had the right to refuse to take part, or to withdraw once the research has begun. To comply with the requirements of this principle, all the participants were asked to sign a consent form. The following was done before the form was signed:

- A clear explanation of the procedures to be followed and their purposes;
- A description of the attendant discomforts and risks reasonably to be expected;
- A description of the benefits reasonably to be expected;
- A disclosure of appropriate alternative procedures that might be advantageous to the participants; an offer to answer any inquiries concerning the procedures and
- An instruction that the person is free to withdraw consent and to discontinue participation in the project at any time without prejudice.

With the learners who are under the age 0f 18, Section 71 of National Health Act provides the procedures and conditions that need to be met in order for minors to take part in research (South African Department of Health, 2012). All the conditions were met as the research did not expose the participants to any risk. This section also required that permission is given by both parent/guardian and child. A parent had to give permission first and because Grade 10 learners are over 12 years of age, they also had to decide if they take part or not (South African Department of Health, 2012).

3.9.2 CONFIDENTIALITY

Confidentiality means that although researchers know who has provided the information or are able to identify participants from the information given, they did in no way make the connection known publicly; the boundaries surrounding the shared

secret were protected (Cohen, Manion, & Morrison, 2007; McMillan & Schumacher, 2001, 2006). To ensure confidentiality, the following were also employed: deletion of identifiers (for example, deleting the names, addresses or other means of identification from the data released on individuals); crude report categories (for example, releasing the year of birth rather than the specific date, profession but not the speciality within that profession, general information rather than specific); micro-aggregation (that is, the construction of 'average persons' from data on individuals and the release of these data, rather than data on individuals)

3.9.3 RESPECT

The principle of equal respect, demands that we respect the equal worth of all people (Cohen, Manion, & Morrison, 2007). This requires us to treat people as ends rather than means, to regard them as free and rational, and to accept that they are entitled to the same basic rights as others. Privacy: this involves a right to control information about oneself, and protects people from unwarranted interference in their affairs. In evaluation, it requires that procedures are not overtly intrusive and that such evaluation pertains only to those aspects of a teacher's activity that is job related. It also protects the confidentiality of evaluation information. To ensure that the principle of respect is observed equality, public perspicuity, humaneness, client-benefit and respect for autonomy were employed.

3.9.4 ANONYMITY

The essence of anonymity is that information provided by participants should in no way reveal their identity (Cohen, Manion, & Morrison, 2007; McMillan & Schumacher, 2001, 2006). A participant or subject is therefore considered anonymous when the researcher or another person cannot identify the participant or subject from the information provided. To ensure anonymity, expressions like teacher A or learner A in data analysis were used. Information that would directly or indirectly help identify the participants was not used.

3.9.4 DISCONTINUANCE

Discontinuance is the freedom of a participant to withdraw at any time during the research without penalty (Altermatt, 2011). To insure discontinuance a consent form

included a statement explicitly informing participants that they were free to discontinue the experiment at any time without penalty.

CHAPTER 4 RESULTS

4.1 INTRODUCTION

Before dealing with data analysis, one needs to look at the properties of the sample. The sample consisted of nine schools selected using simple random sampling. From the nine schools, 211 learners and 5 teachers answered the questionnaires. The following table summarizes the learner sample per school:

Table 4: Sample's frequency table

Frequency Table

School		Number of learners	Percent	Valid Percent	Cumulative Percent
Valid	A	20	9.5	9.5	9.5
	B	8	3.8	3.8	13.3
	C	26	12.3	12.3	25.6
	D	25	11.8	11.8	37.4
	E	45	21.3	21.3	58.8
	F	12	5.7	5.7	64.5
	G	26	12.3	12.3	76.8
	H	17	8.1	8.1	84.8
	I	32	15.2	15.2	100.0
	Total	211	100.0	100.0	

School B had the least number of learners whereas school E had the highest number of learners that is 45. The number of girls and the number of boys in the sample does not differ by a big margin. The following table shows the number of boys versus the number of girls:

Table 5: Sample gender distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
				Gender	
Valid	Male	107	50.7	51.0	51.0
	Female	103	48.8	49.0	100.0
	Total	210	99.5	100.0	
Missing	System	1	.5		
Total		211	100.0		

The sample consisted of 107 boys, which is 50, 7 %; and 103 girls, which is 48, 8 %. One learner did not specify his/her gender. The following pie chart gives a clear picture of how gender issue was covered in this study, from a random sample:
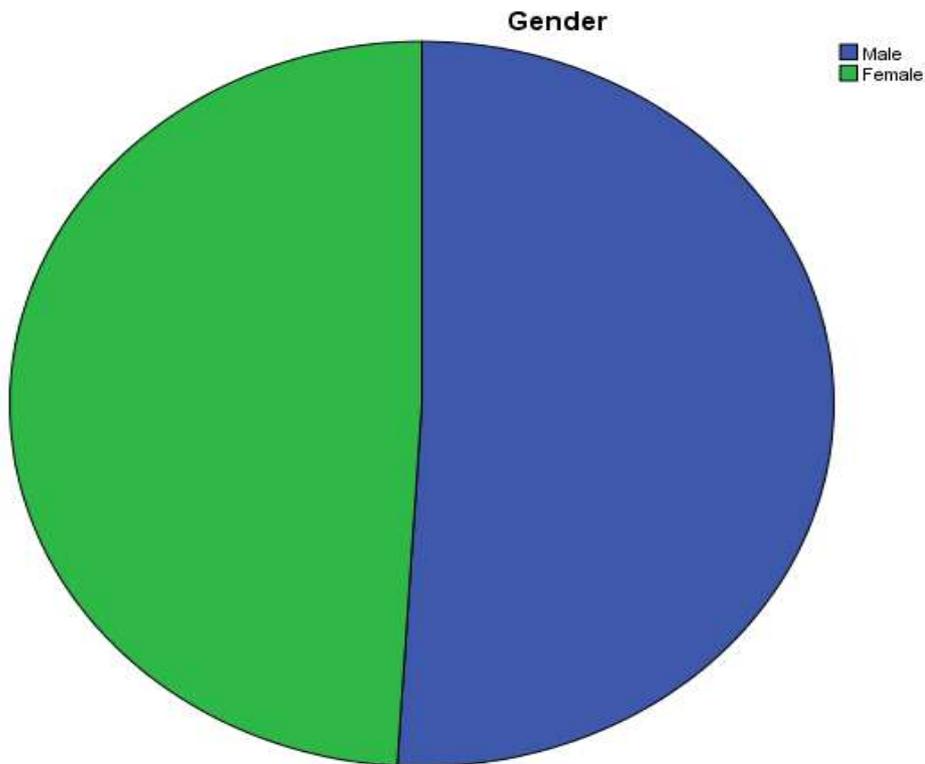
Gender

Figure 2: Gender Chart

The two fractions are almost equal. The gender balance in the sample was also in the schools:

Table 6: Gender per sampled school

School * Gender Cross tabulation

Count

		Gender		
		Male	Female	Total
School	A	11	9	20
	B	5	3	8
	C	11	15	26
	D	17	8	25
	E	22	22	44
	F	4	8	12
	G	15	11	26
	H	6	11	17
	I	16	16	32
Total		107	103	210

School E shows the exact tallying of boys and girls, where the number of boys is equal to the number of girls. Furthermore, a large proportion of the learners spoke Sepedi as their home language. The following pie chart shows the number of learners who spoke Sepedi versus those who spoke the other languages at home:
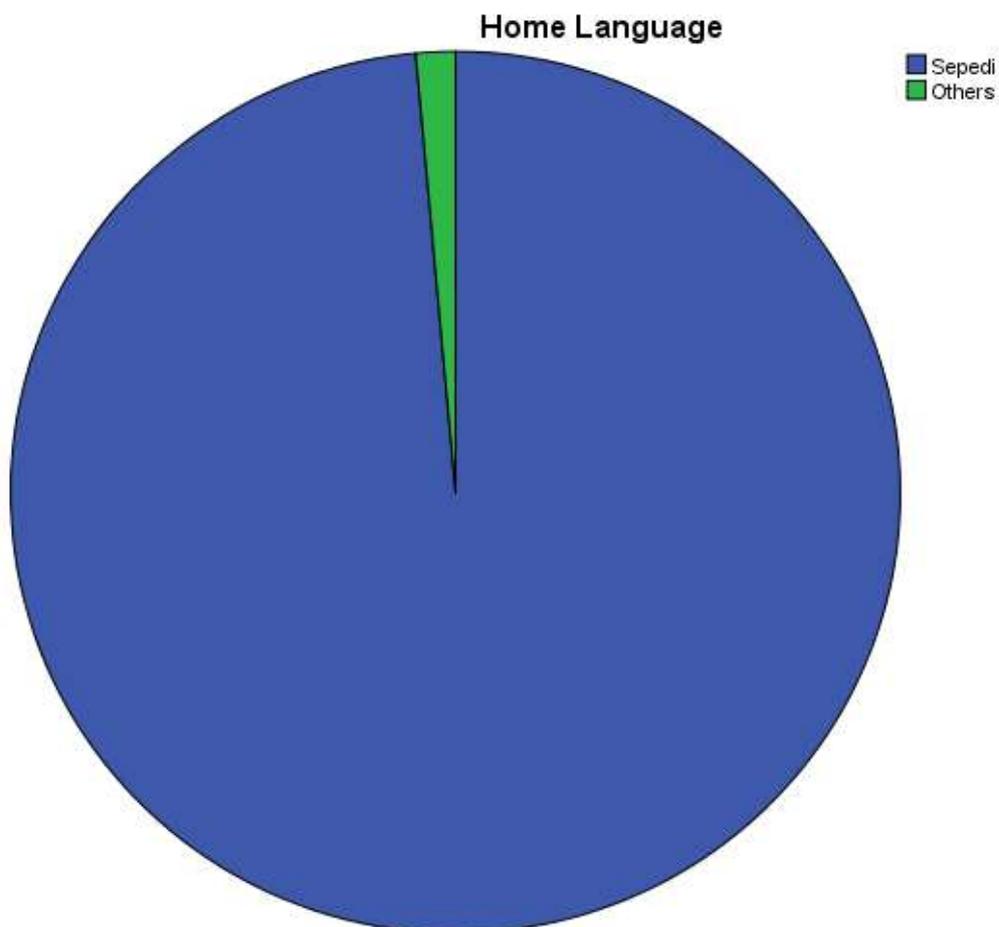
Figure 3: Sample home language distribution

Only 5 teachers answered the questionnaire: the following table shows the teachers who answered the questionnaire against their schools:

Table 7: School Gender Cross tabulation

School * Gender Cross tabulation

Count

|		Gender	Total
		Male	
School	A	1	1
	B	1	1
	C	1	1
	E	1	1
Total		4	4

One teacher did not answer section A of the questionnaire. Out of the 5 teachers who have answered the questionnaire, only two teachers indicated that they spoke Sepedi at home, the other two spoke Shona and the fifth teacher as indicated, did not indicate his or her home language. All teachers who answered the questionnaire are males. Female teachers are among those who did not answer the questionnaire.

Data analysis started by looking at the broader results and thereafter looked at the individual aspects of integrating literacy into Science teaching. Due to the small number of teachers who responded to the questionnaire, data analysis was mostly focused on the data from the learners' sample.

