UNIVERSITY OF KWAZULU-NATAL

Primary Science Teacher's Experience and Understanding of the Problem-Based Learning Approach in the Shiselweni Region

by

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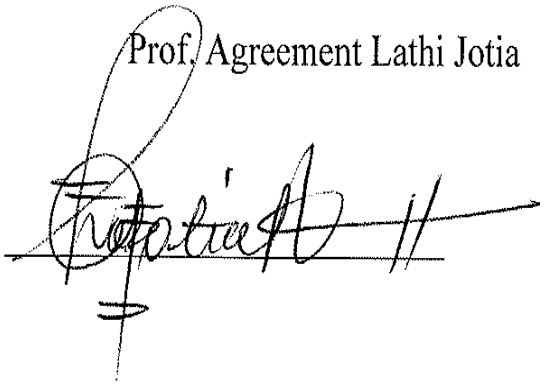
SUPERVISOR'S STATEMENT

This dissertation bas been submitted with my approval.

Prof. Agreement Lathi Jotia



Date

22/05/2017

DECLARATION OF OWN WORK

I, Ncamiso January Shabane, student number: **214 524 364**, declare that the research undertaken entitled:

PRIMARY SCIENCE TEACHERS' EXPERIENCE AND UNDERSTANDING OF THE PROBLEM-BASED LEARNING APPROACH IN THE SHISELWENI REGION,

is entirely my own original work.

All quotes and data sources used in this dissertation have been indicated and acknowledged by complete references.

This thesis has not been submitted for any degree or examination in any other University.

Shabane Ncamiso January

Signature: Shabane :. Date: 23/08/2017

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DEDICATION

This thesis is dedicated to my family, my loving, tolerant, incredible and supportive wife, Cebisile Precious Shabane (née Simelane), and my dearest children Siphesihle Patience, Prosper Nontsikelelo, Celumusa Sibonginkhosi, Nosipho Bliss, and Favour Promise Shabane, thank you so much for your patience, understanding and belief in me. Family is the best thing that ever happened to me.

ABSTRACT

The study aimed at investigating Primary School Science Teachers' experience and understanding of the learner-centred Problem-Based Learning (PBL) approach which promotes active learner participation. A total of fifty one (N=51) science teachers from twenty one (N=21) different Primary Schools in the Shiselweni region of Swaziland were used in the study. In the Shiselweni region there has been a growing trend of learners performing poorly in science and lacking basic scientific skills and attitudes which, in most instances, could be acquired if learners were trained using the PBL approach. The study was guided by the constructivist theory and incorporated four key principles of learning which state that learning should be constructive, contextual, collaborative and self-directed. The constructivist theory was found appropriate for this study in that, in this theory, learning is supposed to take place when learners are given opportunities to actively engage with ideas and materials. The belief is that learning takes place when learners see it as constructive, contextual, collaborative and self-directed. The PBL approach incorporates both the constructivist theory and the above-mentioned key learning principles.

The study's key findings were that teachers in the region have a clear understanding and ample experience of the approach although learners continue to perform badly in science. The reasons for this are that teachers found it very difficult to change from being "fountains" of knowledge to being facilitators of learning. They prefer to teach the twenty-first century class the way they were taught during their studies. They rely more on traditional teaching methods than on current ones which promote active learner participation in class. The researcher therefore recommends that views and perceptions on both educators' and learners' understanding and experience of the PBL approach must be gathered from secondary up to tertiary level.

LIST OF ABBREVIATIONS

ECOS: Examination Council of Swaziland

HOTS: Higher Order Thinking Skills

ICT: Information and Communication Technology

JC: Junior Certificate

MoET: Ministry of Education and Training

PBL: Problem-Based Learning approach

REO: Regional Education Office

SAARMSTE: South African Association for Research in Mathematics, Science and Technology Education

SGSCE: Swaziland General Secondary Certificate in Education

SPC: Swaziland Primary Certificate

STEM: Science, Technology, Engineering and Mathematics

UKZN: University of KwaZulu-Natal

UNESCO: United Nations' Educational, Scientific and Cultural Organization

UNICEF: United Nation International Children's Education Fund

WEF: World Education Forum

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CHAPTER ONE

1.0 INTRODUCTION TO THE STUDY

The process of education demands that learning be facilitated such that the learner is at the centre of the learning process. However, despite such assertion, reality on the ground holds that traditional styles of teaching are still dominant in Swaziland's schools. Such a scenario has encouraged the researcher to examine the Shiselweni region Primary School science teachers' experiences and understanding of the Problem-Based Learning (PBL) approach. The core reasons which were at the basis of this study can be summarized as follows: dissatisfaction with traditional lecturing because of: 1) low number of learners who pass the subject every year (Ruiz-Gallardo *et al.*, 2011), 2) decry about unsatisfactory time allocation for the subject such that teachers are unable to finish the prescribed syllabus (Somukawa, 2012), 3) high number of drop-outs and learners who do not attend examination (Ruiz-Gallardo *et al.*, 2011), 4) positioning learning in accordance with the Ministry of Education and Training (MoET) of Swaziland guidelines that suggest moving learning system to more learner-centred approaches, minimizing number of learners who have a poor scientific background, often complain that science is more difficult to learn than agriculture or consumer science, often hate learning science or develop a negative attitude towards science, and find it hard to apply science in their everyday life (Ghani, 2006).

Hence, it is useful to consider the PBL approach which has enhanced student learning in K-12 science education (Allen & Tanner, 2003; Bush & Saye, 2000; Perdersen & Liu, 2003). The PBL approach aims at promoting student-centred learning; the development of learners' higher order thinking skills (HOTS) and the fostering of learners' social skills. The latter allows learners to function as team

members and to learn cooperatively by sharing their acquired knowledge (Dolmans, Walfhagen, Van der Vleuten & Wijnen, 2001). In PBL, learners work collaboratively to solve ill-structured (does not yield a certain answer and mirrors real world) problems, identify their learning needs, and locate relevant information to address these (Ertmer & Simons, 2006).

The PBL approach emphasizes development of cooperation or collaboration skills amongst learners (Yeh, 2010; Ram, Ram & Sprague, 2004). It is a teaching technique that requires learners to solve problems in a given situation (Delisle, 1997). During the teaching/learning process learners frame a problem and use their knowledge to solve it (Engel, 1997). Eggen and Kauchhak (2010) claim that PBL strategies have the following characteristics: 1) lessons begin with a problem, and solving the problem is the focus of the lesson; 2) learners investigate the problem, designing strategies and finding solutions; and 3) teachers' facilitate or guide learners. PBL involves learners working cooperative groups and thinking about real world problems (Jorden & Porath, 2006).

PBL approach can help alleviate teachers' outcry that time is not sufficient to finish subject syllabus as asserted by Somukawa (2012). Another important reason that made the researcher to embark on this study was the belief that the Problem-Based Learning approach could help minimize the challenges related to curriculum and learner performance. In the PBL approach subject content is provided in a problem-based context which, in a way, minimizes the required time to teach a lengthy syllabus (Maxwell *et al.*, 2001).

The Problem-Based Learning approach can also replace the traditional content-driven syllabus, where learners lack HOTS, interest and motivation. The researcher observed that learners perform poorly in the

"external" (examination not set by subject teachers of schools) Swaziland Primary Certificate (SPC) examination, and fail science tests if questions are extracted from past examination papers. The outcome of this is the high number of failures in the region (website of Cambridge University IGCSE & Swaziland Examination Council (ECOS) JC and SGCSE results, 2009 onward; Somukawa, 2012). The present study is therefore crucial in the sense that it helped explore the teachers' understanding of the problem-based approach and its implementation (or lack of it). The study findings will contribute positively to the improvement of education in Swaziland, especially with reference to issues of curriculum and pedagogy.

1.1 Study Aims and Rationale

The case study aimed at exploring Primary Science teachers' experience and understanding of the PBL approach which promote active learning of science. The participants engaged in various activities on how to develop appropriate higher order thinking skills (HOTS) in students, how to design and improve science lessons creatively through active interactions and sharing of experiences among group members. The PBL approach study had the intention to equip teachers with skills in fostering an inclusive learning-friendly environment that can be attained through practical knowledge and understanding of PBL, meaningful learning in context, with more encompassing and holistic applications which are needed in meeting 21st century learning challenges.

This research focussed on how the PBL method can improve teaching quality and described some of the anticipated implementation difficulties. PBL is learning that is driven by a problem, not by an abstract concept, and, as such, its implementation or utilisation can yield positive results in the teaching-learning process.

1.2 Objectives

The objectives of the study are to:

1. Explore Primary School science teachers' experiences and understanding of the PBL approach.
2. Examine how PBL can positively impact learners' interest in science.
3. Investigate if the PBL approach leads to the development of higher order thinking skills (HOTS).
4. Explore the degree to which teachers use or fail to use PBL in their daily teaching-learning process.

1.2.1 Key Research Questions

In order to fulfil these objectives, the following key research questions were used to guide the study:

1. What are the teachers' understandings of the Problem-Based Learning approach?
2. To what extent is the PBL approach used in the teaching of science in the Shiselweni region?
3. What are the challenges associated with the use of the PBL approach in the teaching of the science curriculum?
4. How does PBL impact on learners' performance?

1.2.2 Problem statement

In the Shiselweni region learners often complain that science is the most difficult subject to learn and to apply in their everyday life an outcry similar to that observed by Ghani (2006). Learners find science content unpopular at Primary School level. They question their teachers, "why do I have to know all this information and how will I ever use it in future?" (Ipek, 2007, quoted by Hirça, 2011: 12). This question

is multifaceted and sends a signal, namely that learners have challenges in the learning of science, especially in Primary Schools.

Primary School learners have a weak science background and often hate learning science, very few students study physical science at High School level. They; develop a negative attitude towards science (Ghani, 2006). Since in traditional science lessons, teachers teach, and learners memorize and repeat what the teachers told them, word for word, the learners find it hard to apply the scientific information in their everyday life (Hirça, 2011). Hence, traditional approaches had paid little attention to the application of scientific concepts; therefore, introducing the problem-based learning approach in the study as an instructional pedagogy which develops higher order thinking skills (HOTS) (Selcuk, 2010) seemed appropriate to the researcher.

The use of learner centred approach like PBL should be encouraged more than the utilization of teacher centred ones which are time-consuming, as suggested by Education Sector Policy of Swaziland (2011). Time constraint is certainly a challenge which calls for our attention. This study can help close the existing gaps in the teaching and learning of science in the Swaziland's Shiselweni region. Since the problem-based learning approach is really more about how to learn science content, it will therefore better prepare learners who are problem-solvers and promote active learner participation in the science lessons (Newman, 2005). The Problem-Based Learning approach can also replace the traditional content-driven science teaching or learning settings, where students are no given the opportunity to develop higher order thinking skills (HOTS) and made to fear majoring in science careers. Therefore, many science teachers experience the learners' lack of interest in science or motivation (Somukawa, 2012).

Furthermore, Junior Certificate results show low learning outcomes of students obtaining a C grade or above with an actual result of between 20% and 30%, whereas the percentage of students obtaining a C grade or above in IGCSE/SGCSE in biology and physical science is between 25% and 30%. The international average in IGCSE/SGCSE in biology and physical science is 60% to 70%. The world averages are in upward trends whereas Swaziland's are in downward trends (website of Cambridge University IGCSE & Swaziland Examinations Council JC and SGCSE results, 2009 onward (http://www.cie.org.uk results 2009-2015; http://www.examscouncil.sz results 2009-2015). The given statistics speak to the fact that there is a problem which ought to be resolved insofar as the teaching and learning of science is concerned.

Swaziland's junior and senior level science results are almost half the world's averages. The gap between the world and Swaziland is widening year by year, especially in biology and physical science (website of Cambridge University IGCSE and Swaziland Exam Council JC and SGCSE results, 2009 onward (http://www.cie.org.uk results 2009-2015; http://www.examscouncil.sz results 2009-2015). The statistics of Swaziland Primary Certificate (SPC) results 2011-2015, according to the Examination Council of Swaziland (ECOS) webpage, showed that the pass rate has not increased since 2011, maintaining a constant rate of 87% in science. More specifically, the lowest pass rates in SPC science examinations were experienced in the years 2011 and 2014, namely87.03% and 87.04% respectively. In the years 2012 and 2013, the results showed a slight increase (87.67% and 87.74%) whereas in 2015 the results dropped to 87.48%. Similarly the percentage of learners obtaining a credit in science remained constant at 55%, with an even lower percentage in the Shiselweni region of 48%. The results for targeted schools where the study was conducted include the following schools for 2015: Phongolwane primary with a passing rate of 53.97%, Etjedze primary with a passing rate of 75%, Galile with a passing rate of

78% and different schools with a 100% passing rate namely Mbukwane, Evenly Baring, Nsongweni, Nyamane and Ngwane Practicing primary in the year 2015.

When comparing the numbers of intake in each school, they range from as low as 4 students per classroom up to 66 students. Urban, rural and semi-urban schools were represented, as well as new and old ones (Examination Council of Swaziland 2011-2015 website of SPC results statistics, http://www.examscouncil.org.sz results). When comparing the Junior Certificate (J.C) science results with the SPC results, the J.C results seem to be inconsistent with a difference of 11.04% between a pass rate of 87.74% in 2009 and the lowest pass rate in 2012 of 76.70%. The pass rate in science at J.C level showed a decline of 1.53% in year 2013, a slight increase in 2014 showing a pass rate of 85.37% and drop in 2015 with a pass rate of 78.09% (http://www.examscouncil.sz results 2009-2015).

These statistics show that as the learners go from the primary education level to the secondary one, their performances in science decline or drop (Examination Council of Swaziland 2011-2015 website of JC results statistics: http://www.examscouncil.sz results 2009-2015). According to Somukawa (2012) the core problem that caused this anomaly is the learners' negative attitude, their lack of motivation and lack of interest in the science subjects. In view of the above, this study aims at encouraging teachers to use the PBL approach when helping the learners grasp more than just a concept and gain an understanding of how and why to use that concept. Research shows that this approach constitutes the best way to help students learn to think scientifically, learn appropriate scientific knowledge, desired skills and profound attitudes of science (Hirça, 2011: 12).

1.3 Study Significance

Many participant teachers in this study expressed their need for in-service training about "teaching methods" which raise students' interest or motivation in the science subject as a solution towards closing the gap observed in the SPC and JC examination results. For several decades learning has been based on didactic (instructional) teaching and few practical classes. The teacher in these classes is the source of information while students have to remember what they are told (Newton, Driver, & Osborne, 1999). The traditional teaching approach has been to "transmit" new knowledge to the learners; students are seen as empty vessels that have to be filled with knowledge and they have little to contribute to the process of learning (Freire, 1970).

According to studies conducted in the USA, approximately 80% of the oral discourse in the classroom is taken up by teacher-talk and this is one way in which teachers control what happens in their classroom (Wertsch & Toma, 1995). This approach is focused on the learning of facts and encourages "rote" learning, regurgitation of knowledge and little if anything about the significance of the topics learnt and their application in real-life situations is acquired (Gallagher, Stepien, & Rosenthal, 1992). Learning in this way does not motivate students to enquire, discover new learning principles, construct their own knowledge or practice what they have learnt (Hmelo-Silver, 2004). Equally important, this approach does not respond to recent societal changes or learners' needs (Murray & Savin-Baden, 2000). The traditional teaching method seems to be designed for another time and evidence shows that it cannot keep students engaged or motivated for learning.

On the basis of the above, the PBL approach which has been reported to enhance students' learning in the area of K-12 science education (Allen & Tanner, 2003; Brush & Saye, 2000; Gallagher *et al.*, 1992;

Gallagher, Sher, Stepien, & Workman, 1995; Greenward, 2000; Pedersen & Liu, 2003; Hmelo-Silver, 2004; Torp & Sage, 2002) is important in any educational environment, especially in the teaching/learning of science. According to Hansen (2006), the PBL approach enhances students' engagement, promotes active participation of learners in science and enables students to develop a number of cognitive skills. The present PBL case study urges teachers to review their instructional methods, philosophies and practices. This study is therefore significant in that it will bring in a new scholarly dimension of understanding the PBL approach in teaching which consequently can produce good students' performance in Swaziland, especially in the Shiselweni region.

1.4 Study Limitations

According to Cook & Moyle (2002) and Margetson (1994), the PBL approach has been used in universities and, to date, its use has been largely limited to the more scientifically-based disciplines like medicine. The application of the PBL approach to teacher education is yet to receive the same degree of attention, with the literature in the field described by some authors as "scarce" (Murray-Harvey & Slee, 2000). Up to now, little research has been done about the use of PBL in primary school science and the analysis of teachers' perceptions (views & understanding) about PBL has been limited to grades 1-7 in Swaziland as it was observed in Australia by Albanese & Mitchell (1993). Savery (2006: 11) listed six reasons for the possibly failure of the PBL approach when it comes to achieving the anticipated outcomes:

- Confusing PBL as an approach to curriculum design with the teaching of problem-solving,
- Adoption of a PBL proposal without sufficient commitment of staff at all levels,
- Lack of research and development on the nature and type of problems to be used.
- Insufficient investment in the design, preparation and on-going renewal of learning resources,

- Inappropriate assessment methods which do not match the learning outcomes sought in problem-based programmes,
- Evaluation strategies which do not focus on the key learning objectives and which are implemented and acted upon far too late.

  Some of the above reasons had negatively affected the study of teachers' experiences and understanding focusing on the Shiselweni region and using only the primary science teachers.

1.5 Theoretical Background

As a pedagogical technique, PBL evolved from the work conducted by Barrows and Tamblyn in the early 1980s in response to their concerns regarding the superficial nature of medical students' learning that was seen to occur in more traditional, lecture-based and didactic teaching methodologies (Savin-Baden, 2001). They wanted to assist learners in acquiring knowledge that could be used in the immediate diagnosis (or problem-solving process) associated with identifying illness in patients. Barrows and Tamblyn believed that medical students could be better served by an education that allowed them to actively participate in the identification and solving of medical problems than they could by an education through which they learned the separate systems of the body without initial reference to illness (Barrows & Tamblyn, 1980).

The concept of PBL was therefore one that centres on the nature of learning as an experience necessarily contextualized by the particular issues or "problems" that the trainee practitioners were likely to face in their profession upon graduation (Edens, 2000). The PBL approach is essential in the teaching of science in that it allows for both horizontal and vertical integration of different disciplines. Learning takes place in a meaningful and authentic context, using clinical cases, for example, students learn to connect

clinical phenomena to underlying basic science concepts. In this context, learning is organised around the investigation and resolution of authentic real-world problems (Van Wyk, & Madiba 2006). PBL has also been referred to as action-learning, inquiry-based or experiential learning (Torp, 2002).

1.6 Theoretical Framework

The philosophical underpinning of the PBL approach holds at its core those principles articulated by the constructivist and socio-constructivist views of learning and cognitive development (Charlin Mann, & Hansen, 1998; McPhee, 2002). Here, the belief is that learning is actively constructed by learners as they interact and engage with other learners (and/or more competent peers). In addition, the exploratory nature of PBL is likewise consonant with the constructivist belief that learning occurs most readily when it is supported by opportunities for learners to engage with ideas and materials.

Therefore, as a pedagogical tool, PBL may be more readily described as an *approach to learning* rather than an actual teaching technique. Engel (1997: 15) defines PBL as "an approach to structuring the curriculum which involves confronting learners with problems from practice which provide a stimulus for learning. According to Engel this means that the emphasis in PBL "is on learning processes of enquiry which proceed by asking what needs to be known to address and improve a particular situation" (*idem*). This means that students studying within a PBL context are required to focus their attention on the issues and constraints that comprise the problem situation and to determine how these might then be addressed. Margetson (1997: 39) argues that "a problem refers to what is *problematic* about a situation; it is generally shorthand for a cluster, network or set of interrelated problems and related contextual conditions". In responding to the particular issues within a given situation, learners are required to operate in a manner that promotes needs for questioning, critical thinking and synthesis of information.

There is an increasing current thinking that education should produce learners who are ready for the world of work with a focus on higher order abilities (problem-solving, critical thinking, etc.), as learner abilities must go beyond routine and exercise informed judgments (NASP resources, 2002).

Moreover, Hubbard (in Jotia, 2008) mentioned the need for an education system to be deeply democratised, an indication of a social system whereby people are given a platform to express their feelings creatively as well as to be responsible for their decisions. The institutionalisation and deepening of democracy in Swaziland's education system is still inadequate. Past research, according to Zyngier (2008), has indicated that schools, in particular, and society, in general, are more effective and academically lively if the learners are engaged daily in the academic environment's functions and operations. These are individuals who have to think outside the "box", are open-minded, attempt to solve problems realistically, sincerely accepting opposing viewpoints, and are able to criticise while at the same time accepting criticism and the judgment of others.

Jotia (2008) further observes that schools cannot become fully functional if the masses are deemed passive consumers whose voices are marginalised or deliberately trampled upon. The curriculum should be seen to be covering from the dimension of promoting dialogue and critical decision-making. It must promote intellectual growth amongst learners in democratic societies by educating these to engage in problem-solving and be pragmatic enough to challenge so-called universal truths as they engage in critical thinking (Orstein & Hunkins, 2009). Making reference to Haber (1998), Jotia (2008) argues that, within democratic set-ups, there is a need to see democratic principles manifesting themselves within the education system whereby both teachers and learners experience democracy in the sense of having a say

over what is taught and learnt. In other words, it aims to give every voice a say in the affairs of the school (Haber, 1998; Abdi & Richardson, 2008; Jotia, 2008; Jotia & Boikhutso, 2015: 11).

According to Jotia (2015), quoting Zyngier (2012), there is a need to examine and conceptualise the principles of *thin* democracy versus *thick* democracy in education: in the case of *thin* democracy students are allowed to search for food, for example, whereas in *thick* democracy students are awarded more rights i.e. in addition to search for food they are also empowered to explore why they are hungry. *Thick* democracy is democracy is about involvement of citizens in decision-making as well as questioning o (Giroux, 2006; Zyngier, 2012). Democracy cannot work if citizens are not able to analyse merits and faults, autonomously, and exhibit independent qualities that are indispensable if they are going to make vital judgments and choices about participating in and shaping decisions that affect everyday life, institutional reform and governmental policy (Giroux, 2006: 76); Zyngier, 2012; Jotia & Boikhutso, 2015: 267).

In fact, Dewey envisages a situation where schools and the people involved in the management of education systems seen to be nurturing social attitudes which enhance cooperative and deliberative democratic engagement (Harber & Mncube, 2012). Jotia & Boikhutso (2015), citing Hooks (2003 & 2012) and making reference to *education as the practice of freedom,* concede that learners must be given an opportunity to embark on decision-making processes and move beyond boundaries as they seek solutions to problems. They further observe that authoritarian practices, promoted and encouraged by many institutions, undermine democratic education in the classroom. By undermining education as the practice of freedom, authoritarianism in the classroom dehumanises and thus shuts down the "magic"

that is present when individuals are active learners. It takes the "fun out of the study" and makes it repressive and oppressive (Jotia & Boikhutso, 2015: 268).

Hilderbrand, Mulcahy and Wilks (2001) identified a three-phrase process through which students working within a PBL scenario are likely to pass, including: (1) encountering the problem; (2) working out the solution of the problem and (3) drawing it all together (Hilderbrand *et al.*, 2001). Since the focus of the present study is on Primary School science teachers' understanding and experiences of PBL, teacher education is an area suited to the pedagogical goals and methods involved in PBL. In this area the focus has leaned increasingly towards the development of teachers who are capable of accessing, evaluating and critically appraising information for use in their own teaching and decision-making process.

The constructivist theory of learning suggests that prior knowledge is used as a basis on which to construct new knowledge. For instance, participants enter the research with great differences in their prior understanding and experiences of PBL initially. PBL is a pedagogical approach which embraces theory, support new learning and integrate new learning with prior knowledge. As well as having different prior learning, participants may also vary in the way they learn.

Research on PBL signals an attempt to make learning more meaningful to learners, incorporating principles of constructive learning (Hmelo-Silver, 2004), self-direction (Colliver, 2002), life-long learning (Miflin *et al.*, 2000; Stefani, 2004; Van Wyk, 2009), and the research is premised on the notion that Primary School science teachers would support learners to become independent, deep learners (who

uses higher order cognitive skills such as ability to analyse, synthesize, solve problems and think meta-cognitively in order to construct long-term understanding (Giggs, 1994; Rushton, 2005).

Vygotsky and Dewey, working within the constructivist tradition, believed that learners do not learn in isolation from others. Cognitive psychology established that people naturally learn and work collaboratively in their lives (Petraglia, 1998). Therefore, interaction is a critical component in a constructivist approach. In addition, the change from a traditional lecture to a more learner-centred approach such as PBL or cooperative learning has an impact on the education system (Ruiz-Gallardo *et al.*, 2011).

Recently, there has been a tendency in science education to move from learners' passivity into more active learners' participation in the teaching/learning process (Breton, 1999; Peterson, 1997; Vardi & Ciccarelli, 2008). The idea that learners have to be responsible for their own learning construction is becoming more accepted every day (Ruiz-Gallardo *et al.*, 2011). This means that learners take responsibility of their learning and are given the opportunity to make decisions about various dimensions of the learning process and to perform self-regulation (Alçikgöz, 2003). In such an active learning process, learning is no longer a standard process, but it transforms into a personalised process.

Here, the skills of problem-solving, critical thinking and learning to learn are developed. Humans face various problems in their lives and try to find particular ways to solve them. In this respect, it is important for students to be prepared for the future by facing real or real-like problems in their learning environment and producing appropriate solutions to these problems. What is expected from education is that it enables individuals to become effective problem-solvers in their actual lives (Walker & Lofton,

2003; Chin & Chia, 2004). Problem-solving is to learn how to apply instead of just recalling information. Knowing how to solve problems enables learners to think critically. The most convenient approach with regard to teaching this aim in teaching and learning environments is the problem-based learning which takes part in active learning (Aķinoğlu, Özkardeş & Tandoğan, 2007).

In fact, guidelines on education encourage teachers to introduce instructional styles in which they reduce their leading role and become a learning guide rather than a knowledge instructor. In the same line the departments of education and training in Swaziland highlight the importance of graduates demonstrating professional skills, which cannot be acquired by traditional memorisation or understanding of what is taught.

Student acquisition of generic, interdisciplinary, field-specific and subject-specific skills is becoming especially important (EC, 2005a) to better prepare them for the work environment (Vardi & Ciccarelli, 2008). The reasons that led the researcher to investigate about Primary School science teachers' understanding and experiences can be summarised as:

- Dissatisfaction with the traditional teaching style because of :
    1. The low numbers of learners that pass the science subject every year,
    2. The high rate of learners dropping out of schools,
    3. The number of learners who do not write examinations
- Positioning learning more in accordance with the MoET guidelines which suggest that learning systems should include more learner-centred teaching methods.

- Learners' acquisition of high-quality learning outcomes wherein specific and general skills are developed remains a challenge for Primary School science teachers. This is difficult with the traditional teaching approach (Vardi & Ciccarelli, 2008).

Hmelo-Silver (2004) concretises the fact that PBL is an instructional method in which students learn through facilitated problem solving. Learners work in collaborative, small groups where a given open-ended problem is a simulation for the learning process (Spronke-Smith, 2005; Vardi & Ciccarelli, 2008). The learners plan and learn by themselves, which is necessary to solve problems (Hmelo-Silver, 2004). Thus, they learn both content and thinking strategies; the role of teacher is that of a guide in this process.

With PBL, learners foster a higher level of skills (Biggs, 2005). Students express greater levels of motivation towards learning than did their traditional counterparts. They show more motivation and satisfaction to learning because of the learning independence afforded by the PBL method. The constructivist theory of learning is essential in this study in that it promotes active learner engagement with materials as it happens in PBL approach. Like in PBL, learners are expected to apply information in solving problems in future, that is to say work out solution of a problem on their own which is associated with the constructivist approach. The learners become creative which is also a skills developed by learners when taught using PBL approach. Therefore, PBL approach like constructivism promotes skills like creativity and problem-solving.

PBL approach fits well within the constructivist theory as it encourage that learners should be provided with opportunities re-discover information while developing critical thinking and

evaluation skills through analysis of real-life problems (Sonmez, Lee & Hyonyong, 2003). According to Sonmez, Lee & Hyonyong (2003) proponents of PBL put emphasis on improving cognitive learner abilities (such as thinking) and learning skills. According to the authors, PBL-trained learners are frequent users of libraries (other information resources) which support independent learning. The authors further concur that learners acquire life-long study skills, in their early years of study, giving rise to sustained learning. They observed that PBL-educated learners have a more holistic approach to their subjects, they more readily integrate new information, adapt to change and work well as members of a group.

In conclusion, PBL appears to increase student interest in and enjoyment with the subject, and enhance students' development (Sonmez, Lee & Hyonyong, 2003: 150). Savery and Duffy (2001) argued that PBL is consistent with the principles of constructivism as it sought to provide a clear link between theory and practice. According to these authors, some of the features of the PBL environment include that learners are actively engaged in working at tasks and activities which are authentic to the environment in which they will be used.

The focus is on learners as constructors of their own knowledge in a context which is similar to the context in which they would apply that knowledge. The learners are encouraged and expected to think both critically and creatively, and to monitor their own understanding, i.e. to function at a meta-cognitive level. In the PBL tutorial groups social negotiation is an important part of the problem-solving; facts are accepted as facts once the group had discussed them and make a decision that they are. Another important factor of the problem solving process is the nature of the team structure (Savery & Duffy, 2001).

According to Dochy *et al.* (2003), PBL produces positive effects on learning principles that underline the application of knowledge. Moreover, studies like those of Hallinger & Lu (in press), Major & Palmer (2001), Norman & Schmidt (2000) and Smith *et al.* (2005) suggest that PBL produces a more engaging, motivational learning environment for learners, which leads to higher rates of students' retention, more rapid programme completion, and the development of more productive attitudes towards current and future learning.

1.7 Organisation of the dissertation

Chapter one consists of the introduction to the whole study. It also includes the study aims and rationale; study objectives and research questions; theoretical background and constructivist framework of the study which make PBL's instructional model explicit. It also details the significance of the study, its limitations and gives a definition of terms which will assist in giving more clarity and direction to the whole study.

Chapter two is the review of related literature which will basically give an overview of research findings with regard to the use of the PBL approach. This will help the researcher to compare previous study findings with those of the present study.

Chapter three states the research design and methodology which describe how the research was conducted and what instruments were used in the data collection process.

Chapter four contains the findings and discussions which are guided by both the study objectives and research questions.

Chapter five gives the summary, conclusions and recommendations. Recommendations offer a signpost for further studies on the same topic.

1.8 Definition of terms

PBL approach: Hmelo-Silver (2004) defined the PBL approach as "an instructional method in which students learn through facilitated problem-solving". Here students learn by solving problems and reflecting on their experiences (Barrows & Tamblyn, 1980). These problems are presented to the students as difficult (Spronke-Smith, 2005; Vardi & Ciccarelli, 2008). Students have to plan and learn by themselves, which is necessary to solve problems (Albanese & Mitchell, 1993; Hmelo-Silver, 2004; Solomon & Finch, 1998). Thus, they learn both content and thinking strategies, and the role of the teacher is that of a guide in this process. Hmelo-Silver (2004) also noted that students work in collaborative groups to identify what they need to learn in order to solve a problem, engage in self-directed learning, apply their new knowledge to the problem, and reflect on what they learned and the effectiveness of the strategies employed (http://www.pbl.org/pbl/generic_pbl.htm).

Conventional or traditional approach: this refers to the standard lecture method of teaching mostly used at the higher education level (mostly universities & colleges), especially when the teacher-to-student ratio is high (Biggs, 2005). For instance a study developed in Spain showed that 60% of the professors almost always use the lecture method (Baena *et al.*, 2004). The lecture method has received criticism (Azer, 2009): there are few opportunities to reflect on learning, it does not foster creativity or critical skills, it is not motivating and it does not ensure the application of learning in practice (Ruiz-Gallardo, Castano, Gomez-Alday & Valdes, 2011). The lecture method is also not a suitable

instructional method for teaching children at primary grades as these learn more by engaging in various pupils' activities (Leach & Scott, 2000).

Higher order thinking skills (HOTS): these are creative and critical thinking skills. HOTS are built from the lower order thinking skills. According to Bloom's taxonomy or hierarchy of the cognitive domain (1956), HOTS are placed in a higher position; they are presented in the following enhancing order: content knowledge, comprehension, application, analysis, synthesis, and evaluation. The higher they are placed on the taxonomy, the more difficult they are to learn and acquire, and as a result the higher they are the more they are worth. For example, synthesis means putting together content knowledge, its understanding, application and analysis, and then creating something new. Creativity is a mental ability to invent something novel from some existing knowledge, after comprehending and applying it (Tat, Preechaporn, Kin & Kheong, 2011). Creativity brings about innovations, which sustain and boost a society's economy.

Constructivism: Savery & Duffy (2001) defined constructivism in PBL as a philosophical view on how we come to understand or know. Their philosophical views were based on the work of Rorty (1991) and Von Glaserfeld (1989). They characterised their views in terms of three primary propositions:

1.8.1 Understanding is in our interactions with the environment.

This is the core concept of constructivism. We cannot talk about what is learned separately from how it is learned, as if a variety of experiences all lead to the same understanding. Rather, what we understand is a function of the content, context, learner activity, and, perhaps most importantly, learner goals. Since understanding is an individual construction, we cannot share understandings but rather we can test the

degree to which our individual understandings are compatible with experiences. An implication of this proposition is that cognition is not just within the individual but rather is a part of the entire context, i.e. cognition is distributed.

1.8.2 Cognitive conflict or puzzlement is the stimulus for learning and determines the organisation and nature of what is learned.

When we are in a learning environment, there is some stimulus or goal for learning – the learner has a purpose of being there. That goal is not only a stimulus or goal for learning, but it is a primary factor in determining what the learner attends to, what prior experiences the learner brings to bear in constructing an understanding, and, basically, what understanding is eventually constructed. In Dewey's terms it is the "problematic" that leads to and is the organiser of the learning (Dewey, 1938; Rochelle, 1992). For Piaget it is the need for accommodation when current experience cannot be assimilated in existing schema (Piaget, 1977; Von Glaserfeld, 1989). Piaget (1977) and Von Glaserfeld (1989) prefer calling the learner's "puzzlement" as the stimulus and organiser for learning since this more readily suggests both intellectual and pragmatic goals for learning. The important point, however, is that it is the learner's goal that is central in considering what is learned.

1.8.3 Knowledge evolves through social negotiation and through the evaluation of the viability of individual understandings.

The social environment is critical to the development of our individual understanding as well as to that of the body of propositions we call knowledge. At the individual level, other individuals are a primary mechanism for testing our understanding. Collaborative groups are important because we can test our own understanding and examine the understanding of others as a mechanism for enriching,

interweaving, and expanding our understanding of particular issue or phenomena. As Von Glaserfeld (1989) noted, other people are the greatest source of alternative views to challenge our current views and hence to serve as the source of puzzlement that stimulates new learning.

1.9 Summary

The researcher's aim in this chapter was to introduce the PBL approach as a learner-centred approach and explain how, if adopted in the teaching method, it could promote active learner participation and stimulate learners' interest or motivation to learn science subjects. The major challenge in our classrooms today is that most teachers are still using traditional methods of teaching which do not raise motivation in learners. Such traditional teaching methods have been criticised a lot (Azer, 2009).

In this chapter the objectives of the study were stated, the problem statement defined as well as the study significance noted. The study's theoretical background was also outlined. The next chapter will review the relevant literature.

CHAPTER TWO

LITERATURE REVIEW

2.0 What is Problem-Based Learning?

Yeh (2010) describes Problem-Based Learning (PBL) as an instructional learner-centred technique in which learners try to solve problems and reflect on their experiences via interactions; according to him it can be an ideal approach to community building (Yeh 2010; Yang, Wang, Shen & Han, 2007). Hmelo-Silver (2004) and Gallardo, Castano, Gomez-Alday & Valdes (2011) concur that PBL is an instructional strategy in which students learn through facilitated problem-solving, where the problems are presented to the learners as difficult (Spronke-Smith, 2005; Vardi & Ciccarelli, 2008). In a sense, it is an instructional pedagogy which gives learners a platform to exercise their intellectual freedom during the teaching-learning encounter as argued by Vardi & Ciccarelli (2008). Spronke-Smith (2005) holds that it gives the learners a chance to engage as individuals or as a collective group to solve problems. Basically, PBL is an empowering approach which mandates learners to be at the centre of the teaching-learning process (Sonmez, Lee & Hyonyong, 2003).

In the PBL approach, learners plan, learn by themselves and foster a higher level of skills (Biggs, 2005). Hmelo-Silver (2004) stressed that PBL trained learners are equipped not only with the current scientific body of knowledge but also with scientific processes e.g. problem-solving. The PBL approach has been advanced in recent decades as an alternative to learning through the traditional lecture method. The benefits of the PBL approach include that it assists students to acquire and retain relevant information (Hwang, & Kim, 2006). Research conducted on PBL instructional pedagogy by Sonmez & Lee (2003) has shown that learners gain more knowledge and have higher motivation towards learning when compared to instances where traditional approaches of learning are used.

2.1 Characteristics of PBL

According to Akınoğlu & Tandoğan (2006) the most outstanding feature in the PBL approach is that it initiates the learning process with a problem (trigger) which may be evidently critical or still unsolved. The authors warn that the subject matter being studied must not be too difficult, because this could discourage learners. Yaman & Yalçin (2004) stressed that both the contents and practices must include situations which attract the learner's attention. Yaman & Yalçin (2004) concluded that, in PBL, teachers must be willing to relinquish their leading roles as vessels of information and become mere tutors, guides or facilitators of learning (Akınoğlu & Tandoğan, 2006).

The learners on one hand must be given enough time to think or gather information, to set up their strategies on how to solve the assigned task and their creative thought in this process must be encouraged (Yaman & Yalçin, 2004). According to Taşkiran *et al.* (2001) a comfortable, relaxing and safe learning environment must be established in order to develop learner's thinking and problem solving skills. Çuhadaroğlu *et al.* (2003) agreed that the PBL approach must begin with a problem chosen from real world problems, and must be open-ended. They pointed out that the problem must arouse a sense of curiosity and should focus on only one issue.

They stressed that the problem must teach good ethical behaviour rather than negative behaviour and also help students to freely reflect on prior experiences and express themselves. Learners must be given the opportunity to treat the problem as if it were their own problem and be willing to solve it (Akınoğlu & Tandoğan, 2006).

Savery (2006: 22) described PBL as a learner-centred pedagogy which empowers learners to conduct research, integrate theory and practice, apply knowledge and skills to develop a solution to a problem.

Torp & Sage (2002) described PBL as focused, experiential learning organised around the investigation and working out solutions for the real-world problems. Duch, Groh & Allen (2001) and Savery (2006) described the methods used in PBL and the skills developed, such as the ability to think critically, analyse, solve problems, to find, evaluate and use appropriate learning resources, to work cooperatively, to demonstrate effective communication skills, and to use content knowledge and intellectual skills to become continual learners. According to Hmelo-Silver (2004) and Savery (2006) in PBL learners learn through facilitated problem-solving. These authors noted that learners work in collaborative small groups while solving the problem, they engage in self-directed learning, apply new knowledge and reflect on what they have learned. Consequently, only three characteristics of the PBL principle are essential, namely the problem, facilitator and small group work (Greenwald, 2000; Taşkiran *et al.*, 2001; Parim, 2002; Çuhadaroğlu *et al.* 2003 Yaman & Yalçin, 2004; Akınoğlu & Tandoğan, 2006).

2.1.1 Using Problems as Learning Stimulus

In order to stimulate student learning, learners in PBL are confronted with problems first, according to Dolmans, De Grave, Wolfhagen & Van der Vleuten (2005). The authors stressed that these problems consist of a description of phenomena which need to be explained. According to these researchers, when learners are attempting to explain the phenomena of the problem, they not only discover what they already know about the problem, but they also find out what they do not yet know (learning knowledge) or which questions still need to be answered and require further study.

Newman (2005: 15) described problems as the driving force behind student learning in PBL as these are used to engage learners actively in their own learning. In fact, the author emphasised that in the PBL approach, problems stimulate learners to actively construct new knowledge which strongly links with

their previous knowledge. According to him, the actual problem is the focus for acquiring knowledge and fostering flexible thinking. Taşkiran *et al.* (2001) agreed that the problems used in PBL are often realistic ones presented in the context of the lesson which make learning a constructive and contextual process. In the literature on PBL, the terms "problem", "trigger" and "scenario" are used to refer to the materials presented to learners in order to initiate learning. The authors further contend that the term "problem" plays four roles; firstly, in the construction of the learning environment; secondly, it serves as an encouragement to activate relevant prior knowledge through discussion; thirdly, it arouses students' interest or intrinsic motivation to learn, and, lastly, it sets a context for learning of knowledge similar to what future usage will require.

According to Sonmez, Lee & Hyonyong (2003), science education's major goal is to develop scientifically literate citizens who can function as adults, equipped with skills necessary for life-long learning. Barrows (1997) contends that teachers, in the PBL approach, attempt to catalyse student learning through critical thinking and an increased ability to seek or find out information related to problems or situations. According to Sonmez, Lee & Hyonyong (2003), student learning in this context develops useful skills, like collaboration, self-directed learning, and finding solutions to authentic problems or situations. Greenwald (2000) observes that when learners encounter an "ill-defined" problem (unclear problem) this raises the following three questions, namely "what is known?", "what needs to be known?" and "how can the answer be found?" According to the author, because the problem is unclear, there are many ways to solve it, and the solutions are influenced by one's understanding and experiences.

The ill-defined problem, as Greenwald (2000) argues, can be introduced to the learners within the context of a larger and more realistic scenario. The teacher asks questions about what is interesting, puzzling, or important to find out in relation to the problem(s); typically, s/he asks learners open-ended questions which create a discussion environment for making interesting observations (Barrows, 1997; Greenwald, 2000; Sonmez, Lee & Hyonyong (2003). The point here is that, during the learning process, the teacher offers different problem-finding strategies for identifying and clarifying problems, s/he poses inquiry-guided questions that help students when strategizing and planning their investigations (Barrows, 1997; Greenwald, 2000; Sonmez, Lee & Hyonyong, 2003). On the basis of the above, the challenge in Swaziland's Shiselweni region is that teachers must ensure that learners developed the scientific skills stated above as like PBL trained ones.

2.1.2 Teachers as Facilitators

According to Dolmans, De Grave, Wolfhagen & Van der Vleuten (2005), the second important PBL feature is that teachers are facilitators who stimulate learners towards self-directed learning. They state that a tutor's task is to keep the learning process going, to probe students' knowledge deeply, to ensure that all learners are involved in the learning process, to monitor educational progress of each learner in the group and to modulate the challenge of the problem. The tutor's role is to scaffold student learning, according to Hmelo-Silver, Duncan and Chinn (2007), which implies that the tutor stimulates elaboration, integration of knowledge and interaction between students by means of asking questions, asking for clarifications and application of knowledge.

In order to stimulate learners towards self-directed learning, the authors insisted that a tutor should not transmit his expert knowledge to the learners, but should probe learners' knowledge by encouraging specific kinds of cognitive activities. They describe the tutor's role as that of a facilitator of the learning process who makes learning in PBL a self-directed process (Dolmans, De Grave, Wolfhagen & Van der Vleuten, 2005; Hmelo-Silver, Duncan & Chinn 2007).

According to Newman (2005: 15), different terms are used to indicate the role played by teachers in the PBL approach context, including "tutor", "guide" and "facilitator". He further describes the facilitator's or tutor's role as that of a more knowledgeable member of a community. The author asserted that socio-cultural approaches like PBL emphasise the teacher's role as acculturating learners into a specific community of practice (for example, internalisation of the community's language, attitudes and values). He described PBL as a cognitive approach which emphasises the teacher's role as facilitator of community knowledge and skills development.

Then he further observed that in PBL classrooms, the teacher employs his or her knowledge of the "subject" area to support learners' cognitive or metacognitive development processes. Dolmans, De Grave, Wolfhagen & Van der Vleuten (2005) suggested a number of techniques which teachers may adopt in their interactions with learners. The authors note that these techniques include the adoption of particular role or personae, or forms of communicative action. Teachers require preparation and support for both the change and maintenance of these role personae, in particular visible institutional support in the form of recognition of the high level of skill required, the additional time to prepare for and carry out their role.

2.1.3 Groups as Stimuli for Interactions

A third important PBL characteristic is that learning takes place in small groups according to Dolmans, De Grave, Wolfhagen & Van der Vleuten (2005). In PBL, problems are discussed in small groups of learners. The above authors elaborate that, in this collaborative learning environment, students learn by interacting with each other, for example, by explaining the materials to each other, by asking and answering questions, and through discussion. In PBL groups, according to Sonmez, Lee & Hyonyong (2003), learners work together to construct collaborative explanations. In addition, these researchers observe that students learn to work together, which may help them to become better collaborators.

Finally, working in groups is assumed to motivate learners. Thus, in PBL, tutorial group work, according to Dolmans, De Grave, Wolfhagen & Van der Vleuten (2005) and Newman (2005), makes learning a collaborative process stimulating learners towards interactions that are intended to have a positive effect on learning. In the case of Swaziland, teachers hardly encourage learner collaboration, they rather emphasise competition among the learners. The learners lack social development or partnership behaviours which are required in the corporate world.

2.2 The study's adopted PBL model

In the study, the researcher maintains that important common features and processes of the PBL model involve learning process which begin with learners' identifying a given unique problem (activity), gathering information, procuring extra information in view of finding a solution and generating possible solutions to the problem (Dolmans, De Grave, Wolfhagen & Van der Vleuten (2005). The learners working in groups, according to Akınoğlu & Tandoğan (2006), must accommodate each other and thus develop collaborative skills, and, as a group, the learners must communicate their solutions after taking a

critical decision. The learners, after selecting and executing the best solution, must make a presentation, evaluate and facilitate expected changes in their findings.

According to Engel (1997), students are responsible for framing a problem and using their knowledge to solve it. Eggen and Kauchhak (2001) claimed that the PBL strategy has the following characteristics: almost all lessons begin with a problem, and solving the problem is the focus of the lesson. Here, the learners are responsible for investigating the problem, designing strategies, and finding solutions. The authors stated that the work of the teacher is to scaffold learners to solve problems, involving the learners by having them work in small tutorial or cooperative groups where they think about real-world problems (Jorden & Porath, 2006).

Barret (2001) contends that the operational definition of problem-based learning contains the following; firstly, learners are presented with a problem which they discuss in a small group; this is called the PBL tutorial. The learners, according to the author, clarify the facts of the case and define what the problem is. Together, the learners brainstorm the ideas based on their prior knowledge. He stated that the learners identify what they need to learn and what they do not know (learning issues) in order to effectively work on the problem; the learners think about the problem trying to find out how it can be solved. The problem must not discourage the learners or cultivate immorality in learners' behaviour. He also specifies that the learners plan for action on how to work out the problem.

Secondly, the author noted that learners engage in independent study outside the tutorial. According to Hwang & Kim (2006), this can include library research, database investigation, web search, resource people and observations. Thirdly, the learners come back to the PBL tutorials to share information, do

peer teaching and work together on the problem. They present their solution to the problem and review what they have learned from working on the problem. All who participated in the process engage in self, peer and tutor review of the PBL process and reflect on each person's contribution to that process.

According to Akınoğlu & Tandoğan (2006), the adopted problem-based learning model turns the learners from passive information recipients to active, free self-learners and problem-solvers, and the emphasis of educational programmes goes from teaching to learning. This model enables students to learn new knowledge by facing their problems instead of being burdened with content (Çuhadaruğlu *et al.*, 2003). Hwang & Kim (2006) hold that the PBL approach develops learner attitudes in such areas as problem-solving, thinking, group work, communication, information acquisition or sharing with others.

According to Yuzhi (2003), Skrutvold (2003) and Kılıç (2006), the basis of PBL comprises mainly of "problem, solution, practice, research, questioning, realism, originality and integration (Yuzhi, 2003: 30)". These researchers also suggest that the aim of the learning model is to give information based on facts. In order to achieve this aim, stressed the authors, the problems are chosen from real-world problems. The authors support that individuals are developed by making possible integration of information accumulated by the students. Though differences are observed in PBL practices, PBL is performed mostly in small groups of 6 to 8 persons guided by an education mentor.

The learners deal with problems and try to find appropriate answers to these problems. According to Onargan *et al.* (2004) the foundation of the problem-based learning system is to enable students to learn by setting off problems which explain the subject matter in the best possible way (Yuzhi, 2003; Skrutvold, 2003; Kılıç, 2006). Greenwald (2000) asserted that the mentor's most important role in

student-centred PBL is to facilitate learning activities by guiding students. According to Çuhadaroğlu *et al.* (2003), the teacher-mentor fulfils his/her role by monitoring discussions, asking questions, helping during resolution of occasional conflicts, enabling participation of each group member in classroom discussions, giving examples when required, preventing scatter discussions and making evaluations (Maxwell & Dornan, 1995; Duffy & Cunningham, 1996; Rhem, 1998; Greenwald, 2000; Posner & Rudnitsky, 2001; Nakiboğlu & Altıparmak, 2002; Açıkgöz, 2003; Çuhadaroğlu *et al.*, 2003; Onargan *et al.*, 2004).

It can therefore be concluded on the basis of the above that a proper PBL model must trigger research using a problem; students are challenged to work out the best solution through investigative questioning of knowledge in order to apply it in their everyday life (Hwang & Kim, 2006). This cannot be achieved without teachers relinquishing their leading role and becoming guides or facilitators of learning (Çuhadaroğlu *et al.*, 2003). The researcher intended to encourage teachers in the Shiselweni region to adopt the proposed PBL model. Teachers in the Shiselweni region must be willing to change from being wells of information and become facilitators of teaching and learning process. In short teachers must be encouraged to train their learners using PBL approach in science.

2.2.1 Benefits and Limitations of Problem-Based Learning

Hwang & Kim (2006: 316) concur that some of the PBL approach benefits are the increased retention of knowledge; which leads to the development of an integrated knowledge base, an encouragement towards life-long learning; a greater practical experience exposure at an earlier stage in the curriculum, an increased learner-teacher link and increased overall motivation. Epstein (2007) argued that PBL's benefits include assisting children to acquire increased retention of knowledge, arouse interest or

motivation to learn relevant scientific information. The use of PBL, according to Vardi & Ciccarelli (2008), resulted in learners' reflecting greater engagement in learning, more self-direction and higher levels of satisfaction. Learning by using the PBL strategy also improves reasoning skills and knowledge amongst learners.

Some studies findings agree that the PBL approach brings better academic results than traditional systems (Anderson, Mitchel, & Osgood, 2004; Breton, 1999; Vardi & Ciccarelli, 2008) and also make learners feel better and more satisfied (Jones & Johnstone, 2006; Kingsland, 1996; Reisslein *et al.*, 2007; Sproken-Smith, 2005). However, other authors found no statistical differences or even lower scores (Allen, Crosky, McAlpine, Hoffman, & Munroe, 2006; Jones & Johnstone, 2006; Lieux, 1996; Phelan, Jackson, & Berner, 1994). Nevertheless, almost all the studies, including those mentioned above, agree on skills and professional performance improvement (Hoffman, & Munroe, 2006).

Barrows and Keelson (2006) stated that the advantage of such approach is that learners are evaluated in multiple ways by the facilitator, peer learners and self, and every member serves as a resource. The learners become aware of how the knowledge they are acquiring can be put to use. In other words, learners are not containers of information only, but also users or inventors of information. Many researchers admit that learning approaches which emphasise cooperation or collaboration are ideal for encouraging learning, PBL is one of the best choices (Guzdial & Turns, 2000; Ligoria, 2001; Lin, Lin & Huang, 2008). PBL pedagogy use has resulted in learners' displaying greater engagement in learning, as they become more self-directed and higher levels of satisfaction are observed among learners (Lin, Lin

& Huang, 2008). Learning by PBL also improved critical reasoning skills, learning motivation and learning autonomy (Colliver, 2001).

Arthur (2001) and Rideout *et al.* (2002) showed that the PBL approach was more effective for increasing knowledge and attitudes towards learning, and learners were more satisfied with the PBL method (Rideout *et al.*, 2002). In a similar vein, PBL positively affected the problem-solving processes in learners (Choi, 2004). Qualitative studies such as White *et al.* (2001), Morales Mann & Kaitell (2001) showed that the PBL approach increases learning autonomy, critical thinking, communication skills, and satisfaction in learners.

Forbes *et al.* (2001) further note that the PBL approach effectively increases learners' ability to integrate theory and practice. However, according to Hoffman & Munroe (2006), it must be noted that comparison between these studies was difficult due to differences in targeted samples, subject matter, and physical environment in which the PBL approach was implemented (Allen, Crosky, McAlpine, Hoffman, & Munroe, 2006; Jones & Johnstone, 2006; Lieux, 1996; Phelan, Jackson, & Berner, 1994). In Swaziland, the most troubling issue is that learners lack skills such critical thinking, problem-solving, communication and collaboration which are skilled developed when learners are taught using PBL approach. The learners end up warehousing information which they are unable to use anywhere, since they lack application or higher order thinking skills.

2.2.2 Advantages of Problem-Based Learning

According to Şenocak (2005) and Akinoğlu and Tandoğan (2007), the PBL approach merges well with learning principles which promote the use of learner-centred instructional strategies instead of teacher-

led ones. Şenocak (2005) argued that the PBL model develops self-control in learners, enabling them to have insight in and to view events at different angles and become evolved into creative thinkers. The learners are challenged to freely voice out their feelings, plan, face real issues and attempt to come up with the best solutions (Şenocak, 2005; Akinoğlu and Tandoğan, 2007). Akinoğlu and Tandoğan (2007) assert that the PBL approach develops learners who are better problem-solvers, and can exploit many new knowledge resources when tackling or solving faced problems. According to Dolmans, De Grave, Wolfhagen & Vleuten (2005), PBL students are more frequent users of libraries, borrow more materials, and more frequently use the internet than students in the traditional teaching method. Concurrently, the learners develop collaborative skills since they are working in groups and communication skills as they present solutions of given problems as a team (Dinçer & Güneysu, 1998; Treagust & Peterson, 1998; Kalayci, 2001; Şenocak, 2005; Akinoğlu and Tandoğan (2007)).

Like Şenocak, (2005), Akinoğlu and Tandoğan (2007) agreed that PBL develops learners who are critical thinkers (developing higher order thinking skills), can merge old knowledge with new one and apply it in future (uniting theory with practice). They discovered that the PBL approach motivates both teachers and learners (Dinçer & Güneysu, 1998; Treagust & Peterson, 1998; Kalayci, 2001; Şenocak, 2005; Akinoğlu and Tandoğan, 2007). Şenocak (2005) asserted that learners develop useful skills like time management, concentration, data collection, report preparation, evaluation, and pave a way for life-time learning (Dinçer & Güneysu, 1998; Treagust & Peterson, 1998; Kalayci, 2001; Şenocak, 2005; Akinoğlu and Tandoğan 2007: 73).

2.2.3 Limitations of Problem-Based Learning

According to Akinoğlu and Tandoğan (2007: 74), the limitations of the PBL approach include the following: firstly, the difficulty teachers encounter to change their old instructional strategies since they are used to them; secondly, learners newly introduced to the PBL approach might require more time to solve problem as individuals or groups and may end up not finishing their work in class or finishing it late; learners, when trying to solve a problem or carry out activities, also require new and different information resources which might be lacking. Akinoğlu and Tandoğan (2007) concluded by stating that it is difficult to implement the PBL approach in all classes, unfruitful to use this strategy with learners who cannot fully understand the scope or value of social problems, and difficult to assess learning (Dincer & Guneysu, 1998; Treagust & Peterson, 1998; Kalayci, 2001; Senocak, 2005; Katinka, van Mameren, Hylkema, Drukker, Albert & van Vleuten, 2007; Akinoğlu and Tandoğan 2007).

Edwards & Hammer (2006) bemoan that literature on PBL approach application in the field of professional development of teacher education is described as "scarce" by some authors (Murray Harvey & Slee, 2000: 2). Maxwell. Bellisimo & Mergendoller (2001) concur by stating that little research has been conducted at the Primary School, High School and higher teacher education level because most studies on PBL have occurred in medical schools. Albanese & Mitchell (1993) concluded that the PBL approach is less effective in teaching basic science content than when used in teaching applications of body of scientific knowledge. In case of science education in Swaziland, teachers need to have capacity-building exercises where they are equipped with instructional strategies, like the PBL approach, which promote active learner participation in class.

2.2.4 Science Classes' Interrelationship to Everyday Life through PBL

Akinoğlu & Tandoğan (2007) point out that PBL orients learners towards reflecting on, interpreting and searching solutions to problems faced by them, not only in science classes, but also in their daily lives. In classrooms where the PBL model was applied, it was observed, by Hwang & Kim (2006), that learners are encouraged to access knowledge by themselves. These researchers clarify that scenarios or problems in the PBL model should connect with learners' daily lives. According to Hwang & Kim (2006) facilitators should almost always relate problems to learners' actual lives in order to enable these to understand how science classes are interrelated with real life.