4.2 RESEARCH RESULTS

4.2.1 OVERALL RESULTS

Overall results were obtained by computing the average per learners and average per teacher using Microsoft Excel. Average per learner/teacher was also captured as a variable in SPSS. The following table shows the results for the learners:

Table 8: Average per learner

Average per learner

N	Valid	211
	Missing	0
Mean		3.4843
Std. Error of Mean		.04272
Median		3.5640[a]
Mode		3.25[b]
Std. Deviation		.62061

The mean of the averages is 3.48 which is leaning between Unsure (3) and Agree (4); the value of median is 3.56 which is also greater than 3 and leaning towards 4. This means overall, the learners in the sample agree that the teaching of Science integrates language literacy skills. The minimum average is 1.31 and the maximum is 5.00 and the minimum and maximum have been selected by SPSS as the outliers (see the boxplot below):
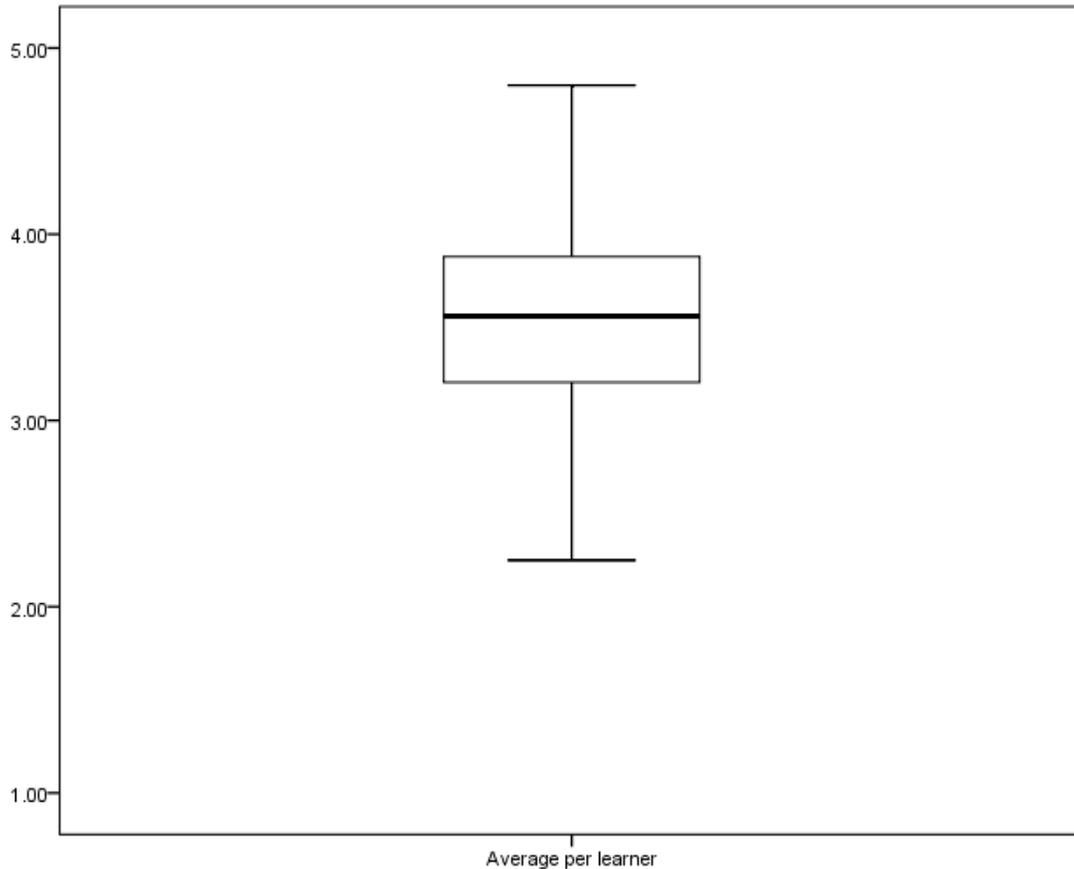
Figure 4 Average per learner boxplot

The boxplot above also indicates that all the quartiles for the average per learner lie between Unsure and Agree, which also gives an impression that learners just agree that integration of literacy skills takes place in their Physical Sciences classroom. This can also be shown by the following compound boxplot:
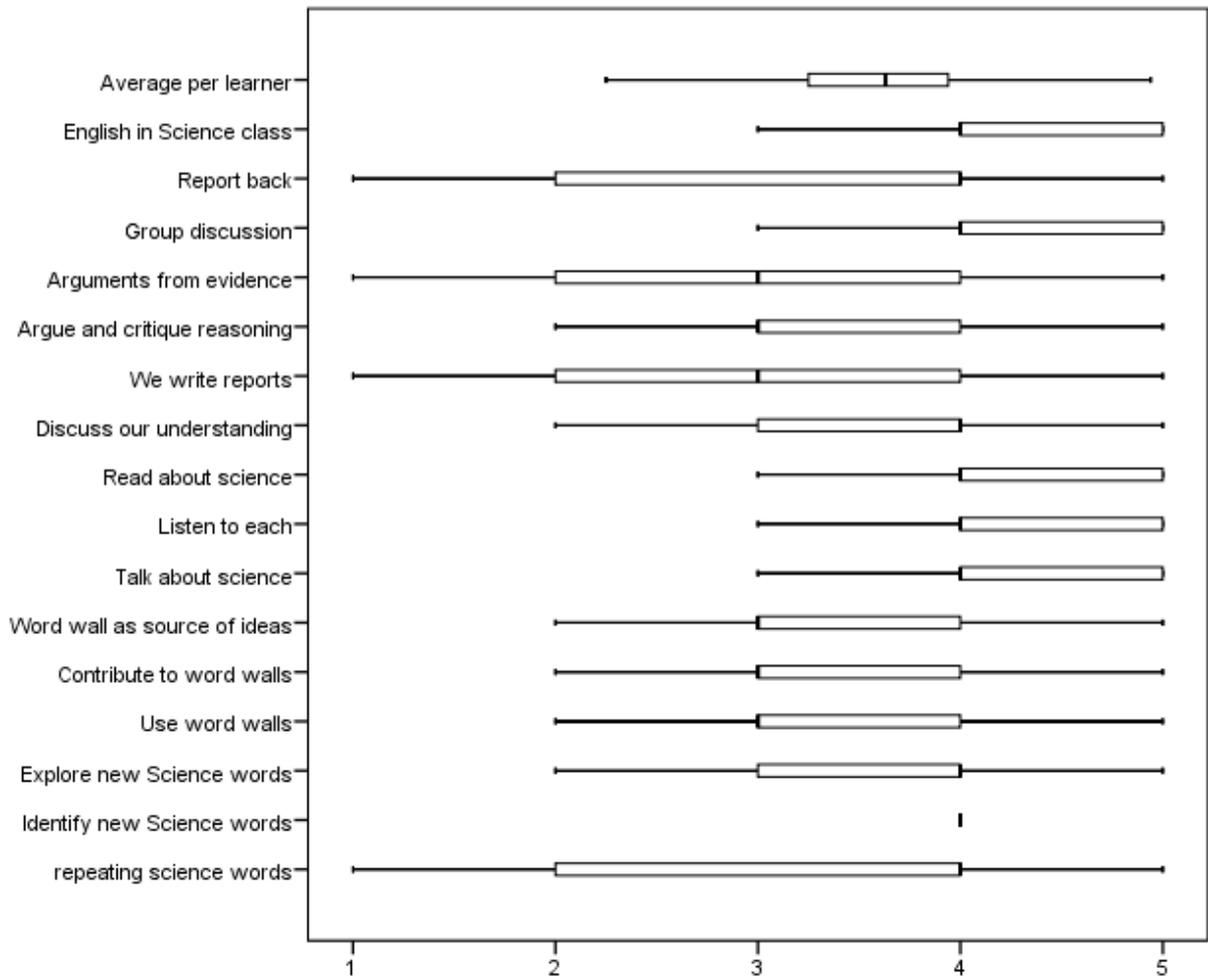
Figure 5: All boxplots from learners' sample

From the boxplot, 11 items out of 18 have lower quartiles above 3 (unsure) and all medians except the one for "We write reports are above 3 (Unsure). The general impression that one would get from the learners' sample is that integration of language literacy skills takes place in their Physical Sciences classroom.

Teachers' averages also support the impression created by learners' sample that integration of language literacy skills takes place in Physical Sciences classroom. The following table shows results from the teachers:

Table 9: Teachers results

N	Valid	5
	Missing	0
Mean		4.2440
Median		4.3900
Mode		3.67[a]
Std. Deviation		.33739
Skewness		-1.754
Std. Error of Skewness		.913
Kurtosis		3.073
Std. Error of Kurtosis		2.000
Range		.83
Minimum		3.67
Maximum		4.50
Sum		21.22
Percentiles	25	3.9450
	50	4.3900
	75	4.4700