The author maintained that assigned events must be familiar or problems used in PBL must be close to learners' experiences in order to make science classes attractive to learners. The authors further argue that, since learners are working together in small groups of 6 to 8 participants, their interaction is being strengthened as well as their communication with each other and their environment. Katinka *et al.* (2007) assert that the learners' skill to express themselves also develops. In this case, learners always define problems as being incomprehensible, complicated, complex and abstract which prevents them from reflecting on, interpreting and solving problems. In order to change that situation Akinoğlu and Tandoğan (2007: 74) stressed that problems must be concretised and associated with the learners' daily lives so that learners will apply science knowledge in their daily lives and avoid having misconceptions.

In conclusion, Katinka *et al.* (2007) suggest that an active learning approach like PBL should be put into practice as early as at the primary education level. Ruiz-Gallardo *et al.* (2011) agreed with the tendency to move into more active learner participation settings in science classrooms using instructional strategies like PBL in order to foster professional or critical skills, motivating and ensuring application

of learning in learners. This sounds ideal for Swaziland which is striving to make its science curriculum contextual or localised in order for it to fulfil the nation or people of the Kingdom's needs.

2.2.5 Comparison of Traditional Instructional Method with PBL

The traditional teaching approach, according to Gallegher, Stepien & Rosenthal (1992) and Azer (2009), focusses on learning facts and encourages "rote" learning and regurgitation of knowledge, and little, if any, on the significance of topics learnt and their application in real-life situations.

Learning in this way, according to Hmelo-Silver (2004) and Azer (2009), does not motivate learners to enquire further, discover new learning principles, construct their own information, and practice what they have learnt. The authors both agreed that traditional approaches cannot keep learners engaged in or motivated for learning. According to the authors, in such classes learning is based on teachers being sources of information while learners are passive recipients of information and only memorise what the teacher says (Newton, Driver & Osborne 1999). In such a traditional approach, according, learners are seen as empty vessels that have to be filled with new knowledge and who hardly contribute anything during the learning process. The authors further stated that about 80% of a teacher's time is spent on talking and that is how the teacher controls what is going on in class.

PBL learners perform as well as or slightly worse than learners from traditional subjects in conventional examinations, according to Azer (2009). However, he pointed out that PBL learners are superior with respect to their approach to study and learning, long-term retention of knowledge, motivation, use of resources, key skills, and subsequent success as they enter secondary education. Equally important,

Murray & Savin-Baden (2000) also decry that the traditional approach does not suit recent societal and individual changes or meet learners' current needs. The researcher proposes that teachers should utilize instructional styles like PBL which promote active learner participation.

Vardi & Ciccarelli (2008) agree that traditional/conventional methods offer few or no opportunities for learners to reflect on learning, do not foster professional or critical skills; development, do not motivate learners nor ensure the application of learning in practice. Therefore, there is a recent trend to move into more active learner participation in the learning process (Breton, 1999; Peterson, 1997; Vardi & Ciccarelli, 2008). The idea that learners have to be responsible for their own learning/knowledge construction is becoming more accepted every day.

When using the traditional method to teach, teachers face the following problems: learners do not know how to apply what they have learnt to solve real problems; they cannot tackle unfamiliar or open-ended problems and thus are unable to apply their knowledge. Learners do not know how to communicate or report what they have learnt (Breton, 1999). The examples cited from the above-mentioned PBL research revealed that learners are more fully engaged in the learning process, their understanding of processes and their processing skills are increased. In other words, research suggests that PBL is better than the traditional method.

2.3 History of PBL

According to Akinoğlu & Tandoğan (2007), PBL first began in the medical schools at the American Case W. University during the 1950s. In the 1960s it was introduced in McMaster University in Canada (Rhem, 1998; Herreid, 2003). According to Pepper (2009), the PBL approach changed educational

practice within higher education and has been introduced into health sciences, engineering, business, science and education (Boud & Feletti, 1991). Azer (2009) reported research in the area of K-12 education which was yet to be adopted/implemented by the relevant teachers (Allen & Tanner, 2003; Brush & Saye, 2000; Pedersen & Liu 2003; Hmelo-Silver, 2004; Torp & Sage, 2002).

According to Akinoğlu & Tandoğan (2007), PBL has also been used in law, economics, engineering, accounting and architecture (Cawley, 1989; Hansen, 2006). In addition to medical faculties, PBL spread to other educational institutions and programmes like the natural sciences, engineering and law (Akinoğlu & Tandoğan, 2007). Finally, Akinoğlu & Tandoğan (2007) revealed that literatures on PBL in Primary, Secondary and Higher Education surfaced in the 1980s (Duch, 1995; Gallagher, 1997; Kaptan & Korkmaz, 2002; Lambros, 2002; Senocak, 2005Cheaney & Ingebritsen (2005) agree that PBL learners are more responsible than lectured learners in their own learning, more independent from their teachers and continue to learn in their whole lifetime.

Although PBL has an American background in terms of its history, it is becoming essential also within the African context, especially in a country like Swaziland, in that teachers must not serve as dispensers of information (teacher-centred classrooms), whereby learners are viewed as empty boxes which are ready to be filled with information. Instead, learners must be given an opportunity to embark on active participation in class and critical decision-making, and to move beyond boundaries, seeking solutions to problems (Jotia, 2015). Learners must be groomed to freely voice out their feelings without fear, promote dialogue and engage in problem-solving (Jotia, 2015: 268). In other words, learners must not receive information which they will not be able to apply anywhere, but should be taught professional skills that bring life-long learning to reality (Wilson, 1996).

As Cheaney & Ingebritsen (2005) nicely sum up the purpose of PBL as essential to encourage development of critical thinking skills, increase interest in the subject, professional competency, problem-solving abilities, increase success, knowledge acquisition, ability to work productively as a team, decision-making in unfamiliar situations, enhance information gathering skills, acquisition of skills that support self-directed life-long learning, self-evaluation and adaptation to change in learners. In this respect, PBL becomes more vital to prepare students in Swaziland for the future so that they become critical thinkers, problem-solvers and decision-makers who can participate positively in all the Kingdom's socio-economic and political spheres.

The authors concurred that the use of Problem-Based Learning approach enhances the development of students' higher order thinking skills (HOTS) and fostering learners' social skills (Dolmans, De Grave, Wolfhagen, Van der Vleuten, 2005; Wijnen, 2001). Wijnen (2001) stated that, since learning is contextual in PBL, PBL stimulates self-directed and life-long learning in students. Learners, according to the author function like team members and learn to share, especially their newly acquired knowledge. Dolmans, De Grave, Wolfhagen, Van der Vleuten (2005) admitted that learners have a common goal and strive to solve problems through their interaction using their problem-solving abilities and collaborative skills in the PBL approach (Ram, Ram & Sprague, 2004).

2.4 Aims of PBL

PBL approach aims at promoting student-learning enhancing, enhancing the development of students' higher order thinking skills (HOTS) and fostering learners' social skills, according to Dolmans, De Grave, Wolfhagen, Van der Vleuten (2005). Wijnen (2001) stated that, since learning is contextual in

PBL, PBL stimulates self-directed and life-long learning in students. Learners, according to the author, function like team members and learn to share, especially their newly acquired knowledge.

The authors both admitted that learners have a common goal and strive to solve problems through their interaction using their problem-solving abilities and collaborative skills in the PBL approach. According to the authors, learners engaging in PBL get a chance to experience both personal and social cognitive conflicts within the context of a discussion. The learners' goal in PBL is to collectively solve these conflicts by explaining the reasoning behind their thinking.

Within the context of Swaziland, the aim really is to promote active participation of learners, increase learners' intrinsic motivation, increase learner success, improve acquisition of skills that foster critical thinking, decision-making, encourage use of learner-teaching strategies like PBL that which support self-directed life-long learning in science as early as the Primary School level. This will ascertain that learners become more independent and continue learning throughout their lives.

2.5 Location of PBL Approach

Biggs (1993), Miflin *et al.* (2000) and Atherton (2005) located the PBL approach within a constructivist perspective or paradigm which emphasises the role of social encounters for the development of meaning and understanding in educational settings, (Atherton, 2005), life-long learning (Miflin *et al*, 2000) and deep learning (Biggs, 1994; Rushton, 2005). According to Van Wyk, Mclean and Peters-Futre (2007) Primary School learners from disadvantaged backgrounds lack elements of critical thinking, problem-

solving and self-direction as these students need more assistance from teachers to identify and address their personal needs.

In recent years, according to Hmelo-Silver & Barrows (2006), there is a shift of paradigm in science education linking it to technological skills and societal needs to produce citizens who are able to utilise knowledge creatively in everyday life to solve problems, make decisions and hence improve the quality of life. Lambros (2002) also stresses a shift from a teacher-centred approach towards a learner-centred approach. This shift will ascertain that learners become more independent and continue learning throughout their lives.

2.5.1 PBL Approach Promoting 21st Century Skills

The present case study aims at promoting the development of the 21st century skills which, as stated by Mangao (2012), are as follows: accountability and adaptability, exercising personal responsibility and flexibility in personal, workplace and community contexts, meeting high standards and goals for oneself and others, tolerating ambiguity. The author further discussed these skills as follows:

> ***Communication skills:*** understanding, managing and creating effective oral, written and multimedia communication in a variety of forms and contexts.
>
> ***Creativity and intellectual curiosity:*** developing, implementing and communicating new ideas to others; staying open and responsive to new and diverse perspectives.
>
> ***Information and media literacy skills:*** analysing, accessing, managing, integrating, evaluating and creating information in a variety of forms and media.
>
> ***Interpersonal and collaborative skills:*** demonstrating teamwork and leadership; adapting to varied roles and responsibilities; working productively with others; exercising empathy; respecting diverse perspectives.
>
> ***Problem identification, formulation and solution:*** ability to frame, analyse and solve problems.

Self-direction: monitoring one's own understanding and learning needs; locating appropriate resources; transferring learning from one domain to another.

Social responsibility: acting responsibly with the interests of the larger community in mind; demonstrating ethical behaviour in personal, workplace, and community contexts.

According to Epistein (2007), the benefits of introducing the 21st century skills as early as at the primary level are as follows: it helps children build a solid foundation for future success; early collaboration or cooperation lessons set the stage for effective future teamwork; young readers and writers begin to use their emerging literacy skills to communicate important ideas; when children are encouraged to ask good questions and indulge their curiosity, they acquire inquiry skills that help them solve tomorrow's challenges. According to the same author, the benefits of PBL include: assisting children to acquire increased retention, increase learners' interest or motivation to learn, reflecting greater engagement in learning, more self-direction, higher levels of satisfaction; PBL improves reasoning skills amongst learners.

2.6 Teaching Reforms

Teoh and Preeechaporn (2009) argue that, if teachers teach in today's classrooms the way they were taught yesterday, learners will not be prepared for today nor for tomorrow. According to them, there is a need to replicate in the classroom the world in which students are living. A Hebrew proverb states that teachers must not confine children to their own learning for they were born in another time (Suan See, 2012: 3). Bill Ferriter (undated) concurs: when tomorrow's children sit in yesterday's classroom, it is their teachers who are failing. We need to prepare students for their future not our past (Ian Jukes, undated).

According to Epstein (2007: 39) good teachers engage their learners in intentional learning that is "plan-full, thoughtful, and purposeful", and "uses their knowledge, judgment, and expertise to organize learning experiences". PBL produces learners who are well-motivated, independent learners, effective problem-solvers, and who have a broad range of interpersonal and professional skills, according to Epstein (2007).

According to Liu Yu (2004), the principles and concepts students learn are an integral part of the problem with which they struggle. Liu Yu (2004) concurs that the knowledge learners gather when solving problems is connected to the science subject, and learners can also integrate what they learn into other subjects. Liu Yu also points out that their grades are based not only on what they remember, but also on what they can do (Kuwana, 1997; Liu Yu, 2004). According to Overton (2001) learners are required to develop problem-solving strategies, to acquire new knowledge and make judgments, approximations and deal with either excessive or omitted information.

2.6.1 Current Teaching Method

According to Dolmans, De Grave, Wolfhagen, Van der Vleuten (2005), more of teaching focusses on more active learners' participation, more learner-instructional techniques, unlike the traditional teaching strategies used which are mainly teacher centred. Learners in such teacher centred scenarios just listen to the teacher, work out standard problems, memorise facts in order to pass tests or grade 7 external examinations, and they spend little time understanding the concepts behind the materials. Dolmans et al (2005) further observed that learners are used to working alone and their achievements are based on routine paperwork, namely tests and home works. This inspired the researcher to introduce Primary School science teachers in the Shiselweni region to current teaching strategies which encourage learners'

own construction of knowledge, collaboration, foster development of critical skills, communication skills, decision-making and problem-solving skills, such as those found within the PBL pedagogy (Teoh & Preechaporn, 2012).

Hirça (2011) also view the use of PBL and Contextual-Based Learning (CBL) instructional strategies as fostering change in learners' attitude to science in order to engage them with science careers. Learners tends to obtain high scores in the tests yet they cannot retaining information long enough to apply it to subsequent subjects. Learners, according to Hirça (2011), should receive the information they will need to be engaged in science projects, both at school and after school. According to Hirça, learners should move from being passive recipients of knowledge to being active participants in activities that encompass analysis, synthesis and evaluation, in addition to developing skills, values and attitudes (Sivan *et al.*, 2000; Hirça, 2011: 3).

Overton (2007) notes that learners do not know how to interpret data and do not know which method they should choose to solve real-world problems. This also prompted the researcher to point out PBL as an effective tool that can help teachers in the Shiselweni region fill the above gap. The researcher's dissatisfaction with the traditional teaching style used by science teachers, coupled with students' poor performance in science, triggered the need to investigate teachers' experiences and understanding of the Problem-Based Learning (PBL) approach in Swaziland.

In Swaziland, the Ministry of Education and Training (MoET) has encouraged teachers to shift from using he traditional teacher centred instructional method to learner-centred constructive learning styles which promote active learner participation in class (MoET Policy, 2010). However, the problem is that

teachers find it hard to relinquish their leading role as fountains of information to become facilitators. Liu Yu (2004) cited that teachers often felt uncomfortable when learners learn on their own without their guidance, they felt it would lower their results even more; they just like being in control.

Azer (2009) describes the PBL approach as one of the instructional methods which promote more active learner participation and development of HOTS in learners. According to him, PBL pedagogy is in line with the move to more active learner participation in the learning process. Overton, 2001 suggested that teachers must use instructional methods which promote more hands-on and mind-on attributes in their learners rather than following rote learning.

2.6.2 Teaching Methods and Learning Styles

Dolmans, De Grave, Wolfhagen, Van der Vleuten (2005) accept that individuals differ in their learning preferences, and that teaching methods also vary. According to these authors, some instructors prefer to provide information through lectures, encouraging more memorisation, whereas others prefer using more active learner-participation methods of teaching. According to Endorf & Mcneff (1991), learners have to be aware of their instructor's style of teaching in order to collaborate with the instructor. Fang (2002) and Suskie (2003) add that educators with an understanding of students' learning styles can improve their choice of instructional delivery in order to create conducive learning environments.

Interestingly, Cassidy and Eachis (2000) reported that learning styles could also be adapted to changes in the environment. Alkhasawneh *et al.* (2008) warn that, if a mismatch exists between teaching method and learning styles, then learners may become inattentive in class, fail exams, and drop out of school. Similarly according to the authors, educators using insufficiently responsive teaching methods can be

faced with bored, unresponsive learners, low test grades, poor attendance and dropouts. Thus, it is very important to strive for a balance of instructional methods to meet learners' learning needs, based on knowledge and understanding of the learning styles' concept. Quality instructional styles should help learners in activating prior knowledge, provide a context that resembles future professional career environments and stimulates learners to use their knowledge.

2.6.3 Change in Teaching Methods

The researcher suggests that there is a need to change the generally accepted teaching approach in Swaziland in order to overcome its deficiencies The goals of the proposed modifications are, amongst others, to give learners an active learning context, help learners to take a deep-level approach to their learning; and train them to become more independent, life-long active learners through the use of the PBL approach. Therefore, Vardi & Ciccarelli (2008) suggest a move away from teacher-centred approach to more learner centred approach which promotes more active learner participation during the learning process. Breton (1999) agrees with the idea that learners have to be responsible for their own learning construction. The researcher believes that Swaziland's teachers/learners need to be introduced to a number of new deep-learning strategies, one of which is PBL.

2.7 Anticipated Difficulties

The PBL method is a relative new concept when it comes to science education in Swaziland's Shiselweni region. Several difficulties were anticipated, such as:

2.7.1 Time

Liu Yu (2004) agrees that the PBL approach may be a new experience for teachers and learners and time is needed to develop and test problems, time to train teachers and time to teach learners. According to him, the PBL approach requires more teachers' time than the traditional method. In the case of Swaziland, the likely challenge with reference to time is that teachers and learners will not be trained on how to implement PBL. Secondly, the time to cover the whole Shiselweni region to collect Primary School science teachers' experience and understanding of PBL is inadequate. Lastly, the period for collecting the data might not be enough (constrained) due to the unavailability of schedule changes by the study informants. The fact that the researcher is also a full-time college lecturer might be a challenge when it comes to balancing work with study/research time.

2.7.2 Learners

In the Shiselweni region the number of learners is above 50, per teacher in a class. So it is hard to teach in front of overcrowded classrooms where the learners are accustomed to studying passively and individually. Learners do not know how to cooperate and communicate in a group. Any frustration they encounter can make them abandon the new method since most learners' aim is to pass tests or external examinations in order to gain admission into secondary schools. Learners care more about scores than abilities.

2.7.3 Money

Liu Yu (2004) points out that in PBL learners are required to operate instruments by themselves. They need to have ready access to relevant resources (hardware, software, internet access and transport). The

researcher needs more money for accessing information and transport to visit schools for observation purpose in the Shiselweni region.

2.7.4 Teachers

In general, teachers prefer teaching their learners in order to finish the syllabus than engaging themselves in non-remunerated research work. The issue of lack of remuneration also makes it difficult to find a collaborator to help when conducting research (Cohen *et al.*, 2000).

2.8 PBL, is a Successful Innovation

There have been many innovations, such as discovery learning and other instructional methods which have had a brief moment of success and then faded away, according to Camp (1996). He acknowledges that the PBL approach has been implemented successfully in different institutions of learning across many fields of study, growing exponentially as to become a successful instructional technique. Pepper (2009) concurs that PBL is a recognised instructional strategy which engages learners in deep rather than surface learning. He also viewed it as a successful strategy which relates science to learners' real-life experiences. According to Edwards & Hammer (2006), faculties who want students to learn, remember, apply, and continue to learn once away from their teachers' control, often have been disappointed with the traditional approach. They point out that too many learners memorise, forget and fail to apply or integrate knowledge, and resist further learning in the traditional approach.

Camp (1996) suggests that many problems with the traditional pedagogy seemed solvable with a shift to a PBL format. Colliver (2000) states positive attributes or attitudes of learning incorporated in students when teachers apply PBL as active participation, incorporating educational principles such as those

derived from adult learning theories. He concludes by saying that PBL certainly seems like a more challenging, motivating and enjoyable way to learn, and learners appear to agree (Colliver, 2000).

2.9 PBL and Science Education

According to Akınoğlu & Tandoğan (2007), science education has certain aims which can be realised by using PBL pedagogy (Tobin, 1986; AAAS, 1993). Sonmez & Lee (2003) cite one aim of science education, namely to develop scientifically literate citizens who have life-long learning skills. According to the authors, the PBL approach is the means through which critical thinking, problem-solving can be developed, self-directed learning enculturated and life-long learning fostered. The authors argued that nowadays many science educators have increasingly started using the PBL instructional strategy in science education after finding out that this approach can help them realise some of science education's aims (Lazear, 1991; Treagust & Peterson, 1998; Gallegher *et al.*, 1999; Slavin, 1999; Greenwald, 2000; Yizhi, 2003; Senocak, 2005; Wilson, 2005; Kılıç, 2006). Kılıç (2006) observes that science education includes practice and interpretation which connect with real life so much so that it requires cooperation, a practice facilitated by PBL.

2.10 Implementation of PBL in Science Education

Akınoğlu & Tandoğan (2007) insist that concepts, learning aims and length of the subject matter must be set first, then small groups of 6 to 10 learners should be formed after informing the learners properly about the PBL approach. Learners, according to Srinivasan, Wilkes, Stevenson, Nguyen & Slavin (2007) should have the necessary time to define the problem (investigate relevant issues) and work out a solution to the problem. According to Nguyen and Slavin (2007) learners must have prior information about the problem; they must be encouraged to do research using various data sources. All the

information obtained in the process must be shared, discussed and evaluated among group members until a solution to the problem is reached (Holbrook & Rannikmae, 2007). Even the solution, according to Teoh, Preechaporn & Leong (2010), must be presented to other groups, and the information or targeted concepts must be discussed during the facilitation of the teaching-learning process by the teacher. In Swaziland it is pivotal to upgrade teaching/learning to meet current global requirements that emphasise that learning should meet all the necessary pillars of learning, developing the learners not only cognitively but also with regard to skills.

2.11 Conclusion

In conclusion, literature suggests that the PBL approach is a useful instructional approach that supersedes conventional instructional methods and can be used as an alternative approach. The PBL approach seems to develop the learner holistically, in all the necessary domains of learning, it develops in learners necessary skills, such as critical thinking, problem-solving, critical decision-making, collaborative or cooperative skills, communication skills, inventive or creative skills, self-directed life-long learning, and it enables them to continue learning throughout their life. It is for this reason that this research was pursued so as to bring about a paradigm shift in the way the teaching-learning process is approached, especially in Swaziland and especially given that students perform badly in science.

This chapter was on the review of the related literature to this study, the next chapter delves on the methodology which was used in the study.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.0 Introduction

This study investigated Primary School science teachers' experience and understanding of Problem-Based Learning in the Shiselweni region. Through this study, the researcher aims at encouraging constructive and participatory learning as an alternative to traditional methods of teaching and learning among Primary School science teachers in the region. The constructive learning principles, according to Dolmans, DeGrave, Wolfhagen & Vleuten (2005), emphasise that learning should be an active process where learners construct or reconstruct their own knowledge. They categorise the constructive learning principles into four different principles. They state the four key principles as follows: learning should be a constructive process, learning should be a self-directed process, learning should be a collaborative process and learning should be a contextual process.

3.1 Learning as a Constructive Process

According to Dolmans, DeGrave, Wolfhagen & Vleuten (2005), learning should be a process of creating meaning and constructing a personal interpretation of the world based on individual experiences, understandings and interactions. Dolmans et al. (2005) pointed out that teaching must not only aim at delivering knowledge (science content) but also at fostering cognitive skills. In other words, learners should be stimulated to be aware of their prior knowledge and to regulate or direct their learning process, both from a motivational and a cognitive perspective.

According to Sonmez, Lee & Hyonyong (2003) learners should be prepared to become life-long students who are able to acquire new knowledge and skills rapidly.

The researcher's aim of the present study is to encourage Primary School science teachers to lay the desired foundation in their learners to become successful thinkers and decision-makers throughout their lives and assist them to learn the science they need to know in order to thrive in the modern world (Kolodner *et al.*, 2003). The research is premised on the fact that Primary School science teachers should not be dispensers of information but rather a resource that provides guidance and assistance. The PBL approach uses multiple ways of evaluations such as teachers, peers, and through self-evaluation (Bridges & Edwin, 1992).

In addition, Hirca (2011) stresses that learners need to be learning science in ways that allow them to put it into practice, such as through solving problems and making decisions, rather than just warehousing collections of scientific facts. In other words, the author suggested that learners acquire knowledge in order to use it in certain situations. The goal of this study was to apply the researcher's knowledge on PBL to impress upon the Shiselweni region science teachers to use this instructional strategy because it promotes deep learning of science concepts and skills. The researcher's intention was to encourage teachers to use the teaching pedagogy that produces learners who are critical thinkers and decision-makers throughout their lives and practise life-long learning. They must promote effective, purposeful and engaging activities in their teaching of science (Hmelo, Narayanan, Hubscher, Newsletter & Kolodner, 1996; Dolmans, DeGrave, Wolfhagen & Vleuten, 2005: 733).

3.2 Learning as a Self-Directed Process

Self-directed learning, according to Dolmans, DeGrave, Wolfhagen & Vleuten (2005), implies that students actively take part in planning, monitoring and evaluating the learning process; planning is when learners consider different ways (approaches) of tackling a task, setting up a goal, selecting strategies for achieving the goal and identifying obstacles that hinder them from reaching the set goal; monitoring is when a learner knows what s/he is doing and anticipates what ought to be done next, by looking back and forward; both the process and the product of the learning process must be evaluated in the end. Evaluation refers to the interpretations and giving of meaning of results or proposal.

It looks at what or how it was accomplished; was it formative (taking place during development of project) or assumptive (drawing lesson from completed projects. Sonmez, Lee & Hyonyong (2003) state that self-directed or life-long learners plan, monitor and evaluate their own learning and direct or regulate their own learning process; the same authors then elaborate that self-regulation involves two aspects, namely cognitive and motivational self-regulation. According to them, motivation promotes and sustains self-regulated learning whereas the cognitive aspect requires prior knowledge which should regulate the learning process. Finally, Dolmans, DeGrave, Wolfhagen & Vleuten (2005) urge learners to become life-long (self-directed) learners who are able to acquire new knowledge and skills fast.

3.3 Learning as a Collaborative Process

Dolmans, DeGrave, Wolfhagen & Vleuten (2005) describe collaboration as a social structure in which two or more people interact with each other and, in some circumstances, some types of interactions occur that have a positive effect. Collaboration, according to Savery (2006), is not a matter of division of

tasks among learners, but involves mutual interaction and sharing of the understanding of a problem. He suggests that the following conditions should be met: participants have a common goal, share responsibilities, are mutually dependent and need to reach an agreement through open interaction when collaborative learning occurs. The factors which enhance collaborative learning are: elaborations, verbalisations, co-construction, mutual support, criticism and tuning in cognitively and socially. In other words, learners should be stimulated to interact with each other because these interactions may positively influence learning.

3.4 Learning as a Contextual Process

According to Kolodner *et al.* (2003), learning should take place in a context or, to put it differently, all learning should be situational. They admit that the situation in which knowledge is acquired determines the use of this knowledge. Knowledge transfer takes place less easily across different types of situations and can be facilitated by anchoring learning in meaningful contexts, revisiting content at different times in rearranged contexts, for different purposes and from different perspectives. Viewing problem environments from multiple perspectives increases knowledge transfer or the flexibility with which learners can deal with new sets of events. As such this prepares learners for future learning (Dolmans, DeGrave, Wolfhagen & Vleuten, 2005: 732). Hmelo-Silver (2004) comments that viewing the problem environment from multiple perspectives stimulates learners to appreciate critical features of the cases presented to them, and helps them to abandon their assumptions.

Too often, instructional teaching strategies used in science education fail, according to Kolodner *et al.* (2003), to engage learners and are divorced from their everyday experiences. The authors decried that traditional teaching methods used in science education have tended to exclude learners who need to learn

from contexts that are real-world, graspable and self-evidently meaningful (Kolodner, Camp, Crismond, Fasse, Gray, Hoolbrook, Puntambeka & Ryan, 2003). The Swaziland's National Curriculum Centre suggested that students should "do science" to gain "lasting knowledge and skills" in science, technology and society (Goals of National Curriculum Centre, 2010). There are also calls for students to learn complex cognitive, social and communication skills as part of their Primary School experiences to help them develop "habits of mind" (Goals of National Curriculum Centre, 2010).

3.5 Location of Study Area

The study was conducted in the rural, sparsely populated town of Nhlangano in the Shiselweni region of Swaziland. The region has a number of schools whose students often perform poorly in science since the learners are from disadvantaged schooling experiences. In general, it can be stated that they lack elements of critical thinking, problem-solving and self-direction as they typically need more assistance from teachers to address their personal needs (Somukawa, 2012). Such a scenario triggered the researcher to explore Primary School science teachers' understanding and experience of the Problem-Based Learning approach in this region, hoping that, by considering the quality of the teachers' instructional method, learners' performances could improve.

The teachers were chosen from six different schools surrounding the Nhlangano area (namely Ngwane Practicing, Nsongweni, Evelyn Baring, Nyamane, Mbukwane and Nhlangano Central Primary School). In this region, students in secondary schools and tertiary institutions have a poor science background and most of them hate learning science (Ghani, 2006). In general, teachers complain that there is a high rate of learners dropping out of school despite the fact that free universal primary education is offered in the Kingdom. This high drop-out rate reduces the pool of science literate citizens. The statistics of the

Swaziland Primary Certificate (SPC) results, according to the Examination Council of Swaziland (ECOS), between 2011 and2015, showed that the pass rate did not increase in the past 5 years, with a constant pass rate of 87% in science (http://www.cie.org.uk results 2011-2015; http://www.examscouncil.sz results 2011-2015).