The mean for the teachers' averages is 4.25 and the median is 4.39, which also show that teachers believe that they are integrating language literacy skills in teaching Physical Sciences. The following boxplot also indicates that, generally, teachers believe that they integrate language literacy skills in teaching Physical Sciences.
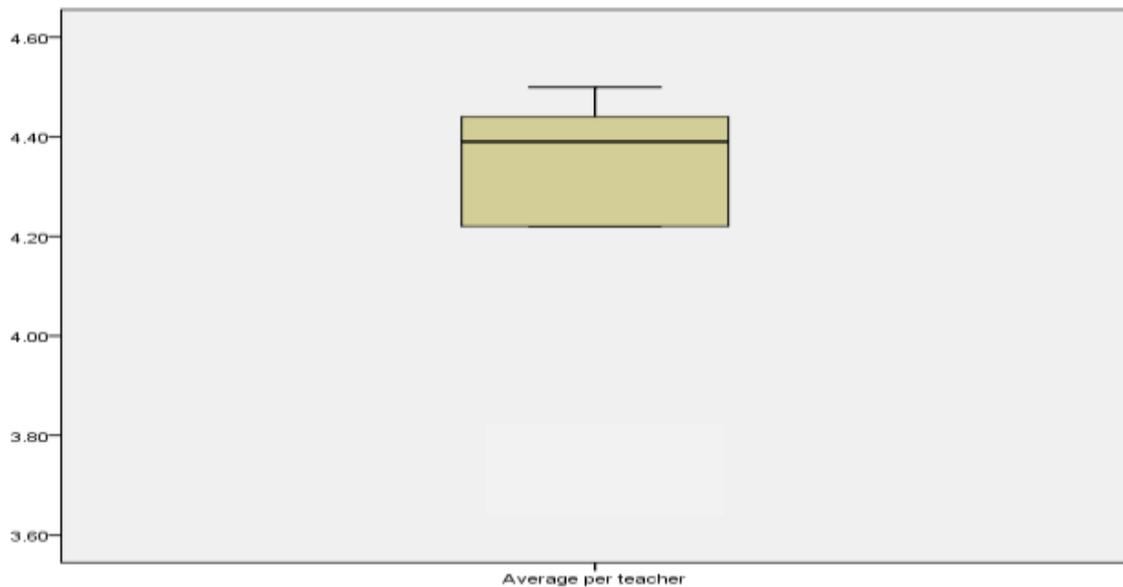
Figure 6: Average per teacher boxplot
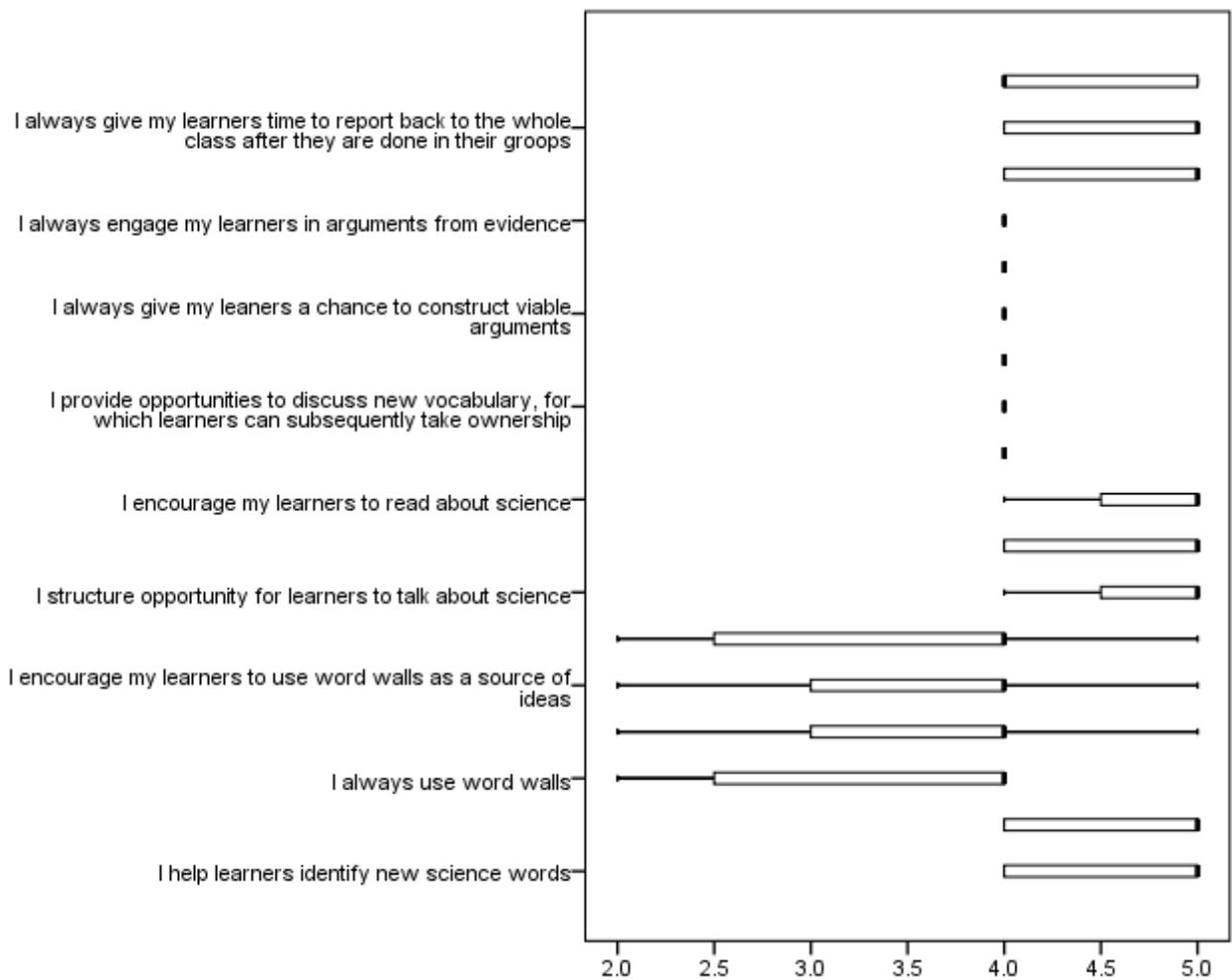
Figure 7: All boxplots (teacher sample)

In the boxplot, the lower quartile for the average per teacher is greater than four, which shows that; overall, teachers agree that they are integrating language literacy skills in teaching Physical Sciences. So, looking at the overall picture, from both learners and teachers sample things look fine because it looks like the integration of language literacy skills takes place in the schools. When one gets deeper in to the sample, one starts to discover problems as it will be discussed later. From the learners' data, there are items that reveal worrying results.

4.2.2 PROBLEM AREA IN TERMS OF CLASSROOM PRACTICE

This part will concentrate mostly on the learner sample as it was bigger and will be compared to the teacher sample. From the line graph below, from the learners' sample, the areas that may be of concern are writing reports and engaging in arguments from evidence. The two are important in the learning of Science, so it is important that they are isolated from the rest as they also present alarming results. The other one that seem problematic is encouraging learners to use word wall, but overall the use of word wall is not a problem as the graph indicates.
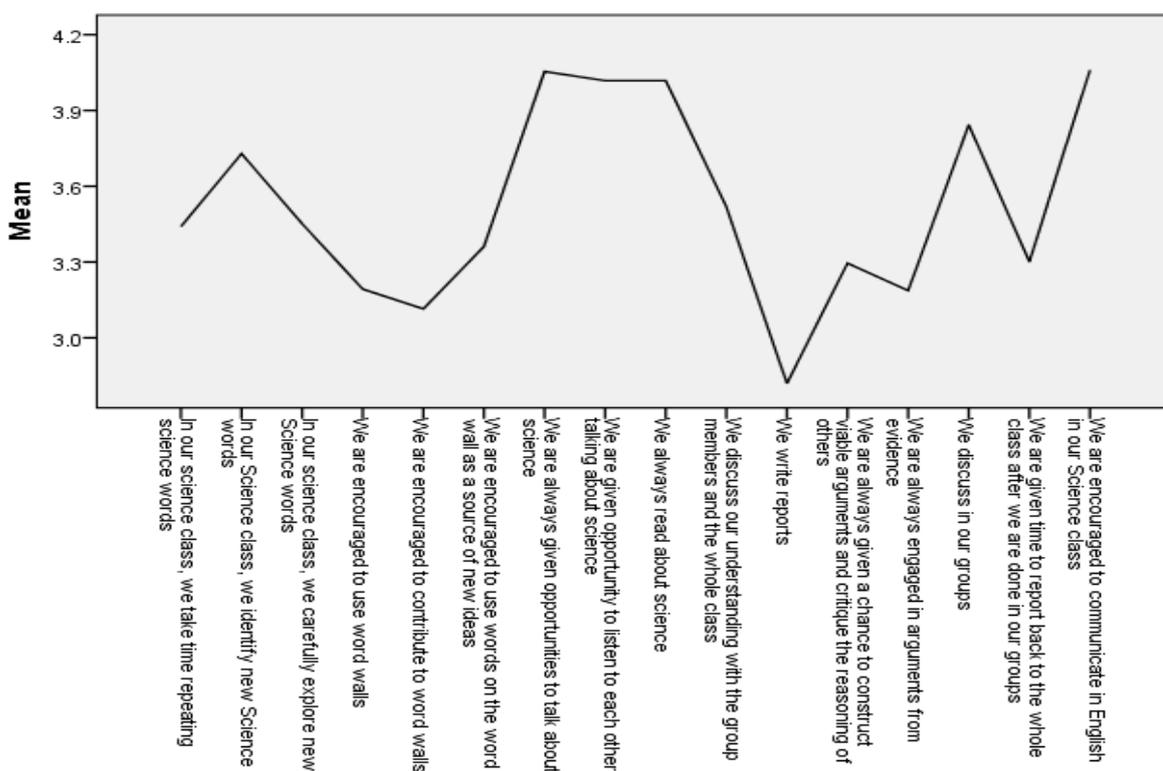
Figure 8: Mean per category

4.2.2.1 *WRITING REPORTS*

The following table shows the results for report writing:

Table 10: Report writing

We write reports

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	29	13.7	13.9	13.9
	Disagree	67	31.8	32.2	46.2
	Unsure	55	26.1	26.4	72.6
	Agree	41	19.4	19.7	92.3
	Strongly Agree	16	7.6	7.7	100.0
	Total	208	98.6	100.0	
Missing	System	3	1.4		
Total		211	100.0		

From the table, one can deduce that only 27.4 % of the learners believe they write reports in their Science classroom. The rest, 72.6 %, are either unsure or think they do not write reports. The following histogram also gives a clear picture of what the learners think about writing reports.

We write reports

Mean = 2.75
Std. Dev. = 1.153
N = 208
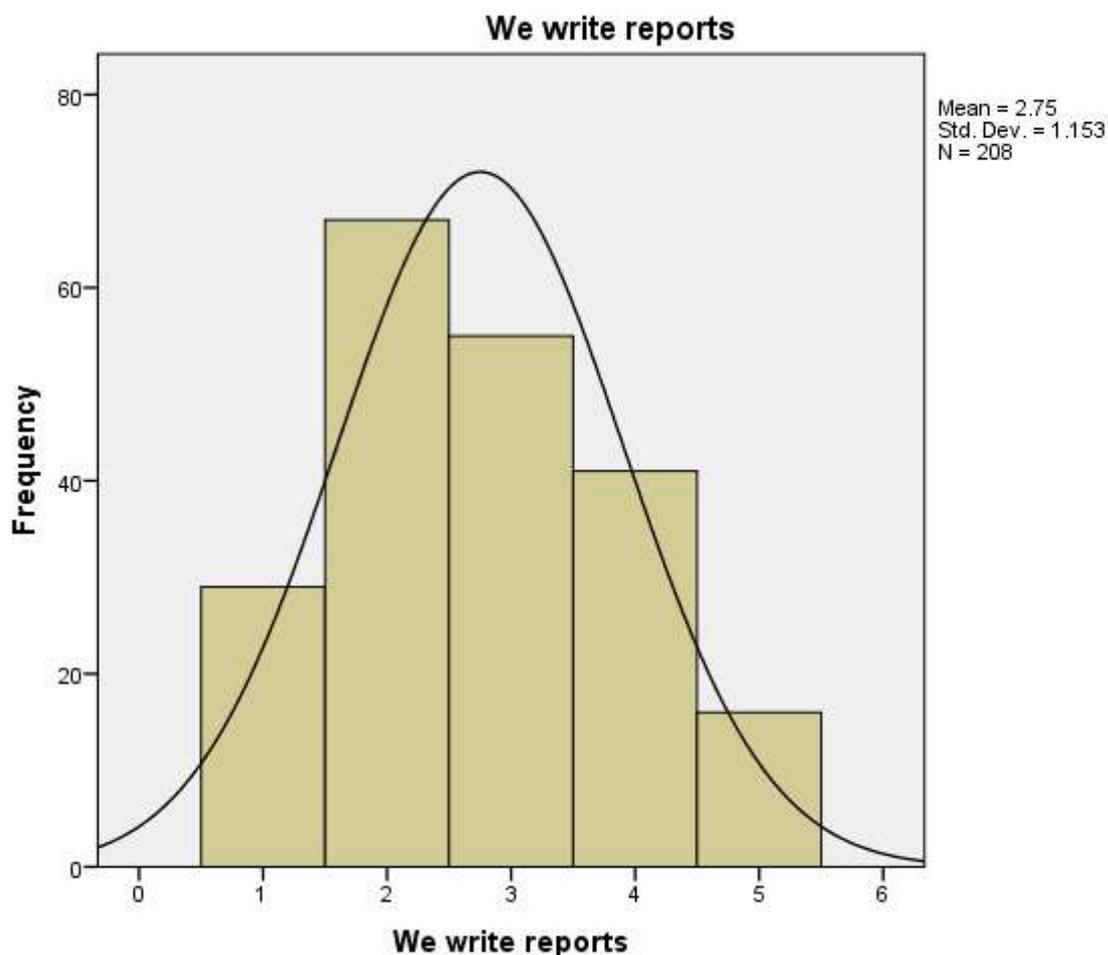
Figure 9: Report Writing

The histogram shows that most of the data is on the left of 3 (unsure) than the right, which means, from the sample; learners were not engaged in report writing as they should be doing. Furthermore, the distribution as the curve indicates is almost ideal (the data is normally distributed) which means this result can be generalised to the whole population (Riba Cross District Secondary schools).