3.6 Research Design

A foundational principle in this study is the notion of social construction of knowledge (Beaumie, 2001), which accommodates the belief that teachers' understanding and experiences of Problem-Based Learning would eventually lead to fostering constructive learning in students. The researcher utilised a qualitative, idiographic case study design. The research was cast in a qualitative interpretative paradigm and adhered to Bascia and Hargreaves' (2000) advice that the best way to investigate subjective experiences and thinking of participants is by means of an in-depth, contextually based, interpretative research paradigm. The chosen methodology accommodated the researcher's presence as a participant-observer in set up, the use of purposive sampling and multiple research instruments.

Like in this case study, the researcher explored Primary School science teachers' (multiple individuals) understandings and experiences of a single instrumental case, the PBL approach in the Shiselweni region. As Yin (2003) advises, detailed and in-depth data collection was used to embrace multiple sources of information. In this thesis, Problem-Based Learning is discussed both in an explanatory and exploratory qualitative manner and the teachers' understanding and experiences of the PBL phenomenon constitutes the research focus.

3.6.1 Importance of Case Study Method

The strength of the case study method is that it permits the use of a number of different strategies and triangulation with the aim of illuminating a theoretical case from different angles (a meta-cognitive way). Therefore, it is more suitable for examining a little known or poorly understood instructional strategy like PBL. It is the generally preferred strategy when "how or why" questions are being addressed. The investigator may have little or no control over events, and focus is on a contemporary phenomenon within some real-life context (Yin, 2003), like in this study. In this research, the case study method is appropriate for investigating Primary School science teachers' understanding and experiences of the Problem-Based Learning phenomenon as a contextual single case (Leedy, 2013), in the Shiselweni region of Swaziland.

3.6.2 Reasons for Selecting Case Study Method

The case study method allows the investigator to discover in a holistic and in-depth way the teachers' understanding and experiences of Problem-Based Learning. Hartley (2004: 133) states that case study research "consists of a detailed investigation, often with data collected over a period of time, of phenomenon, within their context", with the aim of analysing it and illuminating the topic's (theoretical) issues. Here the case relates to participants' personal experiences of the PBL model usage within the teaching/learning profession, using multiple forms of data collection tools such as exploratory questionnaires, unstructured and structured interviews (semi-structured interviews), participant-observation in classroom and direct observation of records or articles written by different scholars (document analysis). The multiple methods of data collection used will help the researcher triangulate and generalise the findings.

3.6.3 Exploratory Questionnaires

The researcher designed two types of questionnaires. The first one focused on gathering information concerning teachers' understanding and experiences of the Problem-Based Learning approach. The questionnaire has fourteen simple, exploratory questions using a five-point Likert scale, directed to Primary School science teachers. The teachers had to complete the questionnaire by indicating if they strongly disagreed, disagreed, were not sure, agreed or strongly agreed. Some of the essential questions asked related to skills acquired by learners when taught using the PBL approach and roles played by the teacher and learner. Participants were selected according to their willingness to participate. The willing participants first signed a consent form before filling in the questionnaire. Letters seeking permission to conduct research in selected schools in the Shiselweni region were sent to head teachers. They were informed that the research had been accepted by the University of Kwa-Zulu Natal (UKZN) and approved by the Shiselweni In-Service Training Office.

Teachers were shown the letter of approval to sample from the Regional Education Office in the Shiselweni region and the Ethical Clearance Certificate issued by the Education Department of UKZN. The second questionnaire was administered as a follow up, probing in-depth information about teachers' experiences and understanding of the PBL approach. In the second questionnaire background and demographic data was required from the teachers. The questionnaire consisted of 18 questions arranged in Table form with a 4-point Likert scale, where 1 indicates strongly agree, 2 agree, 3 disagree and 4 strongly disagree. The participants were asked to place a tick that corresponds with their answer. The answer selected by the participant was then compared with the answer in the first questionnaire to triangulate data and verify its reliability. A total of 25 questionnaires were administered to teachers.

3.6.4 Semi-Structured Interviews

Most researchers use semi-structured interviews because these possess both elements of structured and unstructured approaches. Semi-structured interviews are one-on-one discussions between an interviewer and an individual meant to collect detailed information (expert knowledge) of topic using a guide with questions arranged in order how they would be asked. The strengths of semi structured interviews are that the researcher can ask probing questions to cover the topic and to thoroughly understand the answer provided by an individual. Asking an individual probing question is done in structured interviews in order to ensure that complete and consistent information is received across the different interviews.

The researcher conducted eighteen semi-structured interviews of the 25 participants in order to ascertain their views and experiences on the PBL approach. The interview sessions conducted were audio-recorded using a Genx sound recorder and lasted approximately 30 to 40 minutes. In an attempt to offer a non-threatening or intimidating way of gathering participants' perceptions, the semi-structured interviews were conversational and interactive. The semi-structured interview approach was selected because it offers an engagement in a more conversational style while open-ended questions could be explored that yield in-depth information about participants' experiences and understanding of PBL. The different methods of gathering data enabled the researcher to triangulate his findings. The collected data were transcribed after the interview sessions.

3.6.5 Participant-Observation

Van Wyk (2009) defines observation as a research approach that employs an iterative process of asking, watching and reviewing. The researcher undertook classroom observations as an additional tool for gathering Primary School science teachers' understanding, experiences of and their responses to the PBL

approach. The researcher mainly focussed on finding out if any of the skills attained through PBL implementation are established among the learners as the teacher delivers his/her lesson. The researcher also considered if the instructional strategy used by the teachers was learner-centred. The researcher also explored if the teachers' instructional strategy incorporated the development of higher order thinking skills among the learners during their lessons.

Eight teachers were observed during their lessons; these were mostly teachers from Evelyn Baring, Nsongweni, Nhlangano Central, Nyamane, Mbukwane and Ngwane Practicing Primary Schools. The researcher observed one female and one male science teacher at Ngwane Practicing (N=2), one male and female at Evelyn Baring (N=2), and two teachers per remaining Primary School (N=2) without considering the issue of gender. These schools were chosen because they surround the Nhlangano area, and happen to include the two best performing schools and two schools whose learners perform averagely. Evelyn Baring is a boarding school, whereas Nyamane is a missionary school and Nhlangano Central is a community school. These schools are ideal sites in that they allow the researcher to gather information from a diversity of sources with differing backgrounds.

3.6.6 Document Analysis

The researcher analysed the research findings of scholars of the PBL approach with the aim of comparing these with his own study findings. Different articles on PBL were examined together with other pertinent documents within the schools, such as daily preparation plans. Teaching and learning materials were also analysed when the researcher conducted the classroom observations. The researcher

analysed the teachers' instructional strategy with the aim of discovering if the method established higher order thinking skills and imparted other desired skills to learners through the PBL approach.

3.6.7 Validity and Reliability

The necessary test conditions for maintaining validity and trustworthiness were applied namely construct validity, internal validity, external validity and reliability of this research. Triangulation of was used to ensure validity and reliability by using different instruments, which covered all expected items to be addressed in the study. In the case study, the following instruments were used to ensure validity and reliability: semi-structured and unstructured interviews, different questionnaires and classroom observations. Teachers were given questionnaires to answer before and after their lessons for validity and reliability. Some teachers were given questionnaires to answer before and after classroom observations for validity and reliability. Teachers were also asked questions before and after the unstructured and semi structured interviews to validate the findings.

Data gathered in tape recorders, answered questionnaires were kept safe until the analysis was done and then secured safely in storage for a period of five years. The data was gathered using different instruments for validity and reliability reasons. The participants were free to be part of the study based on personal choice/will and they were free to quit if they no longer wanted to participate. The participants were given the transcripts and analysis to make comments which were captured in the study and implemented in order to maintain study validity and reliability (Cohen *et al.*, 2000: Van Wyk, 2009).

3.6.8 Data Storage

Data in the form of questionnaires, interviews and other instruments was secured in a safe in my office. The information was only used in the present study. After analysis and conclusion, the data will be stored for five years before they would be destroyed by incineration. The researcher intends to publish a research article using this study data in the Journal of South African Association of Research in Mathematics, Science, and Technology Education (SAARMSTE).

3.6.9 Dissemination of Participants' Feedback after Study Completion

The researcher intends to give feedback to participants as he continues with in-service workshops in the Shiselweni region. Detailed letters were sent to participants informing them of the progress in the study and asking their opinion about the research findings. An article based on the research findings will also be published in the Ngwane Teachers' Training College's newsletter. The researcher will encourage teachers to get hold of this newsletter.

3.7 Data Collection and Sampling

3.7.1 Sample Size of study

The researcher initially thought of selecting only 25 (N = 25) participants (teaching Grade 5 to Grade 7 classes) as per the number used in many case studies. Teachers were selected from different Primary Schools in the Shiselweni Region, namely Evelyn Baring (n = 2), Nhlangano Central (n = 2), Nsongweni (n = 2), Nyamane (n = 2), Mbukwane (n = 2), Ngwane Practicing (n=2) and some schools that performed poorly in the 2015 SPC examination (n = 13). According to the MoET, schools whose passing rate was below 65% in last year's results were considered to be performing poorly. The twenty

five teachers were given questionnaires to fill, eighteen of the twenty five teachers (N=18) were interviewed in search of finding their views and perceptions of the PBL approach, twelve of the twenty five teachers (N=12) were observed during their science lessons. The researcher observed two (N=2) teachers per school and three (N = 3) teachers per school were interviewed.

3.7.2 Research Timeline

Sampling was done between February 2016 and December 2016. The first information-gathering tools were the questionnaires which were distributed between February and April 2016. The second instrument was the interviews which commenced in May and went on until July 2016. Classroom observations were undertaken between February and July 2016.

3.7.3 Study Piloting

The in-service department in the Shiselweni region encouraged the researcher to conduct workshops with Grade 7 Primary School science teachers in preparation for data collection. As a result two pilot studies were conducted at the Nhlangano Regional Education Office and Christ the King Primary School (Hlathikulu cluster). The teachers used in piloting the study came from these two locations. These teachers were asked to sign an attendance register and give details like name of school, contact number and gender. The in-service department was used to help the researcher conduct visits and pilot the study at three schools in the Shiselweni region; namely Mbukwane, Ngwane Practicing and Phongolwane Primary Schools.

3.8 Sampling Method

The study participants were selected using the purposive sampling method (Robson, 2002; Van Wyk, 2009). The purposive sampling technique is a type of non-probability sampling that is most effective when one needs to study certain cultural domains with knowledgeable experts. Choosing the purposive sampling is fundamental to the quality of data gathered; thus, informant reliability and competence must be ensured. Data gathering is crucial in research, as data is meant to contribute to the better understanding of a theoretical framework. It then became imperative that selecting the manner and the persons from whom data was to be acquired was done with sound judgment, especially since no amount of analysis can make up for improperly collected data (Bernard *et al.*, 2002). Purposive sampling is a widely used method for selecting informants in most studies.

3.9 Data Analysis

The first data analysis step was to reduce the amount of gathered data by editing the administered questionnaires. The objectives of editing the questionnaires were to identify and eliminate errors made by the respondents. The researcher checked completeness, accuracy and uniformity of the questionnaire answers. Incomplete questionnaires were rejected. The next data analysis stage was the reduction of amount of collected information through data coding, re-coding and post-coding. The data was then recorded in Microsoft Word for ease of analysis. The interview responses were transcribed and edited. The researcher categorised the transcribed findings' emerging themes or patterns. Continuous data perusal was done in order to refine it. The researcher finally triangulated the findings (looked for convergence) and discussed patterns (trends) observed in the collected data (Cohen *et al.*, 2000: Mugabo, 2006). The researcher considered all relevant pieces of information before coming up with

relevant conclusions (Leedy, 2013). Data analysis in this study involved the recording of teachers' perceptions, arranging views or responses of teachers in thematic categories.

3.9.1 Study Limitations

The study is limited to Primary School science teachers in Swaziland's Shiselweni region. Only a part of the region was covered in this study and only a small fraction of teachers was used. On the basis of the above, it is difficult to generalise the study findings to the whole region or country.

3.9.2 Ethical Considerations

Before undertaking the study, and as part of the institutional requirements, the researcher applied for ethical clearance at the University of Kwa-Zulu Natal (UKZN) in the Department of Humanities & Social Sciences (Education). The research was approved on the 23rd of September 2015. The researcher requested and obtained permission to conduct the study from the Regional Education Office (REO) and the In-service department of Swaziland's Shiselweni Region of Swaziland. The researcher also requested permission from the schools' head teachers to conduct interviews and classroom observations. The researcher gave the informants the liberty to remain anonymous throughout the research and also guaranteed confidentiality. As part of the research ethics, participants were made aware that they were allowed to withdraw from the study at any point should they choose to do so.

3.10 Summary

This chapter outlined the study's research methodology and design. The next chapter presents the research data.

CHAPTER FOUR

Presentation of Findings

4.0 Introduction

As stated in Chapter one, the purpose of the study was to explore Primary School science teachers' experiences and understanding of Problem-Based Learning (PBL) approach in Swaziland's Shiselweni region. This chapter presents the study findings. The findings are reported in a narrative format supplemented by descriptive statistics, such as frequencies, graphs, tables, pie-charts and percentages. These findings are presented in eight sections: demographic information; teachers' understanding and experiences of the Problem-Based Learning approach; the usage of the Problem-Based Learning approach when teaching Primary School science; the challenges of the Problem-Based Learning approach; the impact of the Problem-Based Learning approach on learners' performance; some of the reasons why participants choose the Problem-Based Learning approach; the higher order thinking skills developed by Problem-Based Learning and the four key learning principles associated with the use of the Problem-Based Learning approach. Primary School science teachers were interviewed, observed and responded to the questionnaire. As such, the researcher could not control the number of male and female participants who were interviewed, observed or given questionnaires to answer, which led to a numerical disparity of male participants as compared to female.

4.1 Demographic Information

The demographic data of the participants from questionnaires, interviews, and observations was analysed to show the distribution of the participants according to gender, instrument administered and location of the school. The Ministry of Education and Training Sector Policy (2011) promotes gender

equality and offers similar conditions for both males and females in the country's socio-economic development. This is important because both males and females are full partners in the workplace, their community and society; likewise, they were also equal, full participant in this study. The benefit of gender equity is that it maintains fairness and allows men and women to operate on a level playing field (MoET sector policy, 2011).

Figure 1: Percentage distribution of informants according to gender

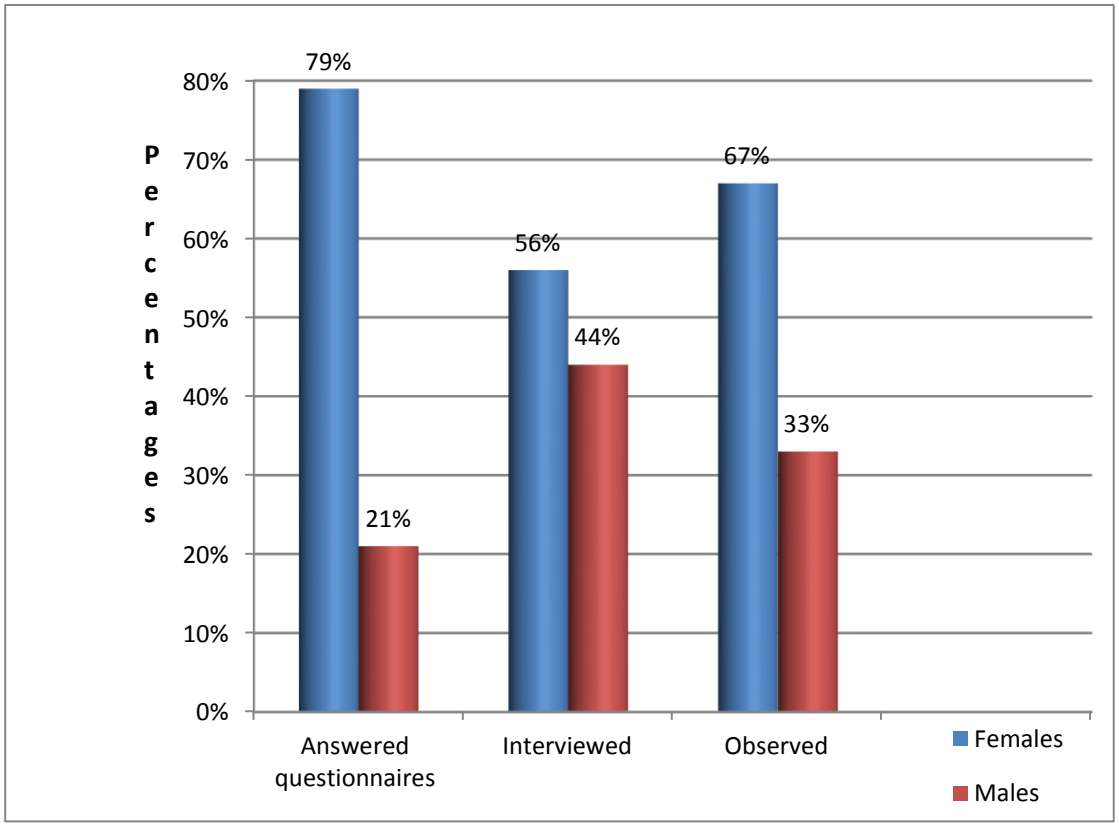


Figure 1 above reveals that of the total participants, 21% were male teachers, who answered questionnaires, 44% were male teachers interviewed and 33% were male teachers observed. 79% were female teachers, who answered questionnaires, 56% were female teachers interviewed and 67% were female teachers observed. The difference in percentage with regard to gender depicts the fact that there are more female teachers than male teachers in our Primary Schools. The researcher did not control the

number of participants since these were selected purposely. According to Yin (2003) the investigator had little or no control over events since the focus was on examining teachers' experiences and understanding of the PBL phenomenon. There was no attempt to control conditions or manipulate variables, as both males and female received the same treatment.

Figure 2: Distribution of female informants according to instrument

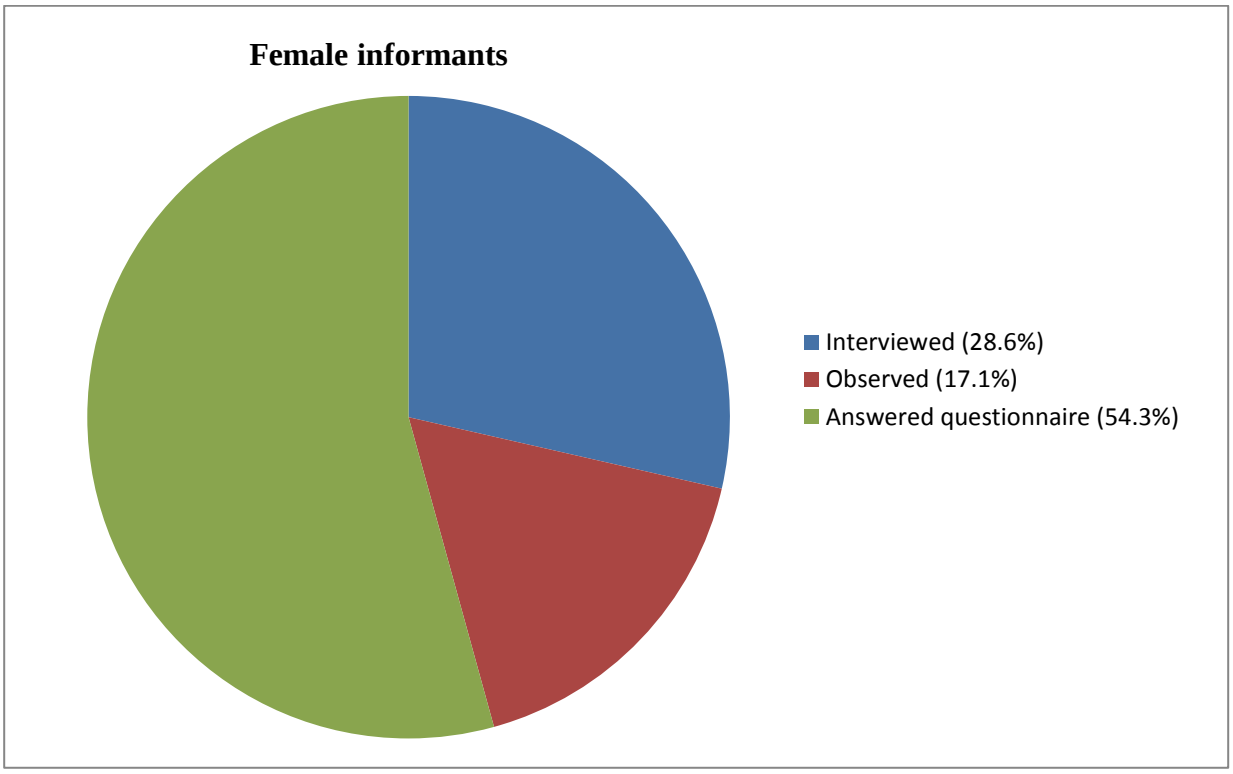


Figure 2 shows the distribution of female informants according to the research instrument utilised. It reveals that 54.3% female teachers answered questionnaires, 28.6% female teachers responded to the interviews and 17.1% female teachers were observed. The statistics show that the number of females interviewed was almost half the number of female respondents who answered questionnaires.

Figure 3: The distribution of male informants according to instrument

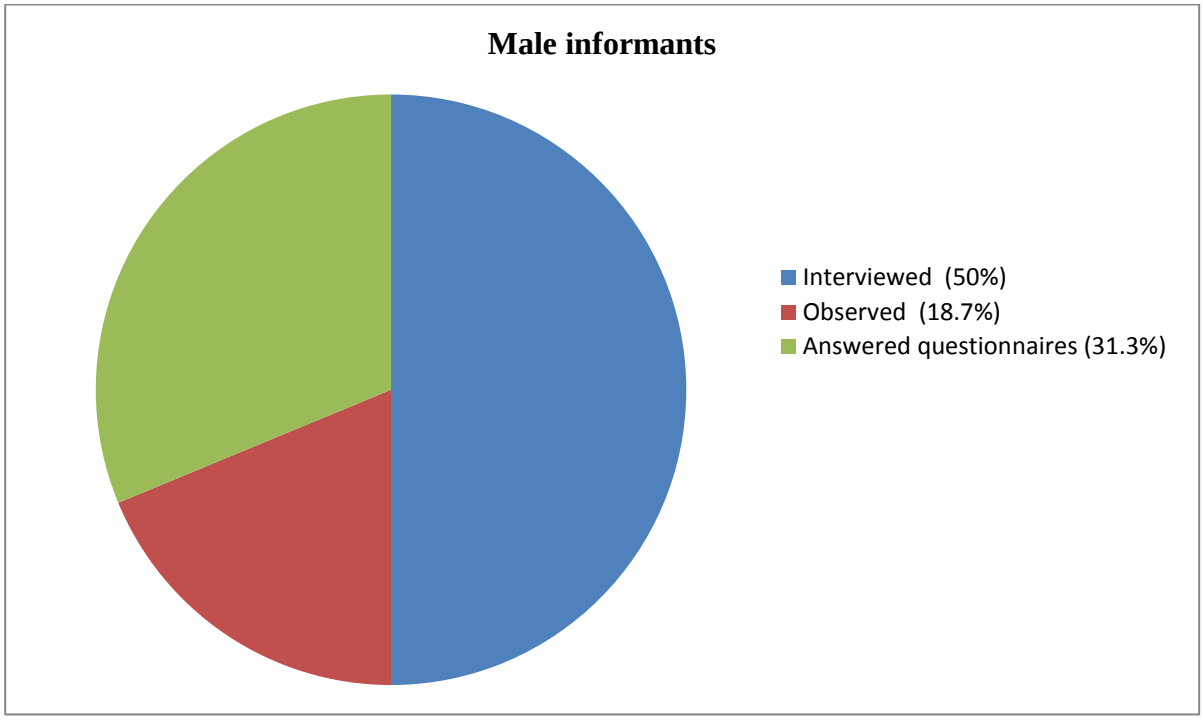


Figure 3 above shows the distribution of male informants according to instrument. It reveals that 31.3% were male teachers who answered questionnaires, 50% male teachers responded to the interview and 18.7% male teachers were observed. The data reveals that the number of male interviewed was more than the number of male respondents who answered the questionnaire. The statistics further reveal that the total number of male respondents who took part in the study was 45.7%, whereas the total female participants represented 54.3%. The total number of males taking part in the study was almost half the total number of females. The data reveals that the majority of the study respondents were female.

Figure 4: Total numbers of male and female teachers

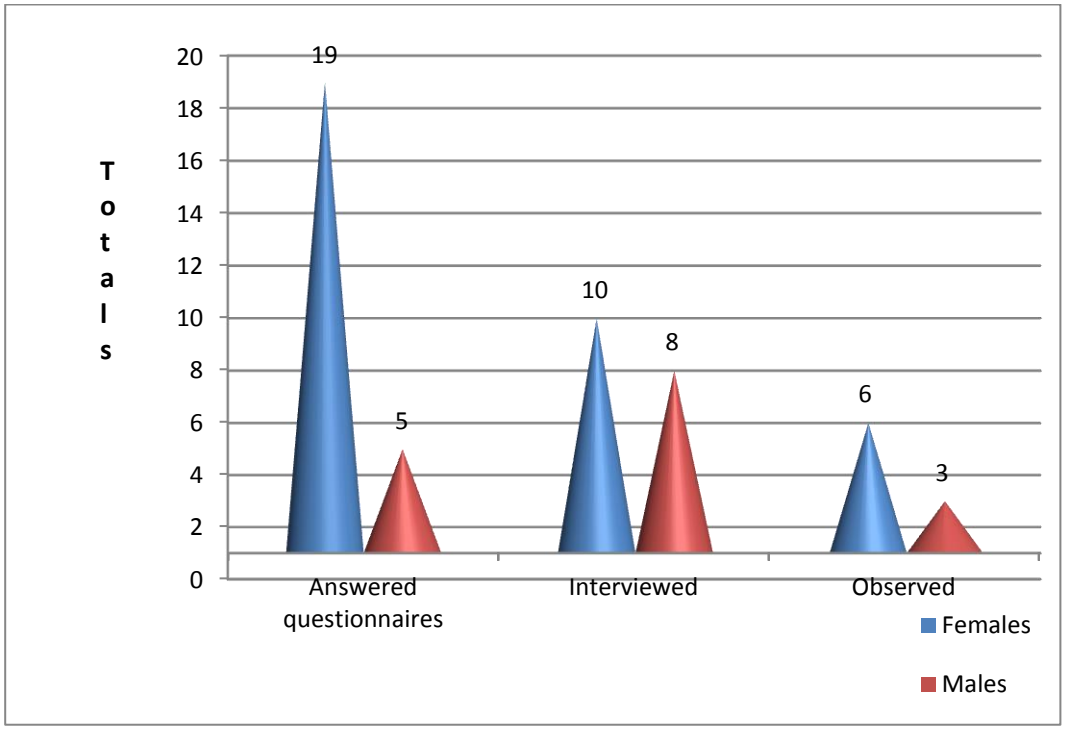


Figure 4 above shows the total number of male and female participants according to the research instrument utilised. The data reveals that more female than male participants answered questionnaires. According to the data, a total of 19 female teachers responded to the questionnaires against 5 male teachers. Thus, the number of female respondents who answered questionnaires was almost 4 times the number of male participants. A total of 10 female teachers and 8 male participants were interviewed, showing a slight difference in favour of the female respondents. The results from Figure 4 show that the number of observed female participants was double the number of observed male participants. According to the statistics shown in Figure 4, a total of 51 respondents were interviewed, observed or answered questionnaires respectively. The findings reveal that a total of 35 female respondents took part in this study and only 16 male respondents. The total number of male respondents who took part in this study was almost half that of the total number of female respondents. The statistics also reveal that

female participants dominated this research, hence creating the irregularity that there were only few male respondents.