4.2.2.2 ARGUING FROM EVIDENCE

Arguing from evidence, from learners' perspective seem not to be done justice, even if the five teachers sample believe they help learners in this regard. The following boxplot summarises learners' responses in this regard:

We are always engaged in arguments from evidence
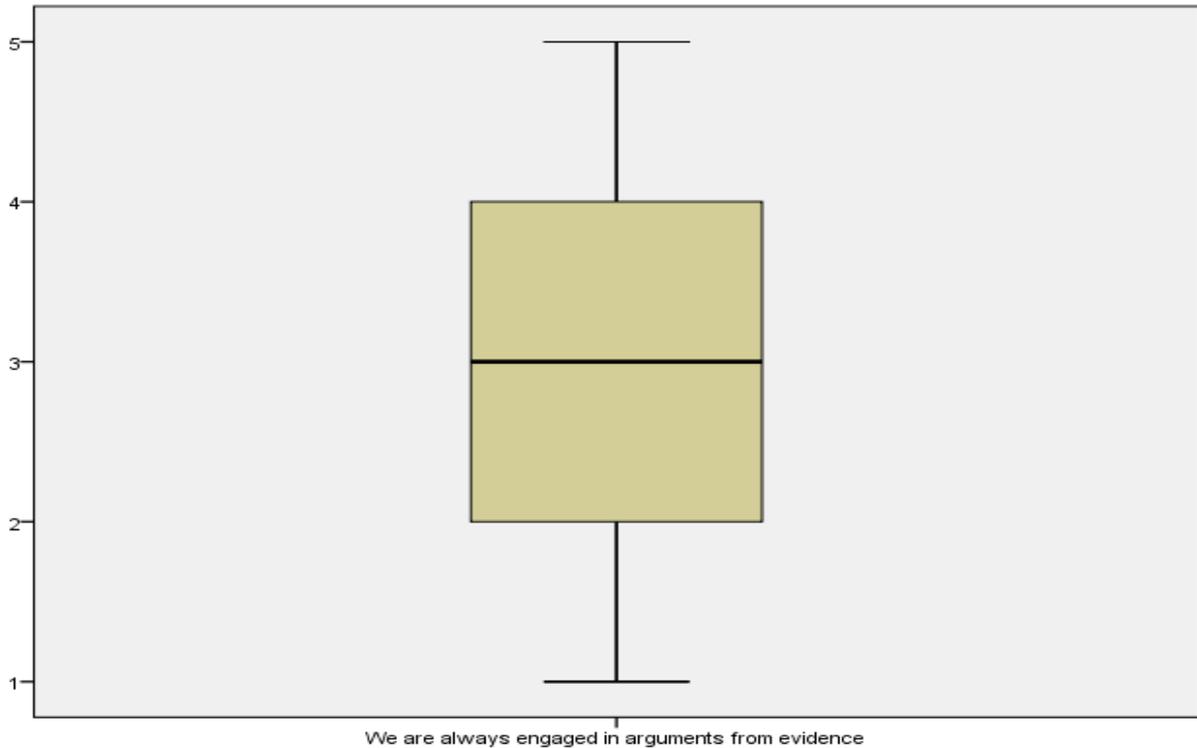
Figure 10: Arguing from evidence

From the boxplot the third response, that is "Unsure" category, seems to be dividing the data into to equal portions, which means number of learners agreeing is almost the same as the number of learners disagreeing. This may also lead one into inferring that arguing scientifically is not common in the sampled schools and also in the whole district as the curve below shows a normal distribution:
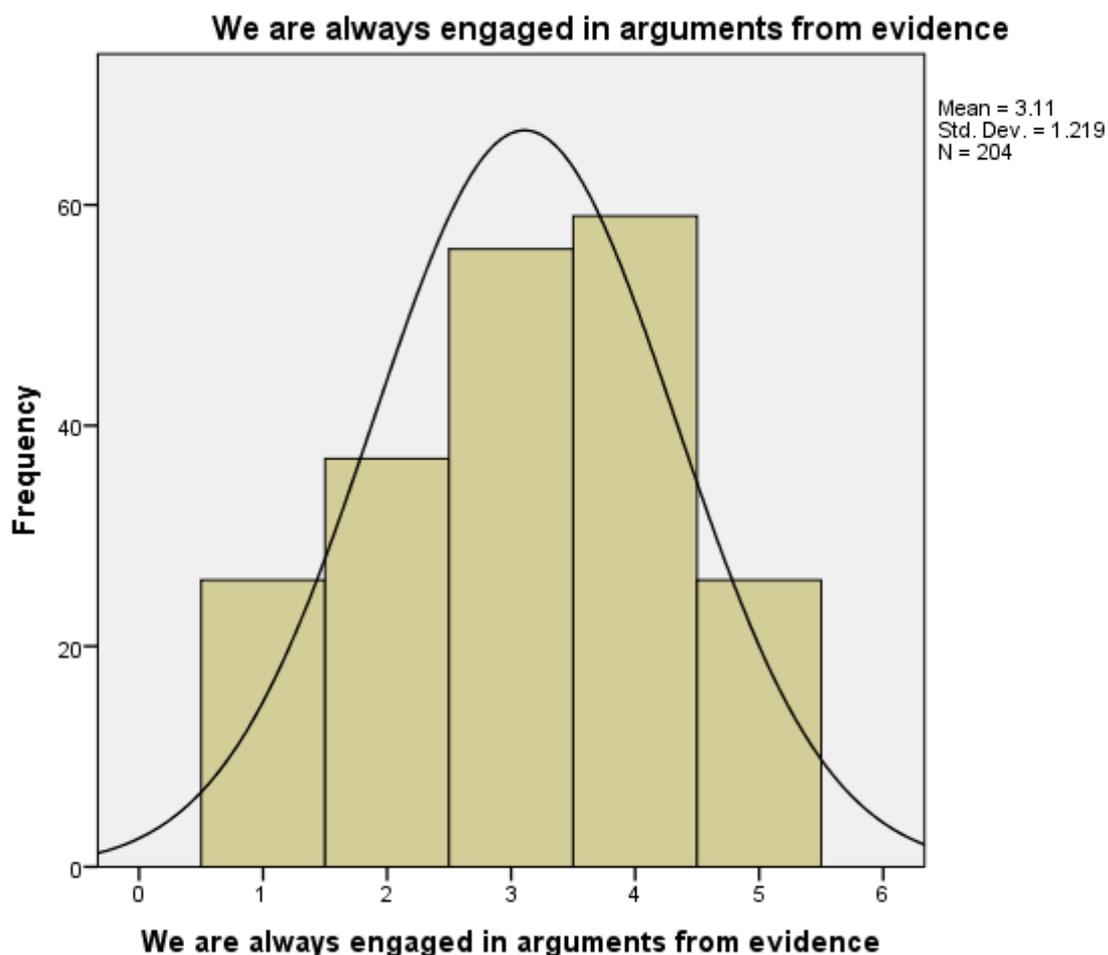
Figure 11: Arguing from evidence

The median for this item is 3 and the mean is also just over 3; and the mode as it can be deduced from the histogram is 3, which shows a normal distribution. As a result, this finding can also be generalised to the whole population.

4.2.3 RESULTS PER SCHOOL

There are two things that will be looked into under this subheading: Average per learner per school and problem area per school.

4.2.3.1 AVERAGE LEARNERS PER SCHOOL

To quickly check if there was a school that is generally experiencing problems in terms of integrating language literacy skills, a line graph was used. The following line graph summarises the results per school:
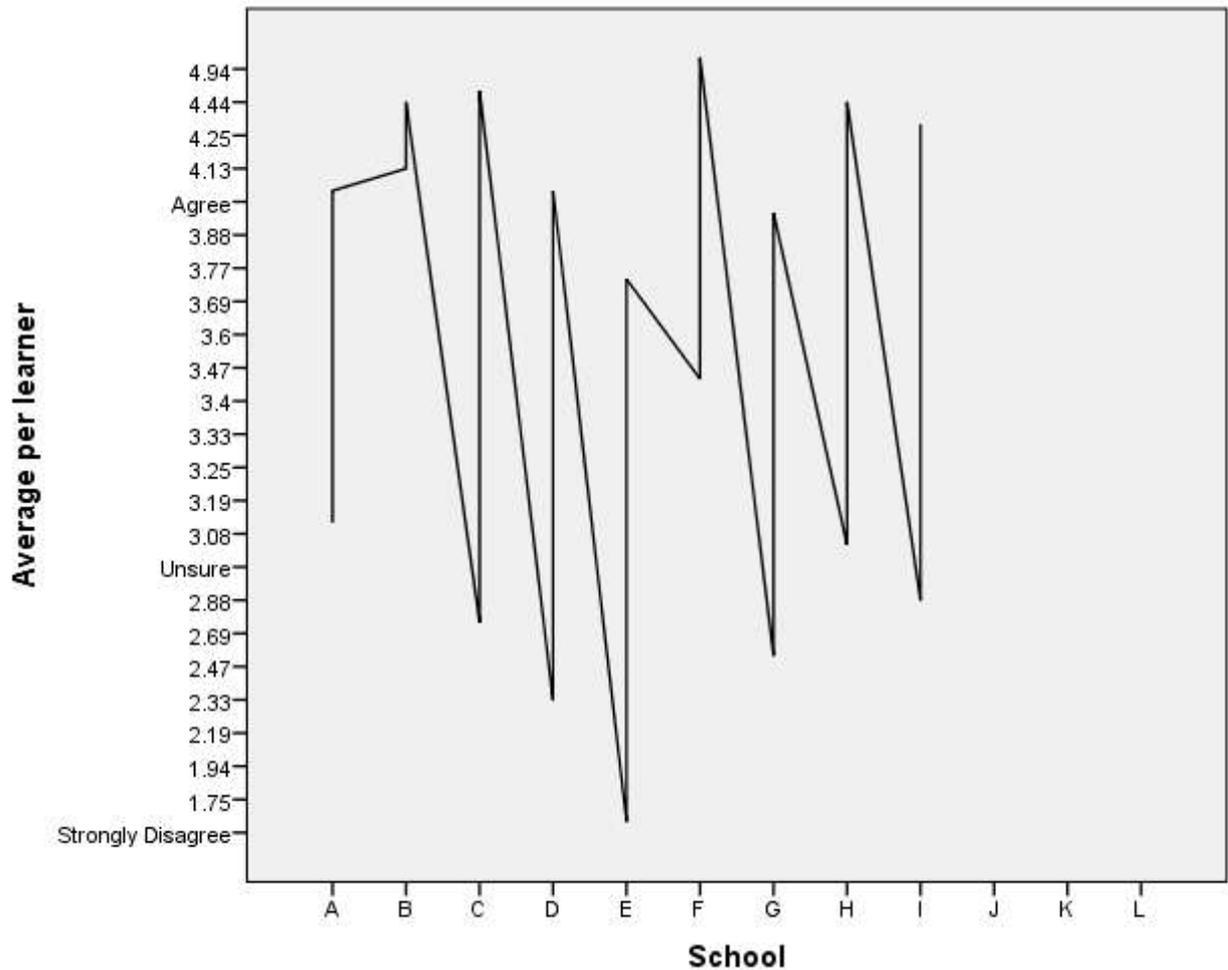
Figure 12: Average per learner versus school

From the line graph above, one can easily deduce that School B is doing well when coming to integrating language literacy skills in teaching Physical Sciences. The data also suggest that School E seems to be struggling. This also presents an interesting issue: School B had the lowest number of learners taking Physical Sciences in Grade 10; that is 8, while School E had 45 learners in Grade 10. This seems to suggest that the size of the class affect integration of language literacy skill in the teaching of Physical Sciences.

Results per school were also analysed using a box plot. The following boxplot also summarises the results:
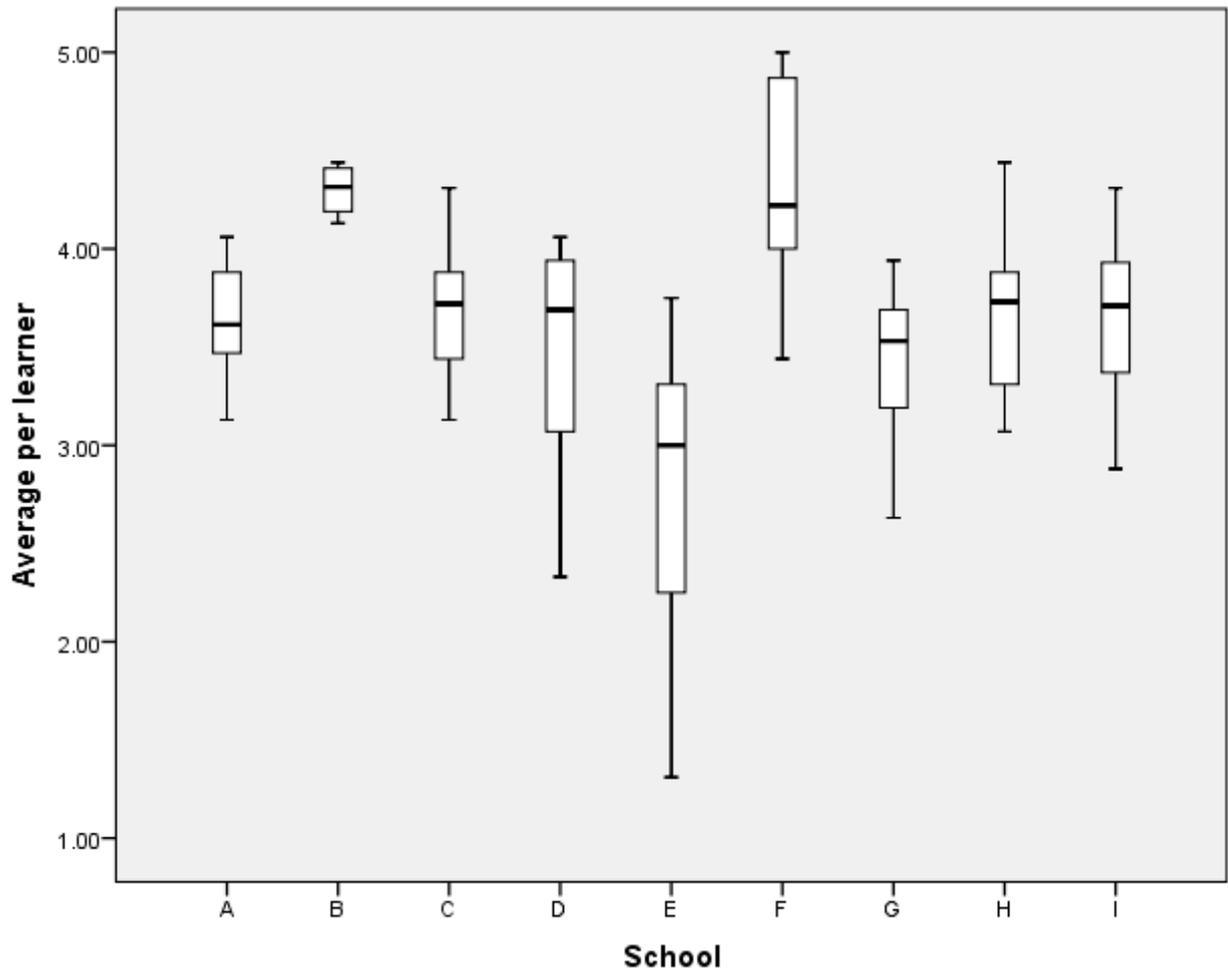
Figure 13: Average per learner versus school (boxplot)

From the boxplot above, it is clear that School E is having problems while School B and school F seem not to have a problem in this regard. In conclusion, although overall picture indicates that literacy skills are integrated in the sampled schools, there are still schools that are struggling and need help.

4.2.3.2 PROBLEM AREA VERSUS SCHOOL

Problem areas were identified as writing reports and arguing from evidence. The two are presented separately, starting with writing reports.

4.2.3.2.1 WRITING REPORTS VERSUS SCHOOL

The following boxplot shows the results when writing reports is compared among the schools from learners' sample:
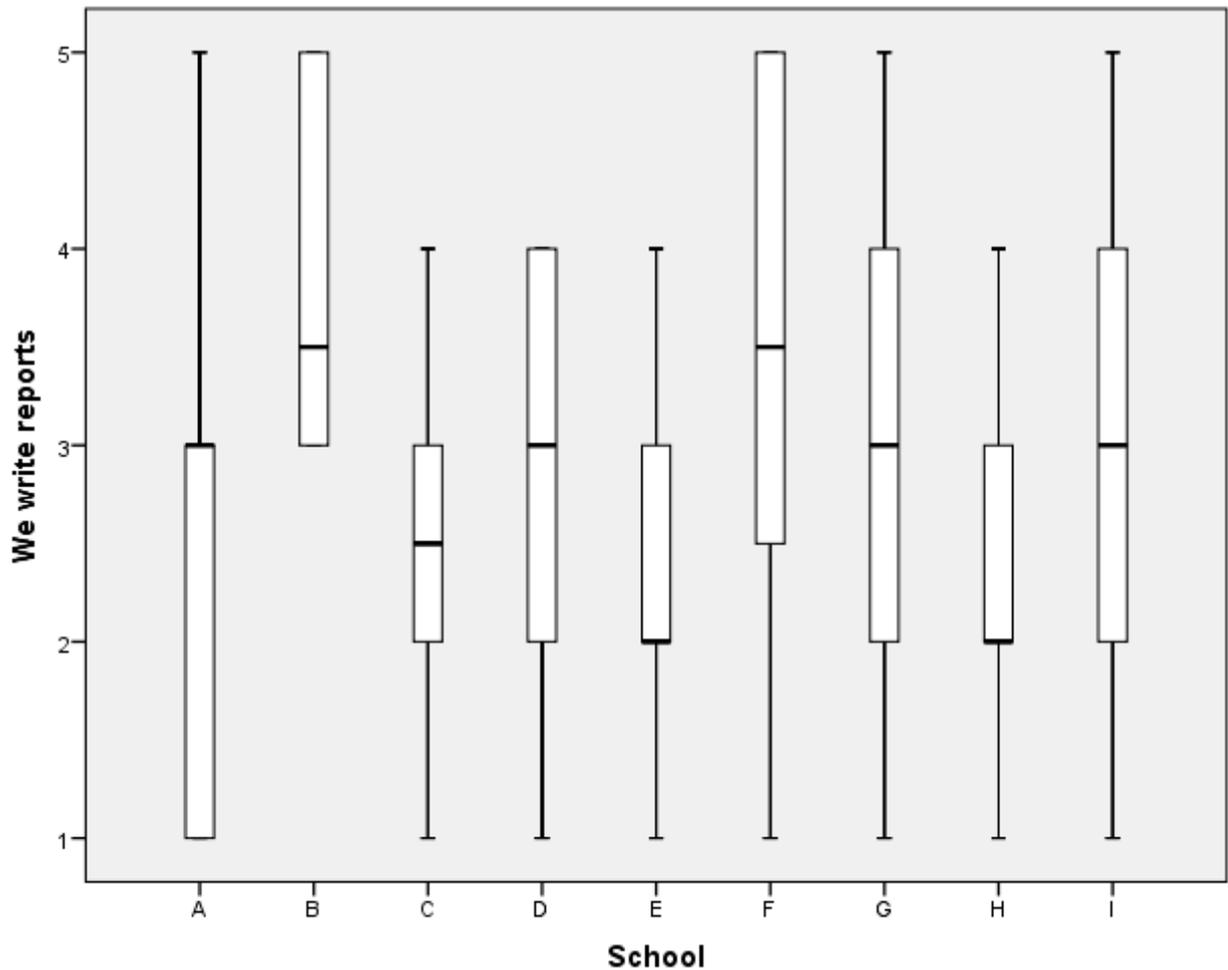
Figure 14: Report writing versus school (boxplot)

From the boxplot, it can be clearly deduced than only two schools seem to be coping, out of nine schools. This is a problem, more especially when the subject that is being taught and learned is Physical Sciences that can easily be learned through enquiry learning of which report writing is the evidence of compliance (Chabalengula & Mumba, 2012).