Figure 5: The distribution of respondents according to location of the school

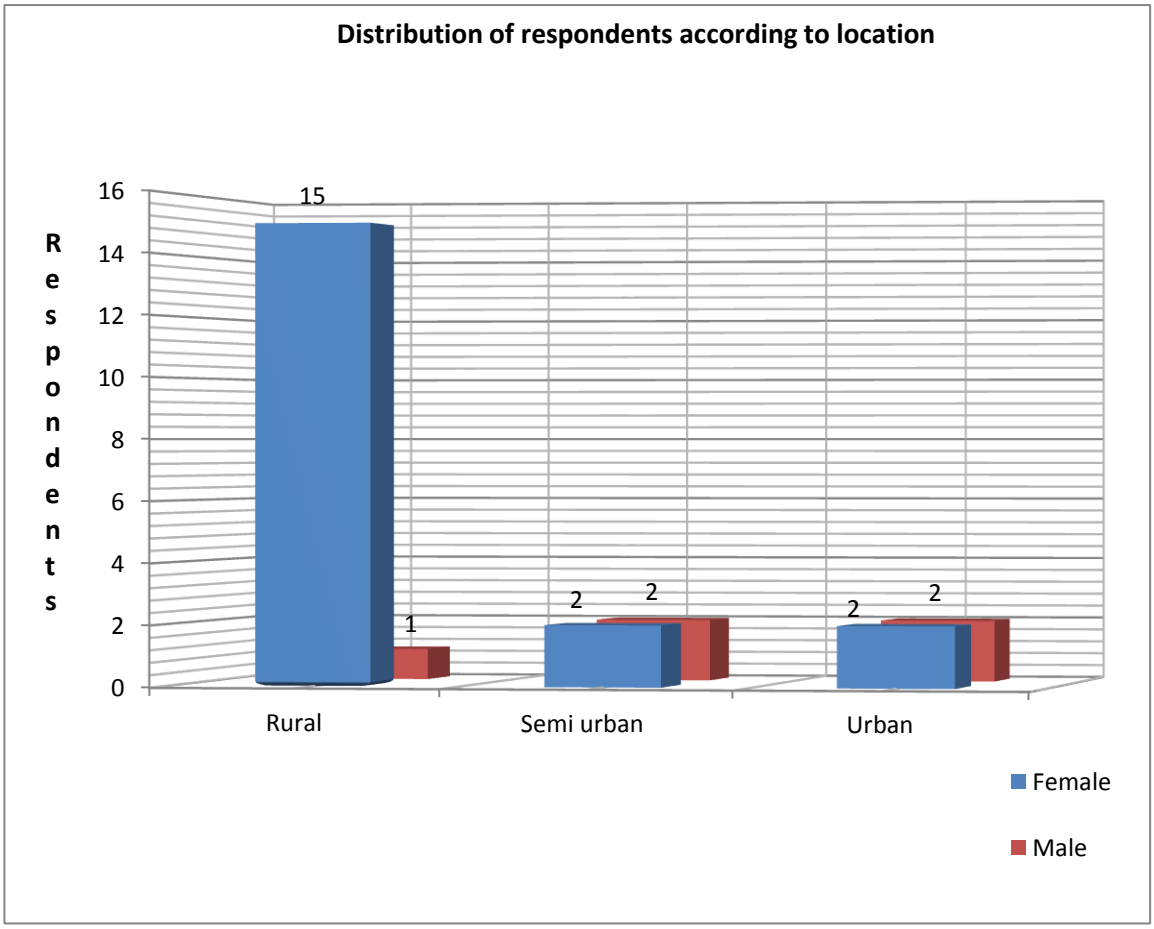


Figure 5 above shows the distribution of respondents according to location of school. The data reveals that there were 15 female teachers against 1 male teacher from rural schools. The findings in percentage form depict that the only male teaching in rural schools represented only 7% and 93% were female teachers. The data also reveal that the total number of informants from urban and semi-urban location were the same for both male and female participants being two respondents respectively. The findings

reflect that distribution of teachers according to location was almost uniform, except that only one male teacher was found in rural schools.

Research question analysis

4.2 Teachers' understanding and experiences of the Problem-Based Learning approach

Figure 6: Reflections on science preparing learners to actively participate in life: teachers' response.

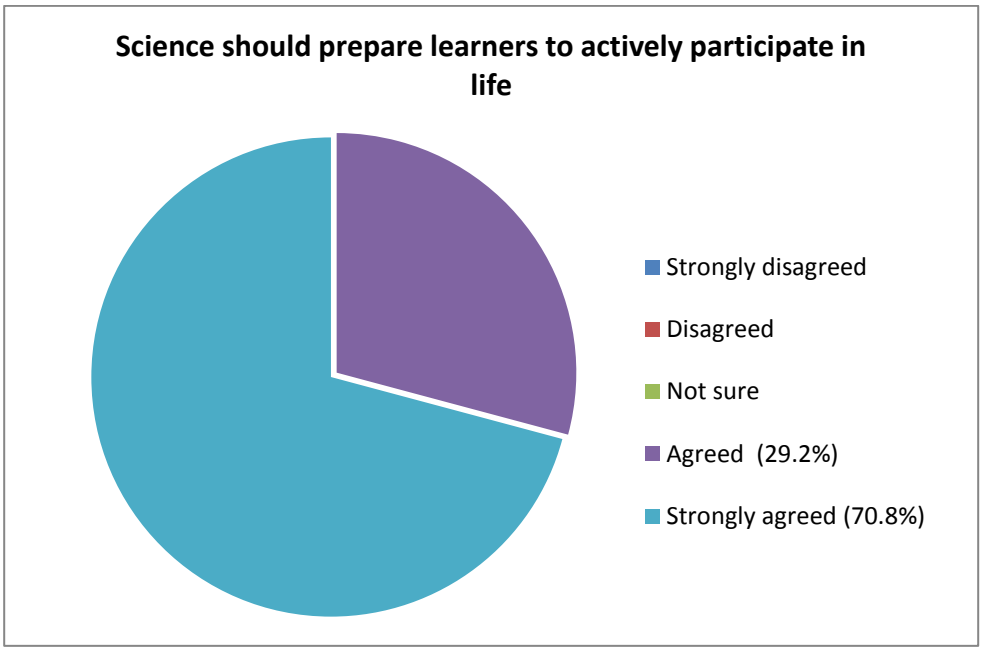


Figure 6 shows the responses of teachers to the question whether science should prepare learners to actively participate in life. The data reveals that 70.8% of the teachers strongly agreed and 29.2% of the teachers agreed. These findings are in line with Akinoglu *et al.* (2007) that it is important for students to be prepared for the future by facing real or real-life problems in their learning environment and producing appropriate solutions to these problems. Problem-Based Learning-trained students are more

likely to successfully pursue science careers in areas such as physics, medicine (health-related) and engineering (applied sciences) in future. These findings are at par with those of Hirca (2011) who concluded that PBL enhances learners' prowess in physical science as well as creativity development. The main objective of his study was to discuss the impact of Problem-Based Learning on students and teachers. Walker and Lofton (2003) in their study entitled Teaching science in the 7th grade using the PBL approach also found that students' willingness to learn increased and their attitudes improved in a positive manner.

Figure 7: Science should prepare learners for independent engagement in career skills: response from teachers

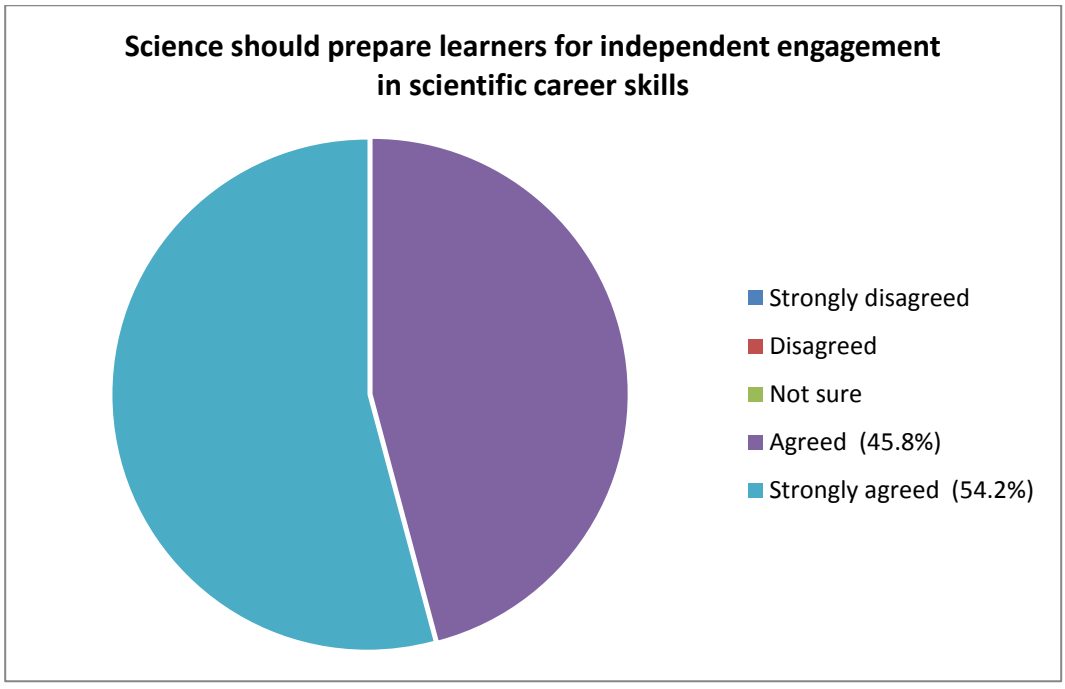


Figure 7 is an illustration of the teachers' response to the question if science should prepare learners for independent engagement in career skills. The data depicts that 54.2% of the teachers strongly agreed and 45.8% of the teachers agreed. This result is in agreement with that of Alper (2008) in that PBL activities

develop more positive attitudes to physics, technology and their environment. Dolmans *et al.* (2005) also discovered that PBL produced positive outcomes in schools and promoted independent learning skills and self-directed learning in students. Srinivasan *et al.* (2007), when comparing PBL with case-based study, found that the PBL approach provided more emphasis on independent learning and encouraged self-directed learning. They concluded that PBL students were highly satisfied and more stimulated toward constructive, collaborative and self-directed learning. The PBL approach, according to this finding, seems to demonstrate more positive effects on learner skills (i.e. knowledge application) than on knowledge (science content).

Figure 8: Pupils learn best through experience and active engagement: response from teachers

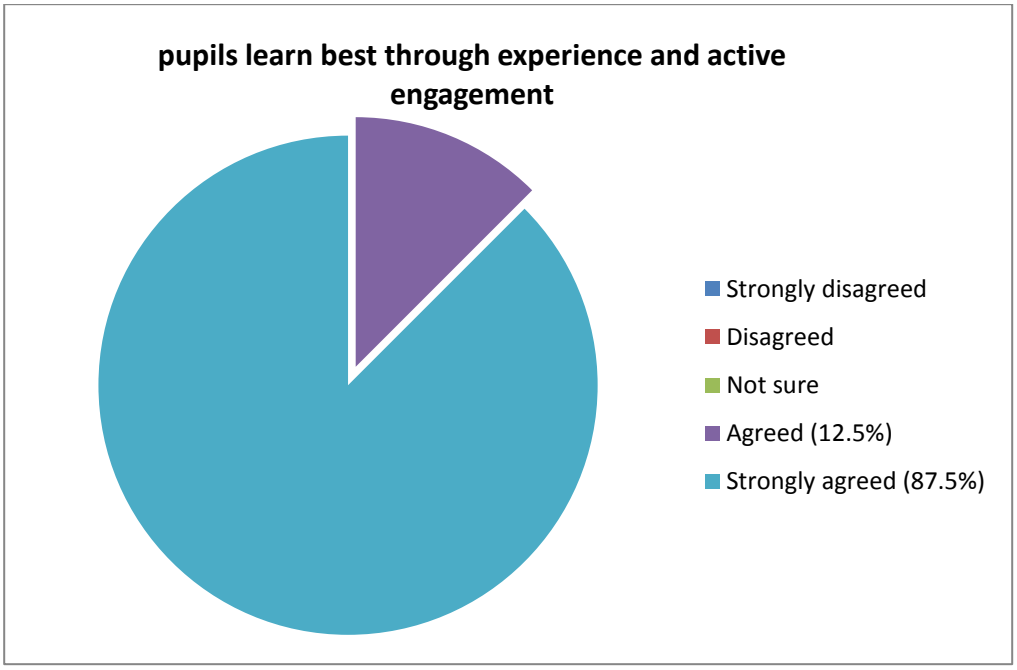
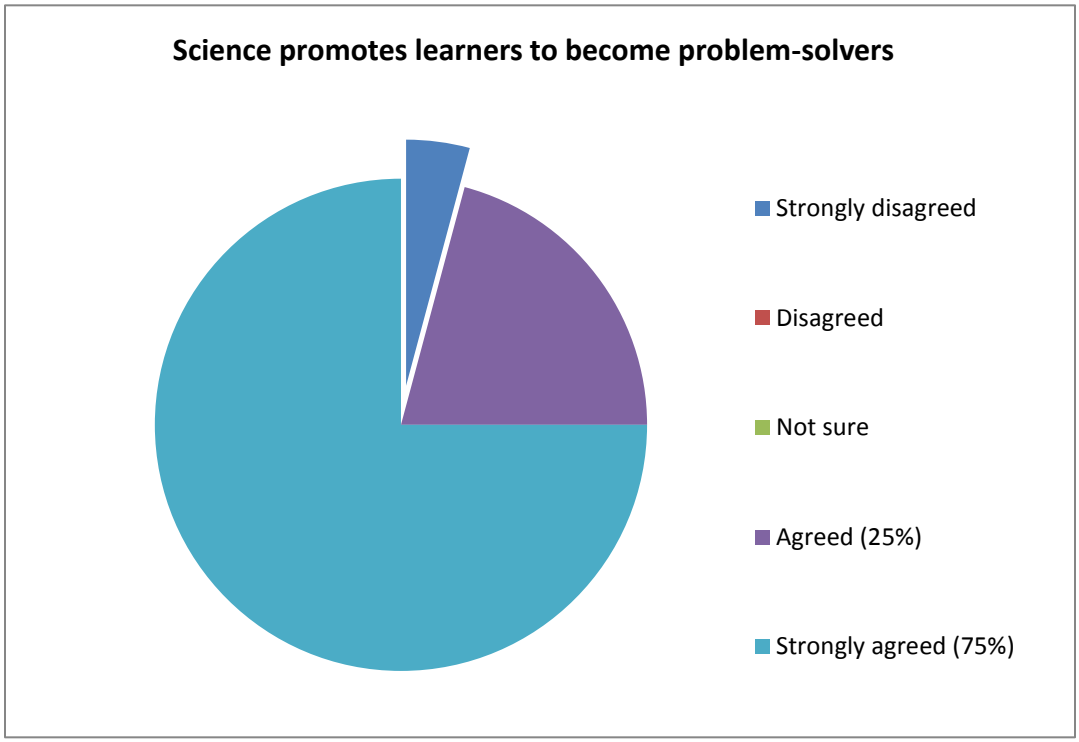


Figure 8 above reveals that 87.5% of teachers strongly agreed that pupils learn best through experience and active engagement, and only 12.5% of teachers simply agreed.

The findings illustrate that teachers were concerned with how they could change learners' attitude towards science in order to engage them with science careers (Minstrell and van Zee, 2000; Hirca, 2011). For this reason, Hirca (2011) suggested that students should be provided with the information they need in science engagement, both in school and after school, in their life. When learners are active in the learning process, they move from being passive recipients of knowledge to being participants in activities that encompass analysis, synthesis and evaluation besides developing skills, values and attitudes (Sivan *et al.*, 2000; Hirca, 2011).

Figure 8 also showed that 100% of the respondents agreed or strongly agreed with the statement that students learn best by experience and active engagement in class. The research focused on initiating a change in pedagogical methods used by teachers and encourages these to make learning and educational processes more flexible, in order for students to participate more effectively. This is the assertion in the constructionist theory: learners must construct and reconstruct knowledge in order to learn effectively (MacLellan *et al.*, 2004: 254). PBL proponents view learning as construction rather than as transmission of knowledge and extend the idea of manipulating materials as the learning idea that is most effective when part of an activity the learner experiences as construction of a meaningful product. Thus, the most effective instructional strategy in science education that can do that is Problem-Based Learning approach.

Figure 9: Science promotes learners to become problem-solvers: response from teachers.



In **Figure 9,** data shows that teachers are in favour of the notion that science promotes learners to become problem-solvers. The results in Figure 9 depict that 75% of teachers strongly agreed with the statement, while 25% of teachers just agreed. This finding is similar to that of Hirca (2011), namely that teachers believe that active learning techniques are useful for permanent learning. Akinoglu (2007) relayed that what is expected from education is that it enables individuals to become effective problem-solvers in their actual lives. According to Hirca (2011) Problem-Based Learning develops effective problem-solving skills, like the ability to apply appropriate meta-cognitive and reasoning strategies, and it develops self-directed, life-long learning skills; learners become effective collaborators who know how to function well as part of a team (Kolodner, 2006; Serin, 2009; Hirca, 2011).

Teachers' attitudes towards creative Problem-Based Learning were positive, with most of the respondents choosing to use the PBL approach. The results also reveal that 75% of the respondents agreed that the PBL approach was a good example of active instructional strategies in the teaching of science. However, it was noted, from the interviews and from the responses to the questionnaires, that some teachers did not have clearly pronounced ideas about active learning techniques like PBL, hence they still preferred traditional teaching techniques in the science lesson such as the question and answer, solving problems and lecture methods. This is in agreement with the findings of studies like those of Karamustafaoglu *et al.* (2001), Demircioglu (2002), Sonmez, Duygu-Lee & Hyonyong (2003), Cheng (2004), Karamustafaoglu *et al.* (2006) and Hirca (2011), which observed that teachers stick to using traditional instructional learning approaches because of ignorance.

The argument is that teachers should change their practices to the PBL approach because PBL is an active learning strategy that promotes learners to become more self-directed and collaborative (Ngeow & Kong, 2001). A similar finding by White (1996) records that government agency, professional organisations and others call for a change in how science is taught as well as what is taught (Cziyko, 1994; Project Kaleidoscope, 1991; Tobias, 1992; Wingspread Conference, 1994). Ruiz-Gallardo *et al.* (2011) stated that, in such approach, students learn by solving problems and reflecting on their experiences (Barrows and Tamblyn, 2006). The importance of Problem-Based Learning, according to Barrows (2006), is that the problem serves as a challenge to students' reasoning or problem-solving skills and as an organiser for their learning.

According to Barrows, the only way to discover what you already know, what you have really stored in your memory is to work with a problem. Through problem-analysis learners realise what they already

know and do not have to study. Participants' views from interviews depicted that most teachers knew that, in the PBL approach, learners are given a problem at the beginning of the lesson. The respondents voiced that the problem acts as trigger of the learning process. They were also knowledgeable about the fact that learners must be given an opportunity to investigate, work out the problem (while trying to find solutions). The participants also understood that PBL-trained learners become problem-solvers (developing problem-solving skills), while working independently in small groups. Most of the Primary School science teachers knew that their role in the PBL approach was only to act as a guide.

Figure 10; Science generates communication, critical thinking, creativity skills and collaboration: response from teachers

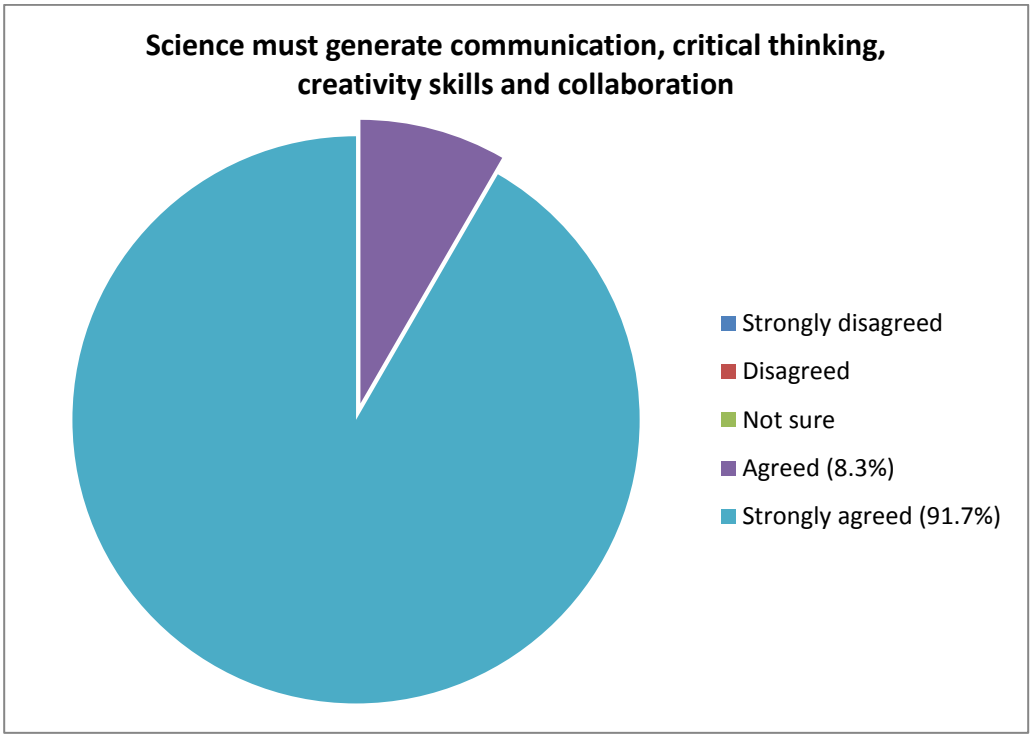


Figure 10 above shows that 91.7% of the respondents strongly agreed that science should contribute towards the generation of creative, critical thinking and collaborative skills. 8.3% teachers simply agreed that science must generate communication, critical thinking, creativity and collaborative skills. This is

evident that teachers understand that Problem-Based Learning foster higher level of skills such as critical thinking, effective communication skills, creativity and collaboration in learners as stated in studies of Biggs (2005) and Riuz-Gallardo *et al.* (2011).

Hmelo-Silver admitted that students learn both content and thinking strategies in Problem-Based Learning pedagogy. The statistics show that a majority of teachers agreed that the PBL approach is an instructional strategy which challenges learners to seek solutions to real-life open-ended problems, involves learners working in groups rather than with textbooks. This result was in agreement with that of Sonmez, Duygu-Lee & Hyonyong's (2003) study. The result was also similar to the findings of Ngeow & Kong (2001) and Sonmez, Duygu-Lee & Hyonyong (2003) which stated that PBL-trained learners develop problem-solving skills, critical thinking, collaborative, communication and creative skills which are 21st century scientific investigation skills.

In a nutshell, teachers suggested that the use of the Problem-Based Learning approach helps learners grasp more information and understand how to use skills learned through PBL in future when solving other problems. Ananiadou *et al.* (2009) indicate that PBL enhances learners' information gathering skills and retention; where learners' knowledge, interest and motivation are increased. This result is also in agreement Goodenough's (2005: 88) findings, which claimed that the PBL approach fosters in learners the development of a range of skills, such as problem-solving, critical thinking, collaborative learning, self-monitoring skills and enhanced student motivation. The researcher observed that the teachers were aware that learners must be highly trained to meet the needs of the 21st century which

demand that learners become critical thinkers, creative problem-solvers, and have good communication skills.

In other words, teachers knew what calibre of learners was desired nowadays to change Swaziland's socio-economic. Szozda (2007) described these intelligent learners as open-minded complex thinkers who assess and analyse the world around them readily. They display cognitive abilities that reflect skills which are developed when learners are trained using PBL approach. This is also in line with the advantages of PBL-trained learners reported Dygu-Lee & Hyonyong's (2003) and Smith's (1995) studies.

These authors asserted that PBL-trained learners are more frequent users of information resources, libraries, ICT laboratories, etc. which foster independent and life-long learning and give rise to sustained learning. Most participants in the study listed advantages of PBL, such as increase of learners' interest and enjoyment of the subject while developing higher order thinking skills. In other words, the respondents were in favour of the notion that PBL approach-trained learners have a more holistic approach to the subject, readily integrate new information, and easily adapt to working as a team member.

Hence, Norman & Schmidt (2000) concluded by stating that students are more satisfied in the PBL approach. Szozda (2007) agreed that the PBL approach develops skills essential in learners' everyday life. The study indicated that increased success of learners involved in PBL is based on the ability of PBL to activate prior knowledge more effectively. Dolmans *et al.* (2005) cited that increased elaboration of information in learners promotes mental processing, greater understanding and learning in a context

that resembles real-world situations. Problem-Based Learning, according to the participants, encourages learners to take charge of their education, develop critical thinking skills, learn how to learn and work cooperatively with others. Learners with the stated PBL-earned skills are most likely to pursue scientific careers in medicine, health and science education fields successfully.

Figure 11; Science must be taught using a learner-centred approach: response from teachers

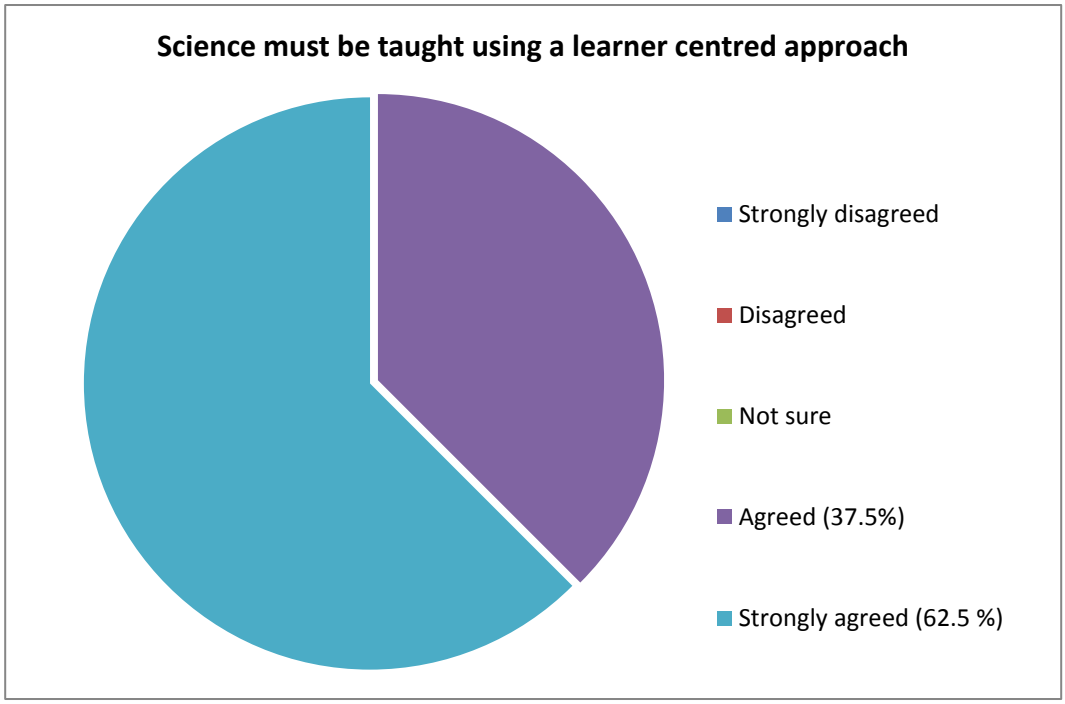


Figure 11 above shows that 62.5% of the informants strongly agreed and 37.5% agreed that science must be taught using a learner-centred approach. The fact that a large percentage of the respondents believe that teachers must use learner-centred approaches such as Problem-Based Learning when teaching science shows that they understand the Problem-Based Learning approach. PBL is a learner-centred approach which puts the learners at the heart of the learning process. This means that the learner is the focal point of the learning process. Learner -centred approaches allow learners to shape their

learning path and place upon themselves the responsibility to actively participate in making their educational process a meaningful one.

This data is in line with the definition of MacHemer & Crawford (2007: 11) who described student-centred learning not as a passive method, since it is based on the premise that 'student passivity does not support or enhance learning' and that it is precisely 'active learning' which helps students learn independently. PBL as a learner-centred approach flags the basic tenet of teaching learners how to think rather than devoting much effort to teaching learners what to think. The respondents further posited that PBL as a learner-centred approach motivates learning, with emphasis on cooperation rather than competition among classmates. As part of this approach, learners are given an opportunity to compare their ideas with those of their peers and their teachers. In this context, the learners are encouraged to ask questions, become inquisitive and actively participate in the learning process.

Therefore, the teacher's role in learner-centred approaches like PBL is to be a guide or facilitator rather than the main source of knowledge. Figure 11 showed that 100% of the respondents either agreed or strongly agreed that science must be taught using learner- approach. These findings are also in agreement with the stipulated Swaziland Government Education Policy which stresses that learning must change from using teacher-into student-centred teaching or learning approach. The Ministry of Education and Training of Swaziland also plays an important role in training teachers and monitoring them in schools to see if they are using student-centred teaching/learning approaches. One of the major aims of the Ministry of Education and Training is to foster life-long and self-directed learning skills in learners as early as possible. The country is in need of leaders that are good critical thinkers and good

decision-makers. Such leaders or critical thinkers cannot be produced if students are passive recipients or warehouses of information.