4.2.3.2.1 ARGUING FROM EVIDENCE VERSUS SCHOOL

The following boxplot shows the results when arguing from evidence is compared among the schools from learners' sample:
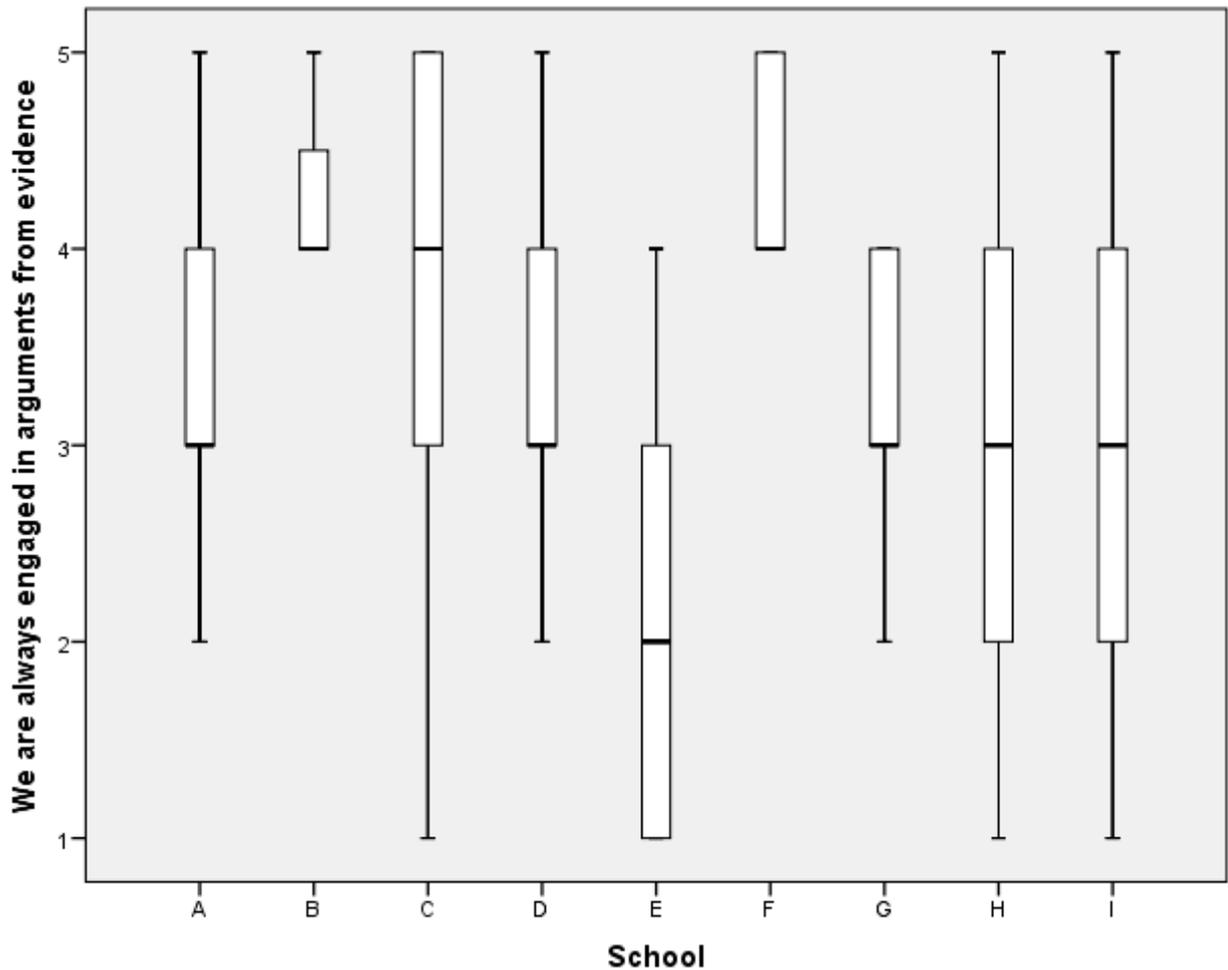
Figure 15: Arguing from evidence versus school (boxplot)

From the boxplot above, one can also deduce that small sized classes seem not to be having a problem. School E is once again having a problem with the upper quartile being 3 (Unsure). School H and School F seem to be having a problem with the engagement of learners in arguments from evidence.

4.3 CONCLUSION

Firstly, in analysing the data, learners' sample was used in most cases whereas teachers' sample was used in a few cases. The reason for that is that the response rate of learner is satisfactory. Learners from all the nine school responded. In contrast, only five teachers from the nine schools responded. Furthermore, one teacher did not even fill in his/her biographical information.

Secondly, the results from this sample can be generalized to the whole population of Riba Cross District for some reasons: Normal Distribution and The Central Limit Theorem (Urdan, 2005).

For the average response per learner/teacher the curves are showing an almost normal distribution of data. Look at the histogram below:
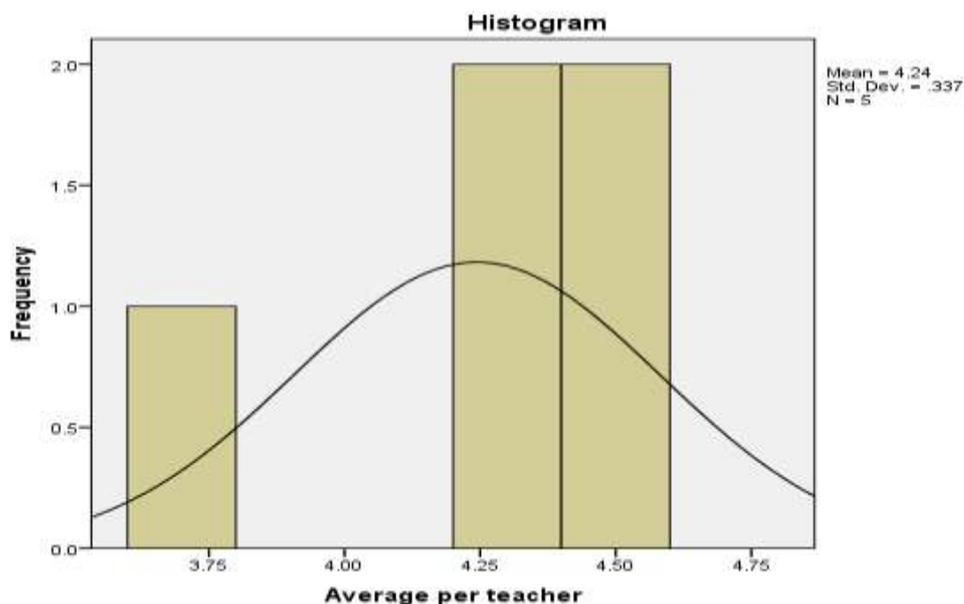
Figure 16: Average per learner distribution curve

According to the Central Limit Theorem, "*as long as you have a reasonably large sample size (e.g., n = 30), the sampling distribution of the mean will be normally distributed*" (Urdan, 2005, p. 49). In terms of the current study, teacher sample cannot be generalised to the whole population unless one gets a normally distributed data of which it gives positive results. Learners' sample of 211 qualifies the results to be generalised for the whole population both ways: Normal data distribution from the drawn curves and through the Central Limit Theorem. In conclusion, the results of this study can be generalised to the whole population according to the inferential statistics and the Central Limit Theorem (Urdan, 2005).

CHAPTER 5 DISCUSSION,

5.1 INTRODUCTION

The aim of this study was to investigate the extent to which language literacy skills are integrated in the teaching of Physical Sciences in Riba Cross District of Limpopo Province of South Africa. The objectives of the study were to identify the extent to which language skills are integrated in the teaching of Physical Sciences in the classroom; and to establish whether the current Science teachers' practices in helping the learners acquire language skills in the language of Science and the language of teaching and learning are in line with recommendations by studies and the Department of Basic Education. In order to achieve the abovementioned aim and objectives, a quantitative survey was conducted. Questionnaires, designed by the researcher were used to collect data from a sample of teachers and learners. Data analysis looked deeply into the learner sample since the response rate of teachers was poor. Data was analysed using IBM SPSS pack version 22 and Microsoft Excel. Descriptive statistics were the main tools in analysing the data and some few inferential to determine if the results can be generalized to the whole population. The next two sections deal with the discussion and conclusion that emerged from the results.

5.2 DISCUSSION

The aim of this study was to investigate the extent to which language literacy skills are integrated in the teaching of Physical Sciences in Riba Cross District of Limpopo Province of South Africa. The results show that generally, language literacy skills are integrated in the teaching of Physical Sciences in Riba Cross District (figure 8, figure 10 and table 4), but there are areas of concern (table 12 and figure 10). Learners' data indicated that 77.78% of the sampled schools were not engaging learners in report writing and arguing from evidence (Figure 8 and table 12) even though the teachers' data indicated otherwise (Table 11). This suggests that social constructivist learning approaches were not employed as the results suggest learners are not arguing from evidence or experiments which limits their autonomy in their own

learning and dialogue and as a result social interaction (Villanueva, 2010). Allied to this, Vygotsky (1978) believes that there must be language development before effective learning can take place and social interaction is the basis of learning and development. What is important during social constructivism is that learners must be able to read texts, graphs and pictures in order to comprehend scientific information; and they must be able to write and speak in order to communicate scientific information (Villanueva, 2010). So the omission of some elements of language literacy in the teaching of Physical Sciences in some schools in Riba Cross District may suggest that teachers are not employing activities that help Science learners to acquire literacy skills for learning Physical Sciences.

Data suggest that 71.56 % of learners were either unsure or thought they did not write reports (Table 12). This finding resonate with the work of Chabalengula and Mumba (2012) which show that teachers have misconceptions of what enquiry learning is as their exhibition of what is enquiry learning exclude the writing part. Chabalengula and Mumba (2012) argue that teaching Science follows a familiar rubric. Teachers assume that in following this rubric learners will learn particular content (e.g., that temperature affects the rate of a chemical reaction). Indeed, this is generally the teacher's main intent in devoting a lesson to a particular experiment. For example, they may believe that in conducting such an experiment, learners will be following a ``scientific method,'' similar to that which led to the original discovery of the relevant fact. In this regard, learners may reduce practical work to only verifying scientific laws and in most cases just including only the testing part without writing. The publication and communication of experimental findings is a crucial part of scientific activity but is not usually referred to in school Science as reflected by the findings of this study and Chabalanga and Mumba (2012)'s study. This shows low quality science education as, according to Shanahan and Shanahan (2008), quality science education can only be achieved when learners are able to write and talk like scientists. Writing like scientists involves mostly writing laboratory reports, which includes the writing of investigative questions, hypotheses, experimental procedures, results, etc. (Rhodes & Feder, 2014). Learners' lack of writing as found by this study does not do them any good when coming to their problem solving skills (Bicer, Capraro, & Capraro, 2013). In addition, lack of report writing denies learners to experience deep science learnig as reported by Gonyea and Anderson (2009).

Furthermore, Bravo, Solís and Mosqueda (2011) state that significant thinking and learning occur during writing which also support learners as they develop their emergent writing skills. Lehrer and Schauble (2005) found in a study of first-grade learners that higher reading achievement scores resulted when learners engaged in narrative and informational writing. Writing about Science concepts assists internalization of Science content (Lehrer & Schauble, 2005). "Inquiry Science and literacy intersect when learners use reading, writing, and oral language to address questions about Science content and to build their capacity to engage in scientific reasoning……" (Hapgood & Palincsar, 2007:56). However, learners' representations of understanding need not be limited to writing. Creating diagrams by using both words and pictures to illustrate a Science concept can demonstrate learner understanding (Wellington & Osborne 2001).

Another element of language literacy skills which was not adequately integrated in the teaching of Physical Sciences was arguing from evidence. The number of learners who agreed that arguing from evidence was integrated was almost the same as the number of learners disagreed (Figure 2), giving the impression that arguing scientifically was not common in the sampled schools. If learners are not arguing from evidence, Science learning is disabled because scientific knowledge develop as learners argue from evidence or experimentation (Kuhn, 1962; Popper, 1959).