Figure 12: Informants' responses when asked if they use PBL

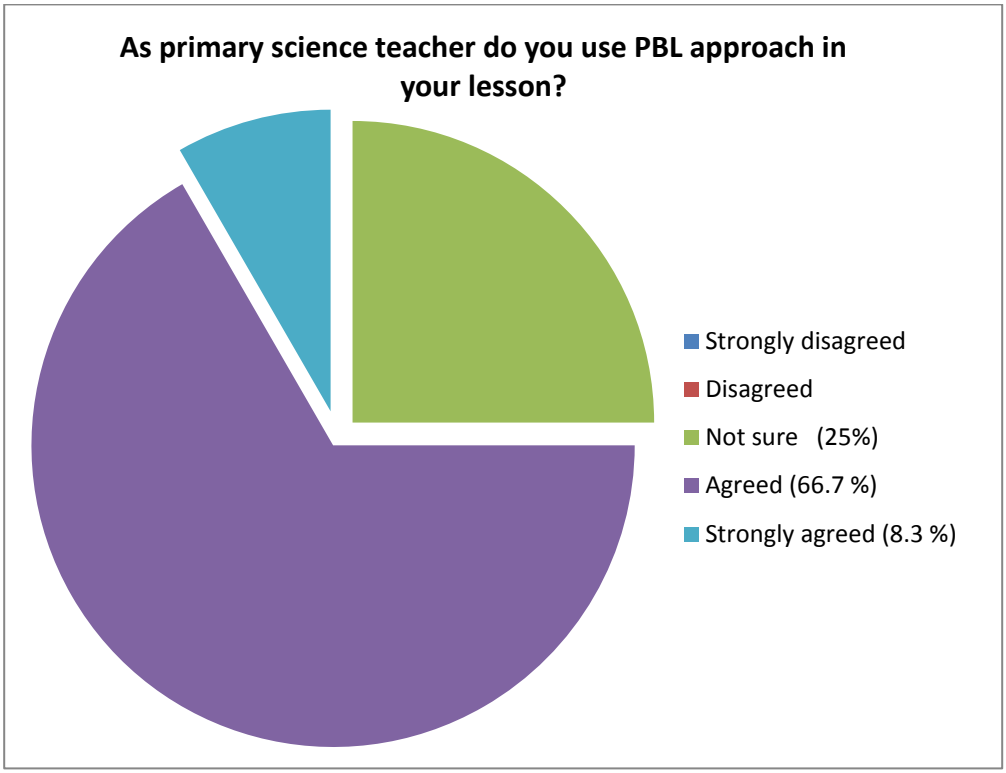


Figure 12 above shows that 66.7% of the respondents agreed and 8.3% strongly agreed that they were using the PBL approach in their teaching. The results also depict that 25% of the Primary School science teachers were not sure if they were using the PBL approach in their teaching. The researcher observed that a majority of teachers were willing to use instructional strategies like PBL which promote active learner engagement in class. This means that the teachers were aware that learners need to be equipped with skills and appropriate attitudes to sustain their learning throughout their life.

The results in Figure 12 showed that 75% of the respondents were using the PBL approach in their teaching which reflects that teachers in the Shiselweni region have vast experience with the PBL approach. The statistics showed that none of the respondents disagreed or were against the use of engagement instructional strategies like the PBL approach. The researcher observed that the teachers were positive and determined to change their traditional teaching approaches. In other words, respondents were ready to discard the existing culture of teaching which promotes students who learn passively and replace it with methods which engage learners to actively participate in their lessons. The results also showed that respondents knew that they must use learner-centred instructional approaches in their lessons.

Figure 13: Respondents' answers when asked if teaching of science should include knowledge, skills and attitudes

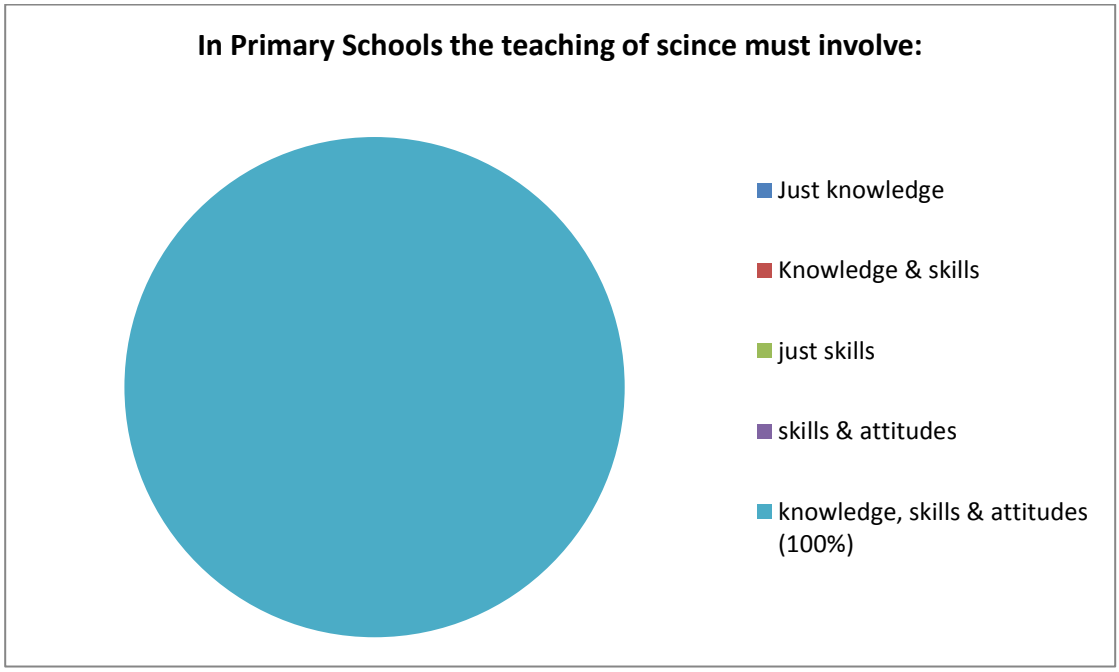


Figure 13 above reveals that 100% of the respondents understood that the teaching of science must involve knowledge, skills and attitudes**.** The respondents knew that they should use science knowledge

to develop in learners the necessary scientific skills or processes and the desired attitudes towards science. Some of these desired skills like collaboration, creativity, communication, critical thinking skill can be developed when science is taught using the PBL approach. PBL approach can foster in learners desirable values or scientific attitudes.

A finding similar to that of Teoh Boon Tat *et al.* (2010) who discovered that PBL promotes values such as honesty, confidence, diligence and cooperative team spirit, to mention only a few. These values are actually also the scientific attitudes learners must develop when a teacher disseminates science knowledge. Some of the PBL skills passed on to the learners are the scientific processes and skills that teachers must develop in learners through the use of science. Surprisingly, one may be prompted to question the instructional method used in our Primary Schools, since such scientific processes or skills and attitudes cannot be achieved in learners if science is taught using traditional lecture methods only.

Figure 14: Participants' responses when asked if it is easy to change from being fountains of information to becoming facilitators

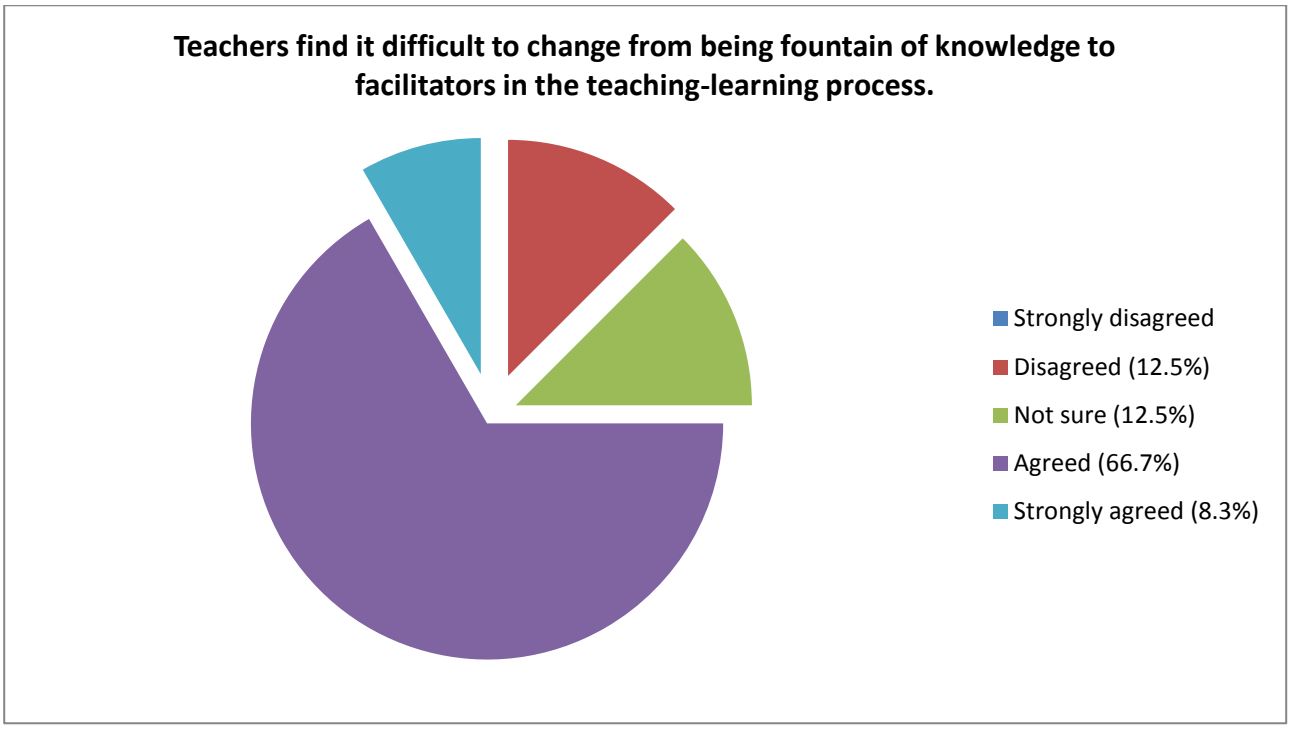


Figure 14 above reveals that 66.7% of the respondents agreed and 8.3% of the informants strongly agreed that they find it difficult to relinquish their role of knowledge fountains to become information facilitators. The findings further reveal that 12.5% of the respondents were not sure and the same percentage disagreed with the statement. The statistics are in agreement with the findings from Dolmans *et al.* (2005) that teachers find it hard to relinquish their position of fountains of information to become facilitators. Pepper (2009) and King (2006) asserted that it is not unusual for teachers to experience a range of emotions, including confusion, anxiety, frustration and anger when implementing change. Some of the reasons why teachers find it hard to become facilitators are, according to Hmelo-Silver (2006), that the facilitator role is critical as they must continually monitor the discussion, selection and implementation of appropriate strategies.

The respondents were also aware that the facilitator guides learners in the learning process and encourages them to think deeply. In other words, facilitators become cognitive apprentices, asking questions which learners should also be asking themselves. As cognitive apprenticeship, PBL situates learning in complex problems. In PBL, the facilitator is an expert learner, able to model good strategies for learning and thinking, rather than providing expertise in specific content. It is important for facilitators to consider the following three factors in order to facilitate effectively: they should provide a suitable knowledge-base regarding the topic, willingness to become involved with students in an authentic way, and the skill to express oneself in a language understood by students (Schmidt & Moust, 2000; Hmelo-Silver, 2004).

Figure 15: Participants' responses when asked if PBL is ideal for teaching learners to become problem-solvers.

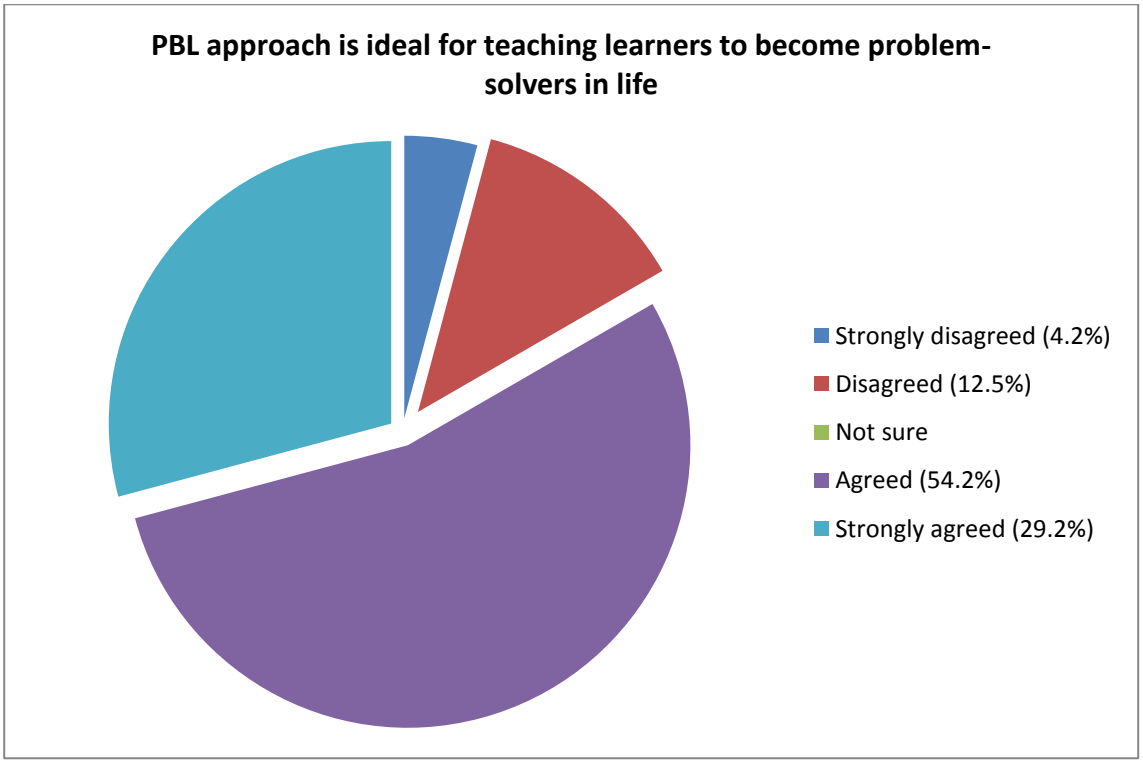


Figure 15 shows that 54.2% and 29.2% of the respondents agreed or strongly agreed that PBL is an ideal approach for teaching learners to become problem-solvers in life. The findings reflect that 83.4%

of the informants believe in PBL as an ideal approach which develops problem-solving skills in learners. PBL-proponents asserted that learners in PBL acquire both knowledge and a range of skills such as communication, teamwork, problem-solving, independent responsibility and respect for others. PBL-trained learners gain experiences such as problem-solving skills from which they will draw in future when solving problems in their real-life situations. Students who have acquired problem-solving skills will want to apply these new skills.

Such problem-solving skills will influence students when they pursue life-long learning and self-directed learning. It is important to develop problem-solving skills in learners so that they become problem-solvers throughout their lives. The reason is that learners learn science because they need to know how to thrive throughout their lives in the modern world. Kolodner *et al.* (2004) concede that students do science in order to gain skills which will help develop habits of their minds. Therefore, students are supposed to learn science in a way that allows them to put into practice solving problems and making decisions rather than just warehousing a collection of inert facts. This is in agreement with findings by Barret (2004), namely that PBL-trained learners acquire critical knowledge, problem-solving skills, self-directed learning and team participation skills.

According to Figure 15 12.5% of the respondents disagreed and 4.2% of the respondents strongly disagreed that PBL is an ideal approach for teaching learners to become problem-solvers in life. This group, in total 16.7% which still subscribes to the usage of traditional teaching/learning approaches, will need further encouragement to desist from relying on teacher-learning approaches and but to student-

centred learning approaches. A systematic PBL approach challenges students to resolve a problem similar to a real problem they will encounter in their life or career.

In conclusion, the researcher advocates for a shift in teachers' belief regarding teaching and learning through the integration and usage of engagement instructional strategies like PBL. In Swaziland teachers must incorporate important skills or abilities that are necessary for students to be effective problem-solvers, both in life and future careers. Teachers should prepare students to be effective workers and citizens.

Figure 16: Should learners sit quietly & listen in a science class?

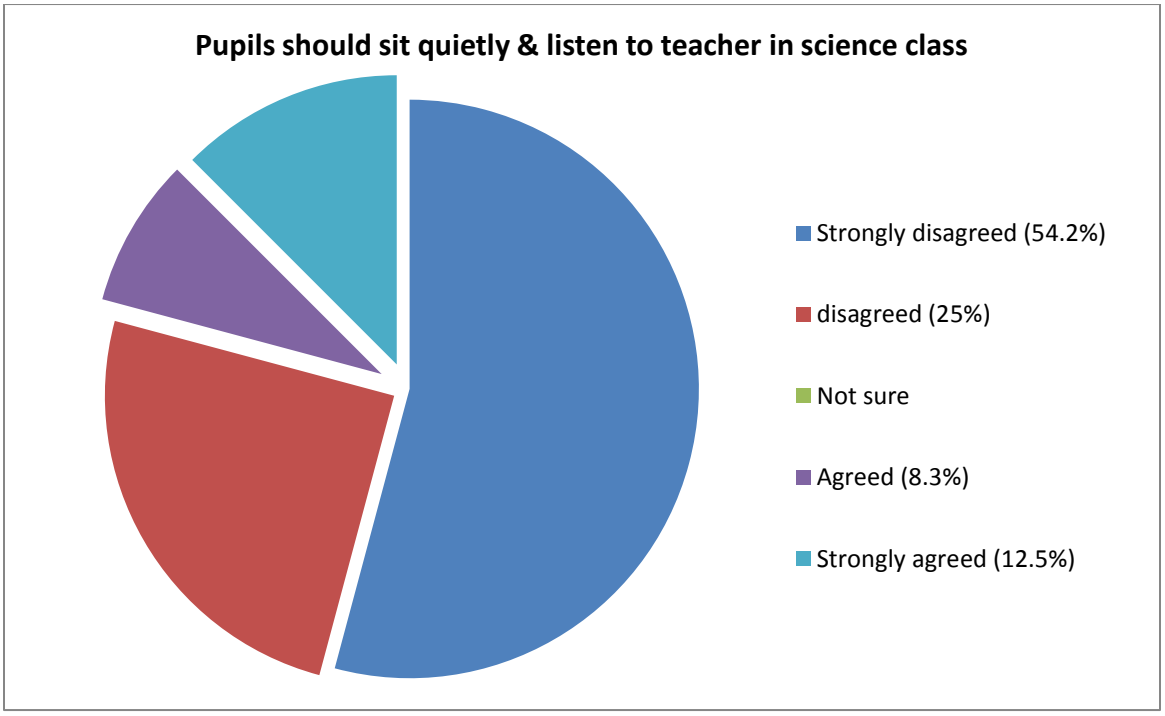


Figure 16 shows that 54.2% of the participants strongly disagreed that learners should be passive recipients of information, only coming to class to sit quietly and listen to the teacher, with 25% of the

respondents disagreeing with this approach. Hence, the respondents strongly support the use of instructional strategies like Problem-Based Learning which encourages active learner participation in class. Therefore, the teacher must change from traditional or conventional teaching which tends to consider students as passive receptors of information, without consideration of the need to actively participate in the learning process.

In the conventional approach, there is a low level of student participation, as decisions in the learning process revolve around the teachers in their privileged position as main source of knowledge. Indeed, the conventional approach is non-participatory, where students are rarely expected to ask questions or challenge the teacher's theories. The learners are warehouses of information which they cannot use anywhere; they lack cooperation skills since team work is discouraged. Figure 16 also shows that 12.5 % of the informants strongly agreed and 8.3% of the respondents agreed that science must be taught in a manner where learners are passive and the teacher is the source of information. This means that there is still a need to train or develop 20.8% of the respondents, so that they change their method, namely that of teaching like they were taught.

If properly developed and influenced they can shift from using teacher-centred learning and adopt a student-centred learning approach as per the Government's Education Policy requirements. The MoET Sector Policy (2011) encourages teachers to use student-centred learning approaches where the learners are placed at the heart of the learning process. It is time to give learners who are deprived by these conventional teachers an opportunity to guide and take charge of their own learning so that they can develop life-long and self-directed learning.

Figure 17: Should teachers cover science content using the lecture method?

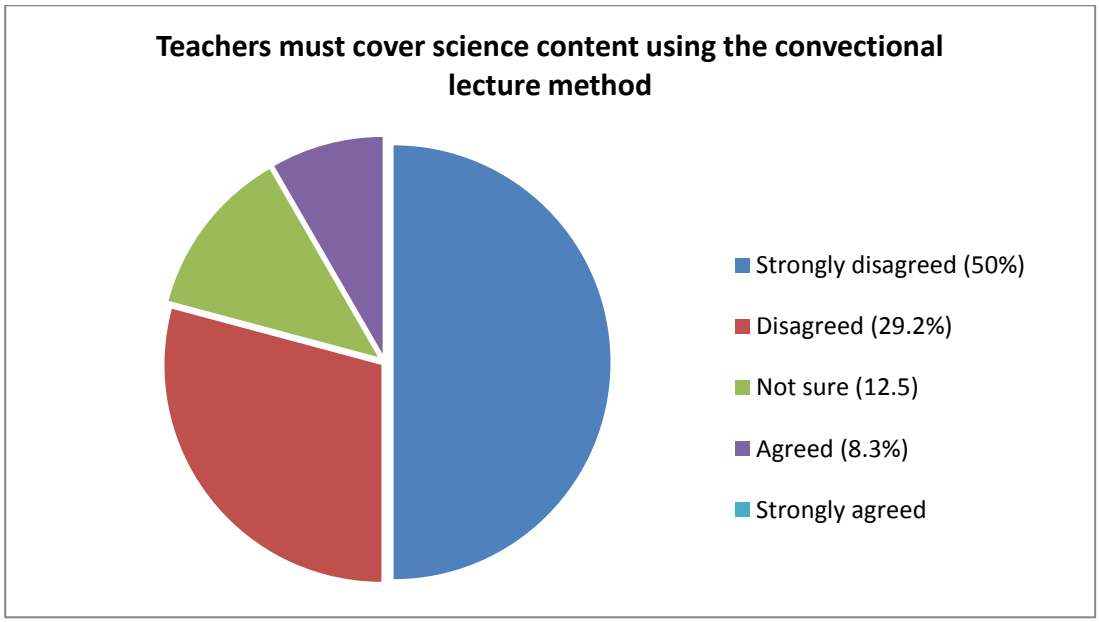


Figure 17 above shows that 50% of the participants strongly disagreed that teachers must cover science content using the conventional lectured method; 29.2% of the respondents disagreed with this statement. This result is in agreement with Azer (2009), namely that the lecture method has received criticism: it offers few opportunities to reflect on learning; it does not foster creativity or critical thinking skills, it is not motivating and it does not ensure the application of learning in practice (Ruiz-Gallardo, Castano, Gomez-Alday & Valdes, 2011). Lecturing is also not a suitable instructional method of teaching children at Primary School as young children learn more by engaging in various activities (Leach & Scott, 2000).

The very reasons why the researcher embarked on this study is because, in most schools in Swaziland, science is taught using traditional instructional approaches which are cookbook-like ready-made recipes (Llewellyn, 2005; Etherington, 2011). Figure 17 also shows that 12.5 % of the respondents were not sure and only 8.3% of them agreed to cover science content using traditional or conventional lecture methods.

Teachers tend to teach the way they were taught. Etherington (2011) & Selcuk (2010) described teachers who rely on using traditional instructional approaches as those that pay little attention in developing application skills in their learners. The traditional teaching of science does not promote higher order cognitive skills (Anderson & Anderson, Varanka, Martins, Romagnano, Bielenberg, Flory, Miera, & Whitworth, 1992; Zoller, 1993; Hackling, 2005; Ronis, 2008; Selcuk, 2010; Etherington, 2011).

According to Liu Yu (2004) these teaching strategies are mainly teacher-centred- ; learners become passive followers of the teacher's instructions and find it difficult to become critical thinkers; they work out simple standard problems and memorise facts for examination purposes only (Hackling, 2005; Etherington, 2011). According to Holbrook (2005) science has become unpopular and irrelevant to the eyes of learners (Krajcik, Mamlok & Hyg, 2001; Osborne & Collins, 2001). Learners work alone, achievement is based on routine paperwork, namely classwork, assignments, tests, final examination. In the end, learners can obtain high scores in the final examination, but may not retain new information long enough to apply it (Liu Yu 2004).

Further probing during the interviews about what the respondents' understandings of the PBL approach were showed that they knew that teachers begin a lesson by giving learners a problem. All the respondents stated that students work out solutions of the given problem in small groups. They further highlighted that the teacher only facilitates or guides in the PBL approach. The results from the respondents' interview responses showed that they described PBL according to the benefits learners obtain when trained using this approach. In such cases, the respondents would state that, in PBL, learners become problem-solvers or critical thinkers, for instance. Overall the feeling was that the

teachers had experience of the PBL approach, and understood that, in PBL, the problems stimulate learning. The data revealed that respondents described the PBL model in accordance with Hmelo-Silver's (2004) PBL format.

The interview findings also revealed that participants, when asked during the interviews whether the approach was important, indicated that the learners had acquired any of the following skills, as indicated in the PBL literature: through PBL learners become problem-solvers, critical thinkers, develop higher order cognitive skills, have creativity, collaboration and communication skills, as well as cooperative and collaboration skills. The respondents were more than ready to embark on constructive learning/teaching in accordance with the requirements of the Kingdom's education system. The main finding from this research is that respondents were receptive toward adopting the PBL approach, hence the need to remind them about some student-centred learning approaches like PBL.

4.3 The extent of using the Problem-Based Learning approach when teaching Primary School science

Figure 18: Informants responses when asked to what extent they use PBL

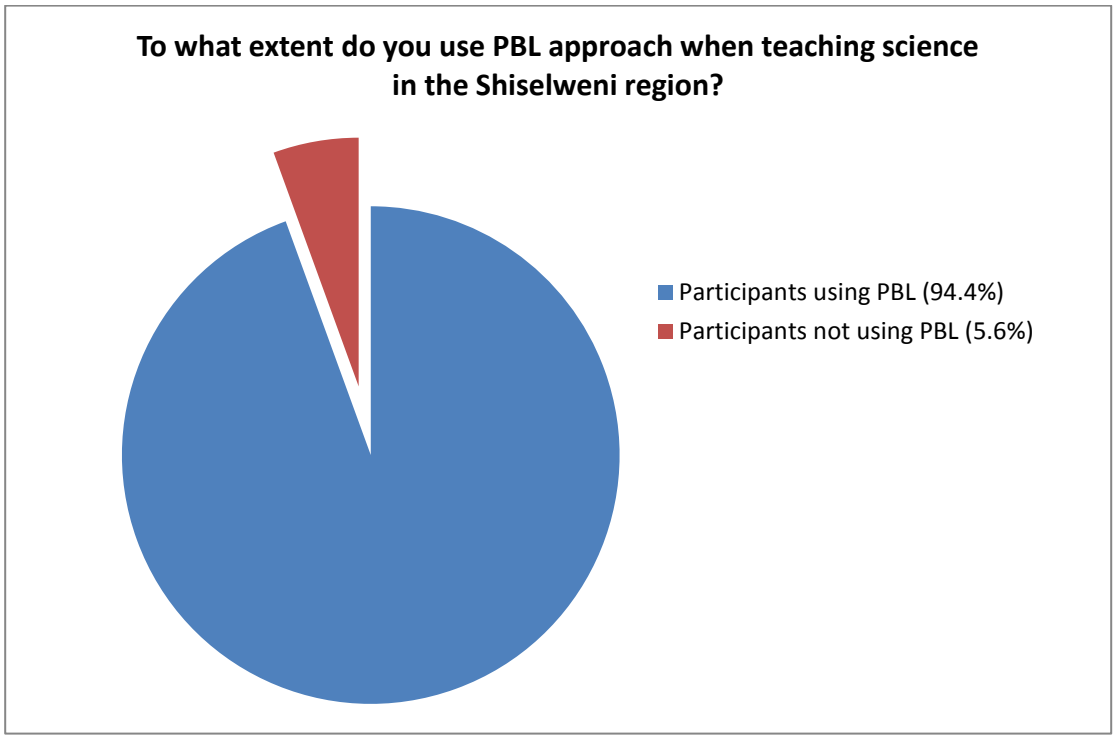


Figure 18 above shows that 94.4% of the participants suggested that they do not use PBL all the time but they use the approach in some of their lessons. They stated that it depends on the nature of the topic since the method is not always applicable. This finding is in agreement with Liu Yu (2004) who suggested that one cannot expect teachers to use PBL all the times and in every aspect of the teaching process. Most teachers lamented the fact that time was insufficient and finding extra time was strenuous. Their views were similar to those of Liu Yu (2004) who noted that time was limited and the volume of materials to be covered by the learners very large.

According to White (1996), teachers usually design problems (to be used in PBL) without fully understanding the importance of the components, or the time required or classrooms which are not user-friendly for the use of Problem-Based Learning format.