Argumentation plays a central role in the building of explanations (Carrier, 2011) as scientists use arguments to relate the evidence gathered. Carrier (2011) relates to argumentation as the justification of knowledge claims, by bringing together converging lines of reasoning, theoretical ideas and empirical evidence toward a claim. In this regard Carrier emphasises the importance of discourse in the construction of scientific knowledge, while Vygotsky (1978) points to the role of social interaction in learning and thinking processes, and purports that higher thinking processes lead to effective learning. The implication is that argumentation is a form of discourse necessary for learning science. As a result, learners who argue more frequently in their Science classroom perform far much better than their counterparts who argue by accident in examinations (Demirbag & Gunel, 2014; Cavagnetto & Hand, 2012; Rhodes & Feder, 2014). So if a teacher does not involve learners in more scientific arguments in his/her classroom, s/he disadvantages them when it comes to examination writing. In addition, Sapir-Whorf Hypothesis also relates thought and

language (Kay & Empton, 1984; Perlovsky, 2009; Whorf, 1956; Sapir, 1985), which means the more the learners talk in their science classroom, the more their thinking develops, but if they are not talking, their thinking will remain static which is not good for science learning. Furthermore, English language learners who are not involved in meaningful scientific arguments are denied an opportunity to close the 20% reasoning capacity (Johnstone & Selepeng, 2001).

The researcher argues that content learning is as much about learning to use the language of the disciplines effectively and fluently as it is about learning disciplinary concepts. Learning Science, from a sociocultural learning perspective (Vygotsky, 1978), is as much about learning to talk, read, and write Science as is it about learning scientific concepts or facts (Carrier, 2011). Contrary to the once commonly held belief that teaching reading and writing is solely the responsibility of elementary teachers and secondary English teachers. Teaching learners the skills of reading and writing is necessary in order for learners to make sense of a variety of texts they read and write. Therefore, we cannot afford to have the high school learners we teach abandon reading and arguing in a science class. After all, it is reading comprehension that influences how learners interpret examination questions and how they answer (August, Carlo, Dressler & Snow, 2005). In addition, Science Education is itself regarded as the pathway for teaching language literacy skills. For example, the use of technologies and narrative writing. In these approaches learners benefit by: improving on their dialogic conversation, authentic activity, metacognition, and reflexivity (Rodriguez, 2010: 47). Furthermore, learners are engaged in "first-hand (hands-on) and second hand inquiry (textual) practices" (Palincsar & Magnusson, 2001).

5. 3 CONCLUSION

From the results, one can conclude that, generally there is integration of language literacy skill in the teaching of Physical Sciences in Riba Cross District, but there are important areas of integration of language literacy skills and the effective teaching of Science that seem not to be given due attention. For example, writing report should be part of normal Science teaching even in a place where learners have higher language literacy, but in this case a little or no attention is given to this area of effective Science teaching and language literacy integration. This finding may fit well

with Chabalengula and Mumba (2012)'s finding that most Science teacher's view of what is enquiry learning exclude the writing part of enquiry learning. In addition the number of learners who believed that they are encouraged to argue from evidence is almost the same as the number of learners who disagreed. This also presents arguing from evidence as a problem area. If learners are not arguing from evidence, Science learning is endangered as there will not be any significant growth in scientific understanding during Science learning (Kuhn, 1962; Popper, 1959) and that may be one of the reasons why our Grade 12 Physical Sciences results are not flourishing. Furthermore, some schools seem to be doing well when coming to integrating language literacy skills in teaching Physical Sciences, but it seems the size of the class is a factor that influences whether teachers integrate language literacy skills or not. This confirms Cook (2011)'s finding that learner characteristics also affect integration of language literacy skills. In conclusion, some areas of integrating language literacy in Physical Sciences classroom are covered in Riba Cross District but it seems like the most important ones are ignored.

From the data, it can be concluded that teachers are trying to comply with the recommendation by studies and the National Department of Education but some teachers and schools still need assistance. Most aspects of integration of literacy skills seem to be covered. It looks like teachers do take time over Science words; word walls are used and learners do read about Science. The problem areas are writing about Science and talking about Science. This shows partial compliance, but it should be said that most parts are covered.

5.4 LIMITATIONS OF THE STUDY

This study used descriptive statistics which, in most cases, cannot be generalised to the whole population. To try to deal with that challenge, inferential statistics were used to check if the data is normally distributed and data was found to be normally distributed for both teachers and learner averages which gave room for generalisation of findings to the whole population (Urdan, 2005). There was also a challenge in the response rate of the teachers. Only few teachers responded to the questionnaire and the number of teachers who responded to the questionnaire does not meet the minimum requirements for the theoretical default normal distribution according to the Central Limit Theorem. Nevertheless, the curve distribution was significantly normal. Furthermore, teachers' sample was considered to a small

degree when data was analysed, so as to reduce the risk that the teacher sample would pose to the generalizability of the whole results. It must also be clearly stated that this study was conducted in Riba Cross District and can only be generalised to the above mentioned District. The results may not apply to any other district of Sekhukhune Region of Limpopo Province. In addition, the results may not be generalised to the other provinces of South Africa or any other country.

This study was not looking at the factors that contribute to the integration of language literacy skills in the teaching of physical Sciences but only the extent. But it emerged that one cannot look at the extent without looking at the factors because it emerged from this study that factors like class size influence how Science is learned and taught in Riba Cross District and as a result the extent to which integration of literacy skills takes place. The results of the study may apply to Physical Sciences as a Science subject not to other subjects like Life Sciences (Biology). In addition, this study cannot give a proper explanation of what is actually going on in the classroom as the data was collected using a questionnaire and in some cases, the researcher did not even go directly to the sites. This suggests that, there should be a further study that would combine quantitative and qualitative methods, to investigate this matter. In conclusion, even though this study has some shortcomings, as elaborated above, it could still be used to direct education officials on the gaps that need to be closed in an endeavour to achieve effective Science Education in the schools where the LoLT for Physicals Sciences is not the home language of the learners.

5.5 RECOMMENDATIONS

The study has identified the need for teachers to be assisted in making the learners argue from evidence and writing of laboratory reports in their science classrooms. The study also identified that some schools are doing well whereas some are not doing so well in integrating language literacy skills in teaching Physical Sciences. This revealed a need for teachers, in their cluster meetings, to talk about how they are doing well and their challenges in terms of assisting the learners with lower language literacy skills swiftly acquire scientific knowledge and science process skills. Finally, there is a need for further study that would combine qualitative and quantitative methods in investigating the matter. The study would also need to increase the generalizability by increasing the sample size. Furthermore, the study should also look at the contextual factors affecting integration of language literacy

skills in teaching Physical Sciences or a separate study may be carried out only for this purpose.

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Appendices

Appendix A

Questionnaire 1: (Literacy Skills Usage Survey Questionnaire (LSUSQ) for teachers)

SECTION A (Person Information)					
1. Gender	A. Male			B. Female	
3. Home language		Years of teaching		Age:	
4. Science Subject you are teaching.					
SECTION B					

Statements	**Response categories**				
	Strongly disagree	**Disagree**	**unsure**	**Agree**	**Strongly agree**
1. I help learners identify new Science words					
2. I let learners explore new Science words					
3. I use word walls					
4. I encourage my learners to contribute to word walls					
5. I encourage my learners to use word walls as a source of ideas					
6. I encourage my learners to use word walls as a place to check spelling					

7. I require learners to talk about scientific issues					
8. I let the learners to listen to each other talking about Scientific issues.					
9. I encourage my learners to read about Science.					
10. I bring to class texts that use correct scientific terms					
11. I provide opportunities to discuss new vocabulary, for which learners can subsequently take ownership					
12. I always let my learners Write scientific investigations (Science writing can take many forms, including journals, diaries, graphic organizers, calligrams (visual representations of words that reflect their meaning)),					
13. I give my learners a chance to construct viable arguments and					
14. I encourage learners to critique the reasoning of others					
15. I engage my learners in arguments from evidence.					
16. I let my learners discuss in groups.					
17. I sometimes give my learners time to report back to the whole class after they are done in their groups					

18. I encourage my learners to communicate in English.					

Appendix B

Questionnaire 2: (learners)

SECTION A (Person Information)				
1. Grade	2. Gender		A. Male	B. Female
3. Home language:	Age			
4. Science Subject:				

SECTION B					
Statements	**Response categories**				
	Strongly disagree	**Disagree**	**unsure**	**Agree**	**Strongly agree**
1. In our Science class, we take time repeating new Science words:					
2. In our Science class, we identify new Science word					
3. In our Science class, we carefully explore new Science words					
4. We are encouraged to use word walls					
5. We are encouraged to contribute to word walls					
6. We are encouraged to use words on the word wall as a source of new ideas					
7. We are given opportunities to talk about Science					
8. We are given opportunity to listen to each other talking about Science					
9. We read about Science					

10. We discuss our understanding with the group members and the whole class.					
11. We write reports.	87				
12. We are given a chance to construct viable arguments and critique the reasoning of others					
13. We are engaged in arguments from evidence.					
14. We discuss in our groups.					
15. We are given time to report back to the whole class after we are done in our groups					
16. We are encouraged to communicate in English in our Science class					

Appendix C
Letter to the Principal

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P O Box 88

Penge

1160

15 September 2014

</div>

Dear Sir/Madam

My name is Romulus Asaph Mogofe. I am a student at University of Limpopo. I would like to ask for permission to collect data from your Physical Sciences teacher(s) and learners for my BED Masters (Sciences) research project. I am interested in investigating Extent to which strategies enhancing the language of Science are used in Sekhukhune Sciences classrooms. I will not interrupt the normal running of the school. My task if permission is granted would be to interview teachers and learners when they are available and observing. The data collected will be treated with high level of confidentiality. The name(s) of the teacher(s), learners and your school will not be used in the analysis of data and the data will be destroyed after six month.

The teachers who will be part of the study will benefit from the enlightenment that will arise from the data; hence the investigation will not only benefit me as a researcher. I hope you find sense from the above and grant me the permission to do research.

Do not hesitate to contact me for any correspondents arising from this letter.
Cell: 082 639 5410 or 078 470 0769
Email address: asaphmogofe@yahoo.com.

Yours truthfully
R.A. Mogofe

Consent form

I _____ the headmaster/principal of _____ School hereby consent to Asaph to involve the Sciences teachers in his investigation.

Signature: _____ date _____

A letter to the teacher

P O Box 88

Penge

1160

15 September 2014

Dear Sir/Madam

My name is Romulus Asaph Mogofe. I am a teacher at Poolzee Combined School. I am a student at University Of Limpopo. As part of the fulfilment of the Master of Sciences degree I am expected to produce a research report. I am interested in investigating Extent to which strategies enhancing the language of Science are used in Sekhukhune Sciences classrooms. I would like you and your learners to be part of my study. I will collect the data from your official documents and interview you. The report from data will be solely for the fulfilment of the degree requirements and presentation from the research can also be made in conferences only. But your names will remain confidential. You will gain tremendously from the investigation.

I am looking forward to your response as soon as possible. Do not hesitate to contact me for any comment or question arising from this request. You can contact me at:

Cell: 082 6395 410 / 0784700796

Email address: asaphmogofe@yahoo.com.