The results also show that 5.6% of the respondents stated that they never used the PBL approach. According to Barret (2004), teachers with a student-centred and learning-oriented conception of teaching tend to adopt a similar approach to teaching. Thus, if one wants teachers to adopt a student-focused approach to teaching such as PBL, one need to ensure that teachers have a similar conception of teaching.

4.4 Problem-Based Learning approach challenges

Figure 19: Respondents' answers when asked what challenges they face when using the PBL approach

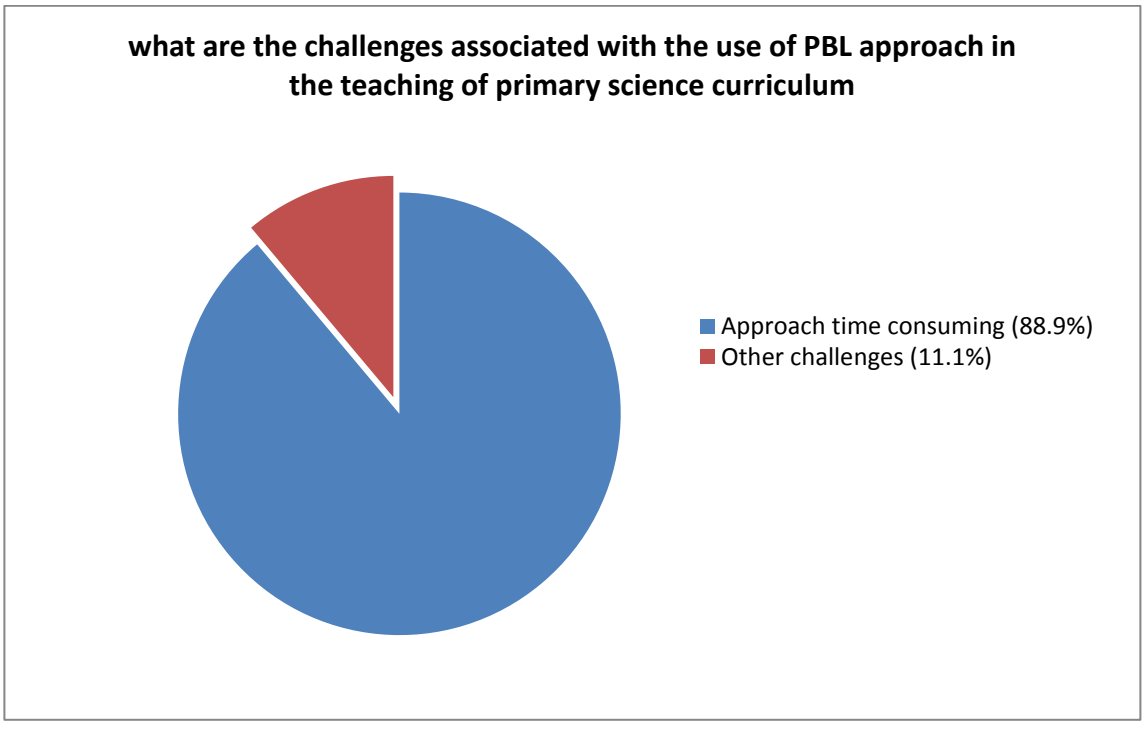


Figure 19 above reveals that 88.8% of the respondents cited time as the main challenge to the implementation of the PBL approach. The participants argued that the approach was time-consuming and time-inefficient for the time-pressurised Primary School science teachers, who have to multi-task because they even have to teach other subjects (Srinivasan, Wilkes, Stevenson, Nguyen, & Slavin, 2007). There is a feeling that the workload is too high and science lessons are restricted to two credits per week at the country's Primary Schools. Most participants also bemoaned the fact that it was difficult to find extra time for science lessons since most learners stay far away from their school.

This finding is similar to that of Srinivasan *et al.* (2007), namely that PBL detractors argue that the PBL approach is time-inefficient, frustrating for time-pressured Primary School science teachers and often leads to erroneous conclusions (Srinivasan, Wilkes, Stevenson, Nguyen & Slavin, 2007: 75). The participants also complained that slow learners find it hard to finish a given task in time. Liu Yu (2004) also lamented the fact that the PBL approach is time-consuming and new. Few participants decried that the approach is unfamiliar and new to them; therefore they feel discouraged to use the approach. Figure 19 also shows that 11.1% of the participants stated challenges like failure of students to voice out their opinion or laziness on the students' part to answer questions. Some of the participants are reluctant to visit information resource centres like the library, ICT laboratory and internet centres. The data also reveals that some of the 11.1 % stated as their challenge the existing belief that learning only takes place when learners study passively.

Among the 11.1% some respondents complained about the poor supply of teaching/learning materials in the country's rural areas, whereas still some others stated that the challenge they face when trying to construct problems and solutions the learners' cognitive level is a serious challenge on its own. These findings are the same as those of Dolmans *et al.* (2005) who discovered that designing an effective problem is not an easy task. Learners may be confronted with problems that are too well-structured, too close-ended and too simple, and all too often not realistic. In such scenarios learners are not challenged to construct knowledge actively (Dolmans, DeGrave, Wolfhagen, Van Der Vleuten, 2005: 734). The findings reflect that such problems may result in the Problem-Based Learning approach not meeting the key principles of learning. Additionally, results from literature show that the Problem-Based Learning detractors complain that there is little guarantee that learners will learn how to apply the knowledge they acquired and, more importantly, they argue that facilitators can correct learner assumptions, which usually does not happen in the Problem-Based Learning approach (Dolmans *et al.*, 2005).

According to existing literature, teachers are struggling to find practical methods to promote critical inquiry and sustainable self-directed learning. Literature reviews from different researchers has shown that, most often, Problem-Based Learning approach values are being represented more on paper, yet on practice in implementers of PBL approach fail even to provide a good evaluation conclusion at the end of the lesson (Dempsey, 2002). Sonmez, Duygu-Lee & Hyonyong (2003) quoting Jones (1996) grouped the PBL approach challenges into six categories as follows: academic achievement, amount of instructional time required, role of learners, role of teachers, appropriateness of problem, and appropriate assessment of learners' performance. Lastly, scholars decried the costs and resistance of teachers to change: These are other PBL approach challenges which have to be addressed (Smith, 1995; Dempsey, 2002; Sonmez, Duygu-Lee & Hyonyong, 2003: 3)

4.5 The impact of Problem-Based Learning approach on the learners' performance

Figure 20: PBL improves learner's performance

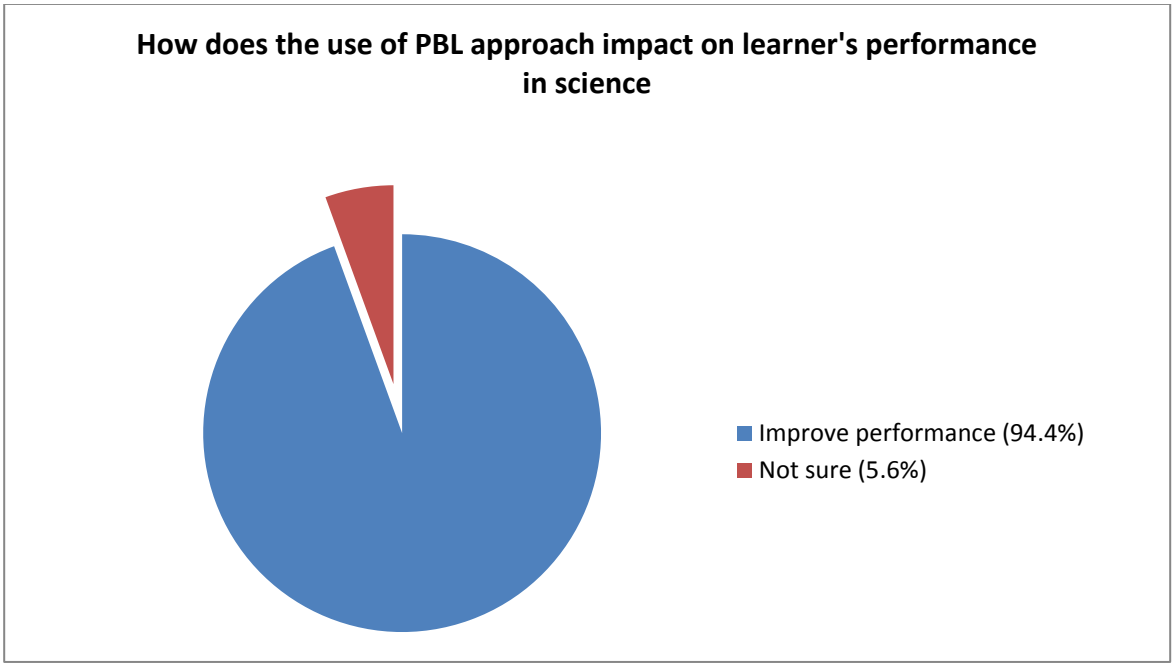


Figure 20 reveals that 94.4% of the interviewed participants believe that the PBL approach can improve learners' performance in the science lesson in Swaziland's Primary Schools. The respondents stated that the PBL approach improves the standard of learning/teaching and develops critical thinking in learners. Learners become problem-solvers, have increased retention of knowledge, increased interest and PBL encourages learners to become life-long, self-directed learners. The findings are in line with Sonmez, Duygu-Lee & Hyonyong (2003) who conceded that PBL puts more emphasis on independent learning and encourages self-directed learning, seen that a large percentage of participants agree that PBL provides opportunities for more active participation in class. Figure 20 also depicts that 5.6 % of the respondents felt that the PBL approach had no advantage. They expressed their uncertainty with regards

to whether the approach would improve learners' performance or not. The participants argued that it was challenging to conclude anything in situations where students were lazy to study.

4.6 Some of the participant's reasons why they choose the Problem-Based Learning approach

The data reveals that most participants chose the PBL approach because of its perceived advantages or values as cited in Etherington (2011): PBL encourages active learner participation in science, promotes self-directed learning, problem-solving skills, critical thinking, rediscovering of knowledge and the fact that this instructional strategy is a student-centred approach. It fosters higher order thinking skills in learners. The results show that, since the PBL approach seems to have more advantages than the traditional approaches, teachers should be taught about it through refresher courses or in-service or pre-service workshops as well as cluster meetings. The findings are similar to most of the responses suggested by interviewed teachers on how the PBL approach can be promoted in Swaziland's Primary Schools. Problem-Based Learning has the potential of preparing effective students for future learning. This is in agreement with findings by Etherington (2011), namely that PBL guides learners to useful facts and concepts that would not otherwise have been encountered. Finally, PBL helps cultivate strategic learners and problem-solvers who can work with local communities as innovators and embracers of productive and progressive education.

4.7 The higher order thinking skills developed by the Problem-Based Learning approach

When learners are active in the learning process such as what happens in PBL, they move from being passive recipients of knowledge to being active participants in activities that encompass analysis, synthesis and evaluation besides developing skills, values, and attitudes (Sivan *et al.*, 2000; Hirca, 2011). The Problem-Based Learning approach helps learners acquire and retain information, increasing

its retention, interest and motivation (Finucane *et al.*, 1998). The use of the Problem-Based Learning approach results in students' greater engagement in learning, more self-direction, and higher levels of satisfaction. Teaching through the Problem-Based Learning approach also improves reasoning skills, learning motivation and learning autonomy (Thomas, 1997; Hwang & Kim, 2005). Studies have also shown that the Problem-Based Learning approach promotes problem-solving, decision-making and judgment (Colliver, 2000). Rideout *et al.* (2002) asserted that Problem-Based Learning effectively increases knowledge acquisition, information sharing with others and improves attitudes towards skills such as critical thinking, group work, communication and other higher order thinking like comprehension, application, synthesis and evaluation in learners (White *et al.*, 1999; Rideout *et al.*, 2002).

4.9 Conclusion

The research findings reveal that Primary School teachers in Swaziland understand the Problem-Based Learning approach and have enough experience for its adoption. The findings were in agreement with the four key principles of learning (namely that learning should be constructive, contextual, self-directed and collaborative). The chapter presented all the study findings based on the informants' responses from the interviews, observations and questionnaire respectively. This chapter also includes relevant literature from various sources brought in to augment and complement the study findings. The next chapter presents the study summary, conclusion and recommendations.

CHAPTER FIVE

DISCUSSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents a summary of the research, discusses the findings and draws conclusions from the data presented in Chapter 4. It also addresses the implications of the research findings to education in Swaziland. The chapter further draws from the literature presented in Chapter two and provides a discussion for the implications for action and recommendations for further research, which can ultimately contribute towards the improvement of teachers' understandings and experiences of the Problem-Based Learning approach when teaching Primary School science in Swaziland. It is important to yet again stress the research objectives that guided the study. The study focused on

- exploring Primary School science teachers' experiences and understanding of the PBL approach.
- examining how PBL can positively impact learner's interest in science
- investigating if the PBL approach leads to the development of higher order thinking skills (HOTS).
- exploring the degree to which teachers use or fail to use PBL in their daily teaching-learning process.

5.1 Study Summary

The present dissertation is an investigation of teachers' understanding and experiences of the Problem-Based Learning approach in the teaching of science at Primary School level in Swaziland, focusing on the Shiselweni region. The Swaziland education system, primary education in particular, is facing challenges with regards to the teaching and learning of the science subject. There is a general feeling that science is difficult and hard to apply in everyday life (Ghani, 2006). Science is the most unpopular subject in Primary Schools. One of the reasons cited for this unpopularity, is that it is taught using the traditional teacher-centred instructional methods which end up consuming a lot of time (Somukawa, 2012). Hirca (2011) argues that students find learning intriguing and motivating when PBL is used as the main instructional strategy. When students are engaged in active learning, they move from being passive recipients of information to becoming active participants involved in the analysis, synthesis and evaluation of problems, besides developing skills and values (Sivan, *et al.*, 2000). To the contrary, Ipek (2007) argued that teacher-centred approaches do not give learners the opportunity to actively participate in learning and develop the necessary skills and values. Thus, learners end up hating the subject or developing a negative attitude and not majoring in physical science at the High School level because of lack of motivation. Teachers are predominantly using traditional styles of teaching which are dissatisfying and often result in:

- Low numbers of learners who pass the subject every year (Ruiz-Gallardo *et al.*, 2011).
- Massive outcry about insufficient time allocation for the subject (Somukawa, 2012).
- High numbers of failure, since learners do not attend examinations (Ruiz-Gallardo *et al.*, 2011).
- Positioning learning in accordance with the Ministry of Education and Training (MoET) of Swaziland guidelines which suggest moving the learning system to more learner-

centred approaches, thus minimising the number of learners who have a poor science background.

This motivated the researcher to embark on the present study which explored teachers' experiences and understandings of the Problem-Based Learning approach which could help minimise some of these challenges. The study findings reveal that most respondents (teachers) described Problem-Based Learning as a learner-centred instructional technique which increases learners' motivation and encourages more active learner engagement in class. The findings also reveal that all respondents strongly agreed or agreed that science must be taught using a learner-centred approach. They conceded that teaching of science must involve knowledge, skills and attitudes. The findings are similar with those of Liu Yu (2003) who stressed that the PBL approach aims at promoting learner-centred approaches, development of learners' higher order thinking skills (HOTS) and fostering of learners' social skills.

The data further reveals that teachers know at least three common characteristic principles of the Problem-Based Learning approach, namely problem, facilitator and learners working in small groups. Most of the respondents indicated that:

> In the Problem-Based Learning approach, teachers prepare a problem which learners work on. (excerpt from interview).

Some respondents described the Problem-Based Learning approach as:

> An approach in which learners are given a problem in the beginning of lesson which they solve on their own (excerpt from interview).

Other respondents stated that:

> Learners are given opportunity to come out with new information; teachers are there to guide while learners do the investigation (excerpt from interview).

The above excerpts denote that, with Problem-Based Learning, teachers must become facilitators of information, not just dispensers. In fact, 75% of the respondents stated that they found it difficult to relinquish their role as fountains of information to become facilitators. These findings indicate that teachers are still using traditional instructional approaches which are teacher-centred instead of learner-centred. There is an urgent need for teachers to use of Problem-Based Learning approaches. The respondents stated that, in the Problem-Based Learning approach, the learners enjoy working in small collaborative groups. The findings are at par with descriptions of the Problem-Based Learning approach in studies by Greenwald (2000), Taşkiran *et al.*, (2001), Parim (2002), Çuhadaroğlu *et al.* (2003), Yaman & Yalçin (2004) and Akınoğlu & Tandoğan (2006), namely that the Problem-Based Learning approach is based on three common principles namely the problem, facilitator and small group work. Teachers also stated that the Problem-Based Learning approach encourages the development of problem-solving skills in learners. In other words, while learners are working out the assigned problem and its solutions, they become problem-solvers. In fact, the learners also apply learnt scientific concepts, they do not just simply warehouse information which they will not use anywhere. For instance, one of the respondents stated that:

> In the Problem-Based Learning approach, learners get information on their own instead of the teacher spoon-feeding them; that is to say it promotes independent learning (excerpt from interview).

In the PBL approach, the skills of problem-solving, critical thinking and learning to learn are developed in learners. Human beings face various problems in their lives. It is in the nature of human beings to always try to find ways of solving these problems. In this respect, it is important for learners to be prepared for the future by facing real or real-life problems in their learning environment and producing

appropriate solutions to these problems. What is expected from education is that it enables individuals to become effective problem-solvers in their actual lives (Walker & Lofton, 2003; Chin & Chia, 2004). To learn to solve problems is to learn how to learn. The most convenient approach with regard to realising this aim in the teaching and learning environment is Problem-Based Learning taken as an aspect of active learning (Aķinoğlu, Özkardeş & Tandoğan, 2007). This emphasises on the shift from using conventional teacher-centred instructions into learner-centred instructional approaches like the Problem-Based Learning approach. Gomez-Alday & Valdes (2011) grants that the Problem-Based Learning approach is a learner-centred instructional strategy in which students learn through facilitated problem-solving, where the problem is presented to the learners as difficult. As a matter of fact, the PBL approach is a pedagogy which gives learners a platform to exercise their intellectual freedom during the teaching/learning encounter (Vardi & Ciccarelli, 2008).

All the teachers engaged in the study agreed that science should prepare learners to actively participate in life. They also agreed that science should prepare learners for independent engagement in scientific careers. These findings are in line with those of Azer (2009) namely that the approach promotes active learner participation and self-directed learning. The findings illustrate that teachers are concerned with how they can change learners' attitudes towards science in order to engage them with science careers (Minstrell and van Zee, 2000; Hirca, 2011). For this reason, Hirca (2011) suggested that students should be provided with the necessary information they need for science engagement, both in school and after school, in their life. Thus the most effective instructional strategy in science education is the Problem-Based Learning approach. Most teachers stated that PBL-trained learners become problem-solvers, critical thinkers and can apply acquired skills in solving future challenges. One of the respondents stated:

In PBL learners become critical thinkers; problem-solvers, solving problems on their own (excerpt from interview).

Hirca (2011) insists that the Problem-Based Learning approach develops effective problem-solving skills like the ability to apply appropriate meta-cognitive and reasoning strategies, and develops self-directed, life-long learning skills; learners become effective collaborators who know how to function well as part of a team (Kolodner, 2006; Serin, 2009; Hirca, 2011).

Teachers either strongly agreed or agreed that the teaching of science must generate in learners critical skills, communication, creativity and collaboration skills. These skills can easily be developed in the learners simply by teaching science using learner-centred pedagogies like Problem-Based Learning. It is an undisputable fact that learners trained using the Problem-Based Learning approach, according to Hwang & Kim (2006), learn both content and thinking strategies which assist them to acquire and retain information longer. One of the interviewees relayed that:

Swaziland desires to have such a high calibre of products who are critical thinkers, independent-minded learners and decision-makers without fear or prejudice. Therefore, such an instructional approach is more than welcomed to be used by teachers in the country and its adoption is long overdue (excerpt from interview).

5.2 How PBL can positively impact learners' interest in science

The Problem-Based Learning approach, according to the respondents, can bring great improvement in learners' performance and interest in science. One of the respondents said;

The PBL approach can improve learners' performance (excerpt from interview).

Another respondent shed more light, stating that:

> The PBL approach can improve learners' performance, since it promotes critical or logical thinking, and enables learners to solve higher order questions (excerpt from interview).

One of the respondents added:

> The PBL approach can improve learners' performance and interest in science because children learn best when another peer is assisting, they enjoy working in groups (excerpt from interview).

The teachers even suggested that PBL increases learners' intellectual capabilities since learners are given a problem to solve on their own, working in small groups. Therefore, teachers need to be encouraged to produce learners with such good attitudes and skills desired nowadays to survive in the 21st century. For the learners to become good citizens in the country, it is a prerequisite that they are scientifically literate seen the present advancement in science, technology, economy and social perspectives.

5.3 The PBL approach leads to the development of higher order thinking skills.

The respondents either strongly agreed or agreed that learners' active participation or engagement in class activities develops higher order thinking skills. Most teachers strongly agreed that science lessons must be improved and designed in a manner that promotes active interaction and sharing of experiences among group members, mainly because the PBL approach aims at promoting appropriate higher order thinking skills like problem-solving and comprehension skills, as cited by Cinar & Bayraktar (2006). Learners develop high levels of understanding of the subject by solving problems related to it (Copland, 2000). Harland (2002) proved that the PBL approach improves analysis, synthesis and life-long learning skills. The PBL approach engages problem-solvers to actively participate by giving them the responsibility of their own learning and developing problem-solving skills as well as basic skills (Cinar

& Bayraktar, 2006). According to Duch *et al.* (2001), the PBL approach motivates learners to define problems and search for concepts, and encourages cooperative learning. Therefore, PBL improves communication skills; promotes active learning and the usage of real contextual problems which learners meet in their lives. Woods (2001) added that learners in PBL work as a team or group to cope with different situations, thus improving their self-learning and self-evaluation skills and motivating learners to practice their newly acquired skills.

The approach also fosters an inclusive learning-friendly environment that can be attained through the practical knowledge and understanding of PBL, meaningful learning in context, with more encompassing and holistic applications which are needed in meeting the challenges of 21st century learning. Just as stressed by Jotia (2015), learners must be given an opportunity to embark on decision-making processes and move beyond boundaries as they seek solutions to problems. Learners must not be dehumanised by 'shutting down' the 'magic' or 'fun' that is present when learners are engaged in active learning or participation (Jotia & Boikhutso, 2015: 268).

In a nutshell, teachers suggested that the use of the Problem-Based Learning approach helps learners grasp information, understand how to use skills earned in PBL in future, when solving other problems. Ananiadou *et al.* (2009) indicate that PBL enhances learners' information gathering skills and retention; where learners' knowledge, interest and motivation are increased. This result is also in agreement Goodenough's (2005: 88) findings, which claimed that the PBL approach fosters in learners the development of range of skills such as problem-solving, critical thinking, collaborative learning, self-monitoring skills and enhanced student motivation. Şenocak (2005) with Akinoğlu and Tandoğan (2007) agreed that PBL develops learners who are critical thinkers (developing higher order thinking skills), can

merge old knowledge with new one and apply it in future (uniting theory with practice). They added that the PBL approach motivates both teachers and learners (Kalayci, 2001; Şenocak, 2005; Akinoğlu and Tandoğan, 2007). Şenocak (2005) stressed that learners develop useful skills like time management, focus, data collection, report preparation, evaluation and pave a way for lifetime learning. According to Dochy *et al.* (2003), PBL produces positive effects on learning principles that underline the application of knowledge (Gibjels, Dochy, Van den Bossche, Segers, 2005).

Moreover, studies like those of Hallinger & Lu (in press), Major & Palmer (2001), Norman & Schmidt (2000) and Smith *et al.* (2005) suggest that PBL produces a more engaging, motivational learning environment for learners, which leads to higher rates of students' retention, more rapid programme completion, and the development of more productive attitudes towards current and future learning (Colliver, 2000; Gibjels *et al.*, 2005; Hallinger & Lu, in press; Major & Palmer, 2001; Newman, 2001; Norman & Schmidt, 2000). The introduction of the PBL approach promotes critical thinking in learners, understanding, learning how to learn effectively, working collaboratively in small groups, and most importantly encourages learners to take charge of their learning, thus becoming life-long, self-directed and collaborative learners (Barrows and Tamblyn, 2006).

Finally, the usefulness of this approach in Swaziland is that it develops cooperative skills in learners which are essential for sustaining partnerships in business and in the corporate world and which the country lacks. The country's workforce also requires self-monitoring learners empowered with self-evaluation and information-gathering skills. Current advances in global communication and technology demand that learners be armed with communication skills. The PBL approach also promotes critical

thinking, problem-solving skills, and increase retention of information in learners which the country desires in its labour in order to improve in socio-scientific, economic and technological advancements.

5.4 Degree to which teachers use or fail to use PBL in their daily teaching-learning process.

According to the findings, only one teacher out of the eighteen teachers indicated that she has never used the PBL approach. The teacher cites that the PBL approach is time-consuming, yet there is so much that needs to be covered according to the syllabus. The teacher lamented that the two periods for teaching science assigned to them was not enough. However, they suggested that, if time was adequate, they would like to use the approach as it has many benefits. About 94% of the respondents voiced out that they use the approach in their lessons, though not on a daily basis. The teachers stressed that not all topics are suitable to be taught using the PBL approach. Just as Liu Yu(2004) stated, teachers cannot be expected to use PBL every time and in all aspects of teaching, especially when considering aspects like workload of teachers, content of syllabus, availability of time and the daily burden of preparing lesson plans.

In the case of Swaziland, there is a great demand for learners with critical thinking, problem-solving, cooperative and communication skills in order to have a workforce that will boost the economy. The use of this approach will help meet the country's Education Sector Policy mission, which is to promote life-long education and training, in order to enhance personal development and contribute to Swaziland's cultural development, socio-economic growth and global competitiveness (Education and Training Sector Policy, 2011).

5.5 Implications of the PBL approach in the education system in Swaziland

The study findings as well research by Anderson, Mitchel, & Osgood (2004) and Vardi Ciccarelli (2008) suggest that the PBL approach improves academic results and increases learners' interest in majoring in science subject. PBL is an effective tool that can help teachers in Swaziland fill the above-mentioned gap and the researcher's dissatisfaction with the traditional teaching style used by teachers. Therefore, the Ministry of Education and Training (MoET) in Swaziland has to encourage teachers to shift from using traditional teacher-centred instructional methods to learner-centred constructive learning styles which promote active learner participation in class (MoET Policy, 2010).

There are more benefits and advantages to this approach, as stated in Chapter two, than disadvantages. Therefore, it is undoubtedly true that the PBL approach improves in learners skills like communication, creativity; collaboration and critical thinking which are more valuable higher order cognitive skills. As suggested by Hmelo-Silver & Barrows (2006), there must be a shift in science education linking it to technological skills and societal needs to produce citizens who are able to utilise knowledge creatively in everyday life to solve problems, make decisions and improve the quality of life in Swaziland. This will ascertain that learners become more independent and ensure continuous learning.

Azer (2009) describes the PBL approach as one of the instructional methods which promote more active learner participation and development of HOTS (Higher Order Thinking Skills) in learners. PBL makes learners responsible for their own learning, it also produces more motivated learners with a deeper subject understanding, encouraging independent and collaborative learning, develops higher order cognitive skills as well as a range of transferable skills including problem-solving, group working, critical thinking, creativity, life-long learning and communication. PBL also merges well with the four

principles of effective learning which suggest learning must be constructive, contextual, collaborative, and self-directed. The goals of this approach, amongst others, are to give learners an active learning context, help learners take a deep-level approach to their learning and train them to become more independent, life-long active learners through the use of the PBL approach. Therefore, Vardi & Ciccarelli (2008) suggest a tendency to move away from teacher-centred approaches to more learner-centred approaches which promote more active learner participation during the learning process (Breton, 1999; Peterson, 1997).

Breton (1999) agrees with the idea that learners have to be responsible for their own learning construction. Maintaining the orthodox approach to teaching in today's classroom will be detrimental to the learners who are eager to embrace the new dimension of learning which can lay a base for future everyday challenges. According to Teoh, Preeechaporn (2009) there is a need to replicate in the classroom the world in which students are living. A Hebrew proverb states that teachers must not confine children to their own learning for they were born in another time. Bill Ferriter (undated) concurs that, when children of tomorrow sit in the classroom of yesterday, it is their teachers who are failing. We need to prepare students for their future, not our past (Ian Jukes educators and Futurist (undated)).
According to Epstein (2008), good teachers engage their learners in intentional teaching that are "plan-full, thoughtful, and purposeful", and that "uses their knowledge, judgment, and expertise to organize learning experiences (p. 39)".