Yours faithfully

RA Mogofe

Consent form

I _____ the teacher at _____ school hereby give consent to Romulus Asaph Mogofe to be part of his investigation. However the data that will be collected from me and my class should be used for the research presented to me by Romulus Asaph Mogofe

Signature: _____ Date: _____

Appendix D

A letter to the Grade 10 Physical Sciences

P O Box 88

Penge

1160

15 September 2014

Dear Participant

The following information is provided for you to decide whether you wish to participate in the present study. You should be aware that you are free to decide not to participate or withdraw at any time without affecting your relationship with the school, the researcher and the principal. The purpose of the study is to investigate the extent to which language skills are integrated in the teaching of Physical Sciences. Data will be collected from you through a questionnaire that you will be needed to fill.

Do not hesitate to ask any questions about the study either before, during or after participation time. We would be happy to share our findings with you after the research is completed .How ever your name will not be associated with the research finding in any way and your identity as a participant will be known only to the researcher. There are no known risks or discomfort associated with this study. Please sign your consent with full knowledge of the nature and purpose of the procedures. A copy of this consent will be given to you to keep.

_____   _____

Signature of participant   Date

Yours faithfully,

Romulus Asaph Mogofe (the researcher)

Appendix E: A letter to the Parent or Guardian (English version)

Dear Parent or Guardian:

I am a faculty of humanities *student* in the *department OF Mathematics, Science and technology Education* at University of Limpopo. I am conducting a research project on **Integrating Language Literacy Skills in Teaching Physical Sciences in Riba Cross District, South Africa**. I request permission for your child to participate in the study.

The study consists of a questionnaire that your child will fill in information. The project will be explained in terms that your child can understand, and your child will participate only if he or she is willing to do so. Only I *and members of the research staff* will have access to information from your child. At the conclusion of the study, children's responses will be reported as group results only.

Participation in this study is voluntary. Your decision whether or not to allow your child to participate will not affect the services normally provided to your child by the *school where research is being conducted*. Your child's participation in this study will not lead to the loss of any benefits to which he or she is otherwise entitled. Even if you give your permission for your child to participate, your child is free to refuse to participate. If your child agrees to participate, he or she is free to end participation at any time. You and your child are not waiving any legal claims, rights, or remedies because of your child's participation in this research study.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means deletion of identifiers; crude report categories and micro-aggregation (that is, the construction of 'average persons' from data on individuals and the release of these data, rather than data on individuals).

Do not hesitate to contact me for any correspondents arising from this letter.

Cell: 082 639 5410 or 0784700769

Email address: asaphmogofe@yahoo.com.

Yours Sincerely,

_____

Romulus Asaph Mogofe

Please indicate whether or not you wish to allow your child to participate in this project by checking one of the statements below, signing your name and.

Africa Sign both copies and keep one for your records.

_____ I grant permission for my child to participate in *Mogofe RA*'s study on **Integrating Language Literacy Skills in Teaching Physical Sciences in Riba Cross District, South**

.

_____ I do not grant permission for my child to participate in *Mogofe RA*'s study on **Integrating Language Literacy Skills in Teaching Physical Sciences in Riba Cross District, South Africa**

_____   _____

Signature of Parent/Guardian   Printed Parent/Guardian Name

_____   _____

Printed Name of Child   Date

Appendix F: A letter to the Parent or Guardian (Sepedi version)

Motswadi/Mohlokomedi wa ngwana

Ke moithuti ka lefapeng la goithutela go ruta bana Dipalo, tša mahlale le thekenolotši ka Unibesithing ya Limpopo. Ke kgopela tumelelo ya gore ngwana wa lena a kgone go tšea karolo diphatišišong tšeo ke didirang mabapi le **go akaretša dikokwane tša polelo goruteng Thuto Tša Mahlale seleteng sa Riba Cross, ka Afrika Borwa**.

Ban aba bat logo tšea karolo, e tlo ba bana bao ban ago le kganyogo le maekemišetšo. Pele ban aba tšea karolo, bat la hlalosetšwa malebana le dipatlišišo tše. Tshedimošo go tša ngwaneng wa lena e tla tsebja ke nna le yo a nthlokometšego babapi le diphatlišivo tše.

Bana aba ba tlago go kgatha tema mo diphatlišišong tve ke fela ba ba tlago go b aba ithaopile. Go tšeya karolo le go se ršeye karolo ga ngwana diphatlošišong ga go tlo ama ngwana dithutong tša gagwe. Ngwana o ngwana o na le tokelo ya goikgethela go sa tšeye karorolo diphatlišišong tše. Le ge ngwna a ka dumela, o san a le tokelo ya go ka ntsha ka hlogo nako ye nngwe le ye nngwe ntle le kotlo. Ga go molao wo o tlamago bana go tvea karolo mo diphatlišišong tše.

Tshedimošo ye e tlago hwetšwa baneng e ka seke ya abela motho ntle le tumelelo ya lena goba kgopelo ya molao. Maina a bana ga a ile go šomišiwa mo repotong ya diphatlišišo tše kage le foromo yeo ban aba yago go e tlatša e sa dumelele bana gongwala maina a bona.

Ge go ena le se se le gakantšhago le ka nteletša mogala go dinomoro tše dilatelago:

082 639 5410 goba 0784700769

Goba la nngwalela go: asaphmogofe@yahoo.com.

Wa lena

_____

Romulus Asaph Mogofe

Ka kgopelo, **šupetša ge eba o dumelela ngwana wag ago ka go thala sefapano go e tee ya dikgetho tše di latelago o be a saene le go šupetša lebitšo la ngwana yo o mo emelago.**

_____ Ke fa ngwana waka tumelelo ya go t**šea karolo diphatišišong tša**l *Mogofe RA* t**ša mabapi le go akaretša dikokwane tša polelo goruteng Thuto Tša Mahlale seleteng sa Riba Cross, ka Afrika Borwa**.

_____ Ga ke fe ngwana waka tumelelo ya go t**šea karolo diphatišišong tša**l *Mogofe RA* t**ša mabapi le go akaretša dikokwane tša polelo goruteng Thuto Tša Mahlale seleteng sa Riba Cross, ka Afrika Borwa**.

_____   _____

Mosaeno wa motswadi/mohlokomedi   Leina la motswadi/mohlokomedi

_____   _____

Leina la ngwana   Letšatšikgwedi

Appendix G (A letter to the District Manager)

Dear Sir/Madam

I am a faculty of humanities *student* in the *department of Mathematics, Science and Technology at* University of Limpopo. I want to conduct a research project on **Integrating Language Literacy Skills in Teaching Physical Sciences in Riba Cross District, South Africa**. I request permission to conduct this research project in your schools.

The study consists of a questionnaire that grade 10 Physical Sciences teachers and learners will fill. The project will be explained in terms that teachers and learners can understand; and teachers; and will participate only if they are willing to do so. Only I *and members of the research staff* will have access to information from your schools. At the conclusion of the study, teachers' and learners' responses will be reported as group results only.

Participation in this study is voluntary. Even if you give permission for your schools to participate, your schools are free to refuse to participate. If your schools agree to participate, they are free to end participation at any time.

Any information that is obtained in connection with this study and that can be identified with your district will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of deletion of identifiers; crude report categories and micro-aggregation (that is, the construction of 'average persons' from data on individuals and the release of these data, rather than data on individuals).

Do not hesitate to contact me for any correspondents arising from this letter.

Cell: 082 639 5410 or 078 470 0769

Email address: asaphmogofe@yahoo.com.

Yours Sincerely,

_____

Romulus Asaph Mogofe

Please indicate whether or not you wish to allow your schools to participate in this project by checking one of the statements below, signing your name and.

Sign both copies and keep one for your records.

_____ I grant permission for my schools to participate in *Mogofe RA*'s study on **Integrating Language Literacy Skills in Teaching Physical Sciences in Riba Cross District, South Africa**

.

_____ I do not grant permission for my school to participate in *Mogofe RA'*s study on **Integrating Language Literacy Skills in Teaching Physical Sciences in Riba Cross District, South Africa**

_____   _____

Signature of District Manager   Printed District Manager Name

_____

Date

Appendix H:

Table 11 Validating teachers' questionnaire

Statements	Experts Judgements (Yes/No)			
	Expert 1	Expert 2	Expert 3	All Yes
1. I help learners identify new Science words	Yes	Yes	Yes	Yes
2. I let learners explore new Science words	Yes	Yes	Yes	Yes
3. I use word walls	Yes	No	No	No
4. I encourage my learners to contribute to word walls	Yes	Yes	No	No
5. I encourage my learners to use word walls as a source of ideas	Yes	Yes	Yes	Yes
6. I encourage my learners to use word walls as a place to check spelling	Yes	No	No	No
7. I require learners to talk about Science	Yes	Yes	Yes	Yes
8. I let the learners to listen to each other talking about Scientific issues.	Yes	Yes	Yes	Yes
9. I encourage my learners to read about Science.	Yes	Yes	Yes	Yes
10. I bring to class texts that use correct scientific terms	Yes	Yes	Yes	Yes

11. I provide opportunities to discuss new vocabulary, for which learners can subsequently take ownership	Yes	Yes	Yes	Yes
12. I let my learners Write scientific investigations (Science writing can take many forms, including journals, diaries, graphic organizers, calligrams (visual representations of words that reflect their meaning)),	Yes	Yes	Yes	Yes
13. I give my learners a chance to construct viable arguments and	Yes	Yes	Yes	Yes
14. I encourage learners to critique the reasoning of others	Yes	Yes	Yes	Yes
15. I engage my learners in arguments from evidence.	Yes	Yes	Yes	Yes
16. I let my learners discuss in groups.	Yes	Yes	Yes	Yes
17. I sometimes give my learners time to report back to the whole class after they are done in their groups	Yes	Yes	Yes	Yes
18. I encourage my learners to communicate in English.	Yes	Yes	Yes	Yes
			Total Yes	15

Table 12: Validating learners' questionnaire

Statements	Response categories			
	Expert 1	Expert 2	Expert 3	All Yes
1. In our Science class, we take time repeating new Science words:	Yes	Yes	Yes	Yes
2. In our Science class, we identify new Science word	Yes	Yes	Yes	Yes
3. In our Science class, we carefully explore new Science words	Yes	Yes	Yes	Yes
4. We are encouraged to use word walls	Yes	Yes	Yes	Yes
5. We are encouraged to contribute to word walls	No	Yes	Yes	No
6. We are encouraged to use words on the word wall as a source of new ideas	No	No	Yes	No
7. We are given opportunities to talk about Science	Yes	Yes	Yes	Yes
8. We are given opportunity to listen to each other talking about Science	Yes	Yes	Yes	Yes
9. We read about Science	Yes	Yes	Yes	Yes
10. We discuss our understanding with the group members and the whole class.	Yes	Yes	Yes	Yes
11. We write reports.	Yes	Yes	Yes	Yes
12. We are given a chance to construct viable arguments and critique the reasoning of others	Yes	Yes	Yes	Yes
13. We are engaged in arguments from evidence.	Yes	Yes	Yes	Yes
14. We discuss in our groups.	Yes	Yes	Yes	Yes
15. We are given time to report back to the whole class after we are done in our groups	Yes	Yes	Yes	Yes
16. We are encouraged to communicate in English in our Science class	Yes	Yes	Yes	Yes
			Total	14