PBL produce learners, who are well-motivated independent, effective problem-solvers, and who have a broad range of interpersonal and professional skills (Epstein, 2008). Liu Yu (2004) interjected that not only do learners have to solve the problem, but they have to find the information and other resources

they will need. He adds that learners engage in active learning, develop and test hypothesis so they can arrive at the solutions of the problems. The researcher believes that Swaziland's teachers/learners need to be introduced to a number of new ways and deep-learning strategies, one of which is PBL.

5.6 Recommendations

The respondents generally appealed to the educators and inspectors to organise refresher courses on student-centred learning approaches. The respondents further recommended that interested inspectors and educators in the MoET of Swaziland should develop teachers by educating them on student-centred learning and engagement instructional strategies like the PBL approach. They recommended the introduction of refresher courses or workshops for teachers to sharpen their skills.

The research study encourages policy-makers to adopt the use of PBL in Swaziland's education system. The research also recommends that curriculum developers in the country should consider roping in the use of the PBL approach at the Primary School, Secondary School and Tertiary Education level, more especially in teacher education institutions. Teachers cannot give what they do not have, if they have not been taught using the PBL approach.

Lastly, the researcher recommends that, in order to gain more insight on teachers' experience and understanding of the PBL approach, the study must be extended to the country's four regions to cover almost all teachers. It will also be interesting to investigate learners' opinions, including even the academically challenged learners, about the PBL approach in Swaziland.

5.7 Implications to Policy Formulation

The study findings encourage the implementation of the PBL approach at basic education level, therefore calling for teaching capacity development so that teachers acquire new or additional knowledge and skills in order to enhance their ability to identify problems, develop solutions and manage such implementation at schools. According to the Education Sector Policy (2011) capacity development in education may take many forms, but, in most cases, it is facilitated by pre-service or in-service education and training, often leading to individual and institutional developments.

The implications of these study findings is that the pre-service institutions training Primary School teachers should spearhead the use of active learner participation and promote their usage while training student-teachers. In other words, Teacher Training Colleges should encourage teachers to use learner-centred instructional strategies that develop in learners the necessary skills and values. They must also manage such programmes by monitoring teachers, even after initial training, on how they utilise learner-centred instructional strategies like the PBL approach. The in-service department should encourage teachers by organising refresher courses and workshops, empowering teachers with information on active learner-centred instructional strategies.

Therefore, there is need to revise and improve the Education and Training Sector Policy of 2011 by adding new policies that promote the use of active learner participation. The Government must also set aside finances to ascertain such implementation. This will help fulfil the Ministry of Education and Training objective of aligning itself with global, regional and national policy initiatives such as

- Enhancing the quality of education

- Meeting the responsibility to promote in learners critical thinking, analytically integrated skills, synthesising knowledge and drawing conclusions from complex materials.

According to Education 2030, the Incheon Declaration towards inclusive and equitable quality education and lifelong learning for all (2015), countries such as Swaziland need to improve the quality and relevance of education and learning by having sufficient numbers of teachers and educators of quality using learner-centred, active and collaborative pedagogical approaches. Quality education includes the development of those skills, values, attitudes and knowledge that enable citizens to lead healthy and fulfilled lives, making informed decisions and responding to local and global challenges. A focus on quality education and innovation will also require strengthening science, technology, engineering and mathematics education (STEM).

In other words, Swaziland is being challenged to empower teachers with knowledge of the PBL approach which is a learner-centred collaborative approach, promoting active learner-participation pedagogy. Therefore, the country should plan to set aside the necessary finances and resources needed to fulfil the Education 2030 vision which the country intends to pursue. The PBL approach also promotes life-long learning -another requirement that Swaziland has to meet in order to fulfil the vision of Education 2030, Incheon Declaration of 2015. Swaziland still needs to strengthen the teaching of science, technology and mathematics education (STEM), so that these subjects are taught using learner-centred pedagogies which will ensure that learners develop problem-solving skills, critical thinking, values and attitudes of scientific literacy in its citizens.

Lastly, the implementation of this approach should involve not only teachers, but also educators (in teacher training colleges) and policy-makers to make provision for the sustainability of active learner-centred approaches like the PBL approach. This will ensure that the education system is in line with the following statements extracted from the World Education Forum (WEF);

> *"This Declaration is a huge step forward. It reflects our determination to ensure that all children, young people and adults gain the knowledge and skills they need to live in dignity, to fulfil their potential and contribute to their societies as responsible global citizens. It encourages governments to provide learning opportunities through life, so that people can continue to grow and be on the right side of change. It affirms that education, a fundamental human right, is the key to global peace and sustainable development".*
>
> (Excerpt by Irina Bokova: Director-General of UNESCO)

> *"Education is the key to a better life for every child and the foundation of every strong society – but far too many children are still being left behind. To realize all our development goals, we need every child in school and learning".*
>
> (Excerpt by Anthony Lake: Executive Director, UNICEF)

5.8 Recommendations for further studies

In this study, only views or perceptions of teachers in the Shiselweni region were taken into consideration, hence there is a need to extend the study to the country's four regions in order to have the general view of all teachers' understanding and experiences of the PBL approach. Another recommendation for further study is to obtain learners' views and perceptions of the PBL approach, not only in the Shiselweni region, but in all four regions of the country. There is also a need to consider finding secondary and tertiary educators' and students' views or perceptions about their understandings and experiences of the PBL approach (active learner-centred approaches).

5.9 Concluding remarks

It is high time that teachers shift from using teacher-centred instructional approaches into using learner-centred approaches. The MoET in Swaziland and relevant stakeholders in government should be accessible to teachers and provide basic training in learner-centred approaches. The teacher-training institutes together with the University of Swaziland should involve themselves in pre-service and in-service training for teachers. These institutes must not focus on producing teachers only, but monitor them and oversee how they are induced in the country's education system. A Board regulating teachers' instructional pedagogies for active learner participation should be instituted. Additionally, the MoET and the Government of Swaziland need to review curricula and ascertain that active participation instructional methods are incorporated. Furthermore, the Government also needs to provide financial means for supporting teacher-training in the use of learner-centred approaches like PBL. Lastly, the Government should offer study loans to employed teachers so that they can follow refresher courses, especially in learner-centred approaches, otherwise they will continue to be stuck in the conservative teaching methods.

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APPENDICES

Appendix 1

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

Student Number: *214 524 364*

Date: 17 March 2014

P.O Box 474, Nhlangano, Swaziland, 0000
+268 7678 5468

Dear Shabane Ncamiso, January

ADMISSION: MASTER OF EDUCATION (Science Ed)

It gives me pleasure to inform you that you have been Accepted into a Master of Education degree, in the School of *(Education)* with effect from the *20 March 2014 – 13 December 2015* University of KwaZulu-Natal's academic year.

Please contact *(Mr. Thoba Mthembu – 031 260 3440)* regarding your registration.

Your admission as a candidate for the Masters Degree is subject to your compliance with the University rules and regulations.

Duration of Masters Degree:

- Students registering for fulltime studies will be required to register for a minimum of two consecutive semesters, and for a maximum period of six consecutive semesters.
- Students registering for part-time studies will be required to register for a minimum period of four consecutive semesters, and a maximum period of ten consecutive semesters.

Please note:

- All qualifications obtained outside South Africa require a SAQA evaluation certificate. *The application form and details can be found at http://www.saqa.org.za/.*
- Please also note that you are responsible for your own accommodation. (Please refer to the postgraduate Application guide on our website www.ukzn.ac.za, for our Housing Officer's contact details on the relevant campus.
- If you are a student from outside of South Africa, please note that it is **YOUR** responsibility to apply for a Study Visa and you may not register without this necessary document. For all further enquiries relating to your arrival at the University of KwaZulu-Natal please contact our International Student Support Officer, Mrs M.A. Marais (Tel: +27 (0)33 2605194 / Fax: +27 (0)33 2605729 or E-mail: Marais@ukzn.ac.za). (Pietermaritzburg Campus) On your arrival, after you have settled in your residence and before you register, please collect your Registration Form and take it together with your study permit and confirmation of your medical aid cover, to the relevant International Student Support Officer on your campus, for clearance to register.
- **If you are a student from outside of South Africa, please note that you MUST have proof of adequate Medical Insurance before you are allowed to register.** A letter from Administrators of your medical aid confirming that your cover extends beyond the borders of your country. If such confirmation is not forthcoming, you will be required to take an additional medical aid insurance while resident in South Africa.

School of Education
Postal Address: Private Bag X03, Ashwood, 3605, South Africa
Telephone: +27 (0)31 260 3663 **Facsimile:** +27 (0)31 260 3600 **Email:** education@ukzn.ac.za **Website:** www.ukzn.ac.za
Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville
INSPIRING GREATNESS

Appendix 2

UNIVERSITY OF KWAZULU-NATAL

This form is to be returned to the University at any of the following campuses
Edgewood, Private Bag X03, Ashwood 3605. Howard College, Durban 4041.
Medical School Private Bag 7, Congella 4013. Pietermaritzburg, Private Bag X01, Scottsville 3209
Westville, Private Bag x54001, Durban 4000

Surname: SHABANE ……**Student No**.…214 524 364……..

First Name:……NCAMISO JANUARY…….....

Degree/Diploma Programme: Masters in Science Education …By Thesis – Full Time)…**Code**: EDSE 8 SY ……

Address: P. O. Box 474 NHLANGANO……**Qual.**…METH……..

FIRM ACCEPTANCE OF OFFER – POSTGRADUATE - NO DEPOSIT REQUIRED

I, (full names) SHABANE NCAMISO J……., Identity Number …7401246100021.. accept the offer of a place for a degree/diploma. **I undertake to bind myself to the University of KwaZulu-Natal and agree to pay the University of KwaZulu-Natal, in full, all fees and other charges due and payable by me in terms of the applicable annual schedule of fees as described in the Student Fees booklet and any other miscellaneous charges.** I further agree that I am bound by the terms and conditions contained in the **Student Fees** booklet, as updated from time to time with, which I shall familiarize myself and will continue to familiarize myself.

I understand and accept that I **will not** be permitted to register, or remain a registered student, if I should default on the payment of any funds due to the University of KwaZulu-Natal. **Interest as prescribed by the National Credit Act of 2005, (currently 2% per month) will be charged on all outstanding amounts.** I further understand and accept that my registration as a student is governed by the applicable legislation, and University Rules and Regulations as amended from time to time.

Signature of Applicant: ……N.J Shabane…… Date: …24 March 2014……..

Address: ……P.O. Box 474 NHLANGANO ……SWAZILAND ……

The above address shall be my *domicilium citandi et executandi* which address I may change provided written notice is given and which will only take effect upon receipt of such notice by the Registrar via the College.

NON ACCEPTANCE OF OFFER

Student No: ……N/A……

Surname: ……N/A…… **First Name**: ……N/A……

I DO NOT accept the offer of a place in the ……N/A…… **Degree/Diploma Programme**

Please indicate with an "X" in the appropriate block your reason for not accepting the offer of a place at this University in 2013:

1 □ **Financial**
2 □ **Attending another institution**
3 □ **Personal**
4 □ **Cannot obtain Residence Accommodation**
5 □ **Other (Please specify)**
6 □ **No reason**

Signature of Applicant: ……N/A…… Date: ……N/A……

14/06/2012

Appendix 3

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

COLLEGE OF HUMANITIES:

MASTERS/PHD RESEARCH PROPOSAL AND ETHICAL CLEARANCE APPLICATION
(HUMAN AND SOCIAL SCIENCES)

PLEASE NOTE THAT THE FORM MUST BE COMPLETED IN TYPED SCRIPT. HANDWRITTEN APPLICATIONS WILL NOT BE CONSIDERED

SECTION 1: PERSONAL DETAILS

1.1 Full Name & Surname of Applicant: :___NCAMISO JANUARY SHABANE__
1.2 Title (Ms/ Mr/ Mrs/ Dr/ Professor etc :_____Mr. _____
1.3 Applicants gender : _____Male_____
1.4 Applicants Race (African/ Coloured/Indian/White/Other) : _____Swazi /African _____ _____
1.5 Student Number (where applicable) : ____4214 524 364_____ _____
Staff Number (where applicable) : _____26591_____ _____
1.6 School : __Lobamba National High___ __ _____
1.7 College : ___University of Swaziland_____
1.8 Campus : _____Kwaluseni _____
1.9 Existing Qualifications : ___Bachelor of Science + P.G.C.E.___
(Biological sciences-chemistry major)

1.10 Proposed Qualification for Project :_Masters in Education (science education)
(In the case of research of degree purposes)

2. Contact Details

Tel. No. : __0026822078466_____
Cell. No. : ___0026876785468_____
e-mail :shabanencamisojanuary@yahoo.com / shabarank1974@gmail.com
Postal address (in the case of students and external applicants) : P.O. Box 474
:_NHLANGANO_____
__Swaziland_____

Appendix 4

UNIVERSITY OF KWAZULU NATAL

COLLEGE OF HUMANITIES

SCHOOL OF EDUCATION

INTENTION TO DEFEND A PROPOSAL

SURNAME: Shabane FIRST NAME: January Ncamiso

STUDENT NO: 4214 524 364

QUALIFICATION CURRENTLY REGISTERED FOR: Masters in Education (Science Education)

NO OF SEMESTERS REGISTER: One year

TITLE OF THE PROPOSAL TO DEFEND:

PROBLEM BASED LEARNING APPROACH: Primary Science Teacher's experiences and understandings of Problem Based Learning Approach in the Shiselweni region

DATE TO DEFEND: 27 November 2014

SIGNATURE: N.J. Shabane DATE: 15 October 2014

SIGNATURE OF SUPERVISOR: DATE: 16/10/14

SIGNATURE OF CO-SUPERVISOR: DATE:

Appendix 5

UNIVERSITY OF KWAZULU-NATAL

UNIVERSITY OF KWAZULU NATAL

COLLEGE OF HUMANITIES

SCHOOL OF EDUCATION

INTENTION TO DEFEND A PROPOSAL

SURNAME: Shabane FIRST NAME: Ncamiso January

STUDENT NO: 4214524364

QUALIFICATION CURRENTLY REGISTERED FOR: Master in Science Education

NO OF SEMESTERS REGISTER: One

TITLE OF THE PROPOSAL TO DEFEND:

PROBLEM BASED LEARNING APPROACH: Primary Science Teacher's experience and understanding of Problem Based learning Approach in the Shiselweni region

DATE TO DEFEND: 19 Sept. 2015

SIGNATURE: n.j. Shabane DATE: 19 May 2015

SUPERVISOR/PROJECT LEADER/DISCIPLINE ACADEMIC LEADER

NB: PLEASE ENSURE THAT THE APPLICANT HAS COMPLETED THE ATTACHED CHECK SHEET AND THAT THE FORM IS FORWARDED TO YOUR SCHOOL RESEARCH COMMITTEE FOR FURTHER ATTENTION

DATE: 01/09/15

SIGNATURE OF SUPERVISOR/ PROJECT LEADER/DISCIPLINE LEADER

Appendix 6

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

30 November 2015

Mr Ncamiso January Shabane 26591
School of Education
Edgewood Campus

Dear Mr Shabane

Protocol reference number: HSS/1315/015M
Project Title: Problem Based Learning Approach; Primary Science teachers' experience and understanding of Problem based Learning Approach in the Shiselweni region

Full Approval – Expedited Application

In response to your application received on 17 September 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....

pp **Dr Shenuka Singh (Chair)**
Humanities & Social Sciences Research Ethics Committee

/pm

Supervisor: Professor AL Jotia
Academic Leader Research: Professor P Morojele
School Administrator: Ms T Khumalo

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

Appendix 7

NGWANE TEACHERS COLLEGE

P. O. BOX 474
NHLANGANO

TEL: +268 2078466/7
FAX: +268 2078112

04 April 2015

The REO Officer
P.O. Box 112
NHLANGANO

Dear Sir,

Re: Application for conducting PBL study with grade 5 & 6 primary teachers in the Shiselweni region

Sir, kindly allows me to conduct my research on Problem-Based Learning (PBL) approach with grade 5 & 6 primary (science) teachers here in the Shiselweni region. Please, permit me to gather their experience and understanding of PBL approach using different measuring instruments or tools including questionnaires, interviews and observe science teachers at Ngwane Practicing School.

The case study requires me to collect data from April-Oct. 2015. Please kindly allow me the opportunity to share even my knowledge of PBL with your teachers.

Thank you for your positive consideration and thank you for your support in advance.

Yours Faithfully,

N.J. Shabane
N.J shabane
Ncamiso J. Shabane

Appendix 8

MINISTRY OF EDUCATION AND TRAINING

SHISELWENI REGIONAL EDUCATION OFFICE

P O BOX 112
NHLANGANO
TEL: 22078239
22078545
FAX: 22078004

11th September 2015

Mr N.J. Shabane

Ngwane Teachers College

P.O. Box 474

Nhlangano

Dear Sir

RE: PERMISSION FOR CONDUCTING PBL STUDY WITH PRIMARY SCIENCE TEACHERS IN THE SHISELWENI REGION

The Inservice Education and Training Office do allow you to conduct your research on Problem-Based Learning (PBL) approach with Science Primary Teachers in the Shiselweni region. The office would highly appreciate if you may first assist the underperforming schools.

We hope you will cooperate with headteachers and Science teachers in respective schools.

Yours faithfully

REGIONAL EDUCATION OFFICE
SEP 2015
P.O.BOX 112
NHLANGANO - SWAZILAND

GRAHAM L. ZWANE
INSERVICE COORDINATOR

Appendix 9

P.O. Box 474
Nhlangano

6 February 2016

The Principal
Evelyn Baring Primary School
P.O. Box 47
Nhlangano

Dear Sir/Madam,

Re: Request to conduct Observation of Science Teachers during their science lesson in grade 3-7

I am Ncamiso January Shabane student No. 4214524364, am a Masters of Education Degree (Science Education) students, at the school of Education, College of Humanities, at the University of KwaZulu-Natal (UKZN), would like to request for your permission to conduct Observation of science teachers during their science lesson from grade 3 up to grade 7. The aim of this, is to explore primary science teachers' experience and understanding of problem-based learning approach in fulfillment of the research study I am conducting titled "PROBLEM-BASED LEARNING: Primary Science teachers' experience and understanding of Problem-Based Learning Approach in the Shiselweni region"

In the study I am focusing on why teachers decide to engage or not to engage in Problem-based learning and if possible find out solution to why learners perform poorly in science external examination. Through the participation of your teachers, I hope to acquire their understanding and experience of problem-based learning. I guarantee that their responses will not be identified with them personally. Their participation is voluntary, and there is no penalty if they do not participate in this study. Teachers are free to pull out of the study if they no longer desire to be part of the study.

Attached with this letter of request is approval certificate from UKZN that permit me to collect data from primary science teachers for academic purposes only. Responses will only be published in the College's journal, and other relevant journals like SAARMSTE.

Thank you for you positive support.

Yours Faithfully,
N.J. Shabane
Shabane Ncamiso January
(TSC No. 26591 Cell No. 7678 5468 Placement; Science Lecturer Ngwane College)

P.O. Box 474
Nhlangano

6 February 2016

The Principal
Mbukwane Primary School
P.O. Box 03
Mahamba

Dear Sir/Madam,

Re: Request to conduct Observation of Science Teachers during their science lesson in grade 3-7

I am Ncamiso January Shabane student No. 4214524364, am a Masters of Education Degree (Science Education) students, at the school of Education, College of Humanities, at the University of KwaZulu-Natal (UKZN), would like to request for your permission to conduct Observation of science teachers during their science lesson from grade 3 up to grade 7. The aim of this, is to explore primary science teachers' experience and understanding of problem-based learning approach in fulfillment of the research study I am conducting titled "PROBLEM-BASED LEARNING: Primary Science teachers' experience and understanding of Problem-Based Learning Approach in the Shiselweni region"

In the study I am focusing on why teachers decide to engage or not to engage in Problem-based learning and if possible find out solution to why learners perform poorly in science external examination. Through the participation of your teachers, I hope to acquire their understanding and experience of problem-based learning. I guarantee that their responses will not be identified with them personally. Their participation is voluntary, and there is no penalty if they do not participate in this study. Teachers are free to pull out of the study if they no longer desire to be part of the study.

Attached with this letter of request is approval certificate from UKZN that permit me to collect data from primary science teachers for academic purposes only. Responses will only be published in the College's journal, and other relevant journals like SAARMSTE.

Thank you for you positive support.

Yours Faithfully,
N.J. Shabane
Shabane Ncamiso January
(TSC No. 26591 Cell No. 7678 5468 Placement; Science Lecturer Ngwane College)

P.O. Box 474
Nhlangano

6 February 2016

The Principal
Nyamane Primary School
P.O. Box 131
Nhlangano

Dear Sir/Madam,

Re: Request to conduct Observation of Science Teachers during their science lesson in grade 3-7

I am Ncamiso January Shabane student No. 4214524364, am a Masters of Education Degree (Science Education) students, at the school of Education, College of Humanities, at the University of KwaZulu-Natal (UKZN), would like to request for your permission to conduct Observation of science teachers during their science lesson from grade 3 up to grade 7. The aim of this, is to explore primary science teachers' experience and understanding of problem-based learning approach in fulfillment of the research study I am conducting titled "PROBLEM-BASED LEARNING: Primary Science teachers' experience and understanding of Problem-Based Learning Approach in the Shiselweni region".

In the study I am focusing on why teachers decide to engage or not to engage in Problem-based learning and if possible find out solution to why learners perform poorly in science external examination. Through the participation of your teachers, I hope to acquire their understanding and experience of problem-based learning. I guarantee that their responses will not be identified with them personally. Their participation is voluntary, and there is no penalty if they do not participate in this study. Teachers are free to pull out of the study if they no longer desire to be part of the study.

Attached with this letter of request is approval certificate from UKZN that permit me to collect data from primary science teachers for academic purposes only. Responses will only be published in the College's journal, and other relevant journals like SAARMSTE.

Thank you for you positive support.

Yours Faithfully,
N.J. Shabane
Shabane Ncamiso January
(TSC No. 26591 Cell No. 7678 5468 Placement; Science Lecturer Ngwane College)

P.O. Box 474
Nhlangano

6 February 2016

The Principal
Nsongweni Primary School
P.O. Box
Nhlangano

Dear Sir/Madam,

Re: Request to conduct Observation of Science Teachers during their science lesson in grade 3-7

I am Ncamiso January Shabane student No. 4214524364, am a Masters of Education Degree (Science Education) students, at the school of Education, College of Humanities, at the University of KwaZulu Natal (UKZN), would like to request for your permission to conduct Observation of science teachers during their science lesson from grade 3 up to grade 7. The aim of this, is to explore primary science teachers' experience and understanding of problem-based learning approach in fulfillment of the research study I am conducting titled "PROBLEM-BASED LEARNING: Primary Science teachers' experience and understanding of Problem-Based Learning Approach in the Shiselweni region".

In the study I am focusing on why teachers decide to engage or not to engage in Problem-based learning and if possible find out solution to why learners perform poorly in science external examination. Through the participation of your teachers, I hope to acquire their understanding and experience of problem-based learning. I guarantee that their responses will not be identified with them personally. Their participation is voluntary, and there is no penalty if they do not participate in this study. Teachers are free to pull out of the study if they no longer desire to be part of the study.

Attached with this letter of request is approval certificate from UKZN that permit me to collect data from primary science teachers for academic purposes only. Responses will only be published in the College's journal, and other relevant journals like SAARMSTE.

Thank you for you positive support.

Yours Faithfully,
N.J. Shabane
Shabane Ncamiso January
(TSC No. 26591 Cell No. 7678 5468 Placement; Science Lecturer Ngwane College)

P.O. Box 474
Nhlangano

6 February 2016

The Principal
Ngwane Practicing Primary School
P.O. Box 792
Nhlangano

Dear Sir/Madam,

Re: Request to conduct Observation of Science Teachers during their science lesson in grade 3-7

I am Ncamiso January Shabane student No. 4214524364, am a Masters of Education Degree (Science Education) students, at the school of Education, College of Humanities, at the University of KwaZulu Natal (UKZN), would like to request for your permission to conduct Observation of science teachers during their science lesson from grade 3 up to grade 7. The aim of this, is to explore primary science teachers' experience and understanding of problem-based learning approach in fulfillment of the research study I am conducting titled "PROBLEM-BASED LEARNING: Primary Science teachers' experience and understanding of Problem-Based Learning Approach in the Shiselweni region".

In the study I am focusing on why teachers decide to engage or not to engage in Problem-based learning and if possible find out solution to why learners perform poorly in science external examination. Through the participation of your teachers, I hope to acquire their understanding and experience of problem-based learning. I guarantee that their responses will not be identified with them personally. Their participation is voluntary, and there is no penalty if they do not participate in this study. Teachers are free to pull out of the study if they no longer desire to be part of the study.

Attached with this letter of request is approval certificate from UKZN that permit me to collect data from primary science teachers for academic purposes only. Responses will only be published in the College's journal, and other relevant journals like SAARMSTE.

Thank you for you positive support.

Yours Faithfully,
N.J. Shabane
Shabane Ncamiso January
(TSC No. 26591 Cell No. 7678 5468 Placement; Science Lecturer Ngwane College)

P.O. Box 474
Nhlangano

6 February 2016

The Principal
Nhlangano Central Primary School
P.O. Box 39
Nhlangano

Dear Sir/Madam,

Re: Request to conduct Observation of Science Teachers during their science lesson in grade 3-7

I am Ncamiso January Shabane student No. 4214524364, am a Masters of Education Degree (Science Education) students, at the school of Education, College of Humanities, at the University of KwaZulu Natal (UKZN), would like to request for your permission to conduct Observation of science teachers during their science lesson from grade 3 up to grade 7. The aim of this, is to explore primary science teachers' experience and understanding of problem-based learning approach in fulfillment of the research study I am conducting titled "PROBLEM-BASED LEARNING: Primary Science teachers' experience and understanding of Problem-Based Learning Approach in the Shiselweni region"

In the study I am focusing on why teachers decide to engage or not to engage in Problem-based learning and if possible find out solution to why learners perform poorly in science external examination. Through the participation of your teachers, I hope to acquire their understanding and experience of problem-based learning. I guarantee that their responses will not be identified with them personally. Their participation is voluntary, and there is no penalty if they do not participate in this study. Teachers are free to pull out of the study if they no longer desire to be part of the study.

Attached with this letter of request is approval certificate from UKZN that permit me to collect data from primary science teachers for academic purposes only. Responses will only be published in the College's journal, and other relevant journals like SAARMSTE.

Thank you for you positive support.

Yours Faithfully,
N.J. Shabane
Shabane Ncamiso January
(TSC No. 26591 Cell No. 7678 5468 Placement; Science Lecturer Ngwane College)

Appendix 10

DECLARATION OF CONSENT (FOR PARTICIPANTS)

PROBLEM-BASED LEARNING: Primary Science Teacher's experiences and understandings of Problem Based Learning Approach in the Shiselweni region

RESEARCHER
Full Name: Ncamiso January Shabane
School: School of Education
College: College of Humanities
Campus: Westville
Proposed Qualification: Med (Science Education)
Contact: +268 7678 5468
Email: shabanencamisojanuary@yahoo.com

SUPERVISOR
Full Name of Supervisor: Prof. A. L. Jotia
School: School of Education
College: College of Humanities
Campus: Westville
Contact details: +267 3555 2368
Email: agreementjotia@yahoo.com

HSSREC RESEARCH OFFICE
Full Name: Prem Mohun
HSS Research Office
Govan Bheki Building
Westville Campus
Contact: 0312604557
Email: mohunp@ukzn.ac.za

I, Ncamiso January Shabane, Student No. 4214524364 am a Masters of Education Degree (Science Education) student, at the School of Education, college of Humanities, at the University of KwaZulu Natal, would like to invite you to participate in a research project entitled: ***Primary Science Teachers' experience and understanding of problem-based learning approach in the Shiselweni region***. The aim of the study is to explore primary science teachers' experience and understanding of problem-based learning approach in the Shiselweni region of Swaziland. Focusing on why teachers choose to engage or not to engage in problem-based learning approach and finding out solutions to why learners performed poorly in primary science examination.

Through your participation, I hope to acquire your understand and experience of problem-based learning approach. I guarantee that your responses will not be identified with you personally. Your participation is voluntary and there is no penalty if you do not participate in the study. Please sign on the dotted line to show that you have read and understood the contents of this letter. The questionnaire will take approximate 15 minutes to complete.

DECLARATION OF CONSENT

I…… (Full Name)

hereby confirm that I have read and understand the contents of this letter and the nature of the research project has been clearly defined prior to participating in this research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

Participants Signature……

Date…….

Appendix 11

First: **Questionnaire: for primary science teachers' understanding and experience of PBL approach in the Shiselweni district:**

Instructions:
Thank you for filling in the questionnaire. Please, tick one box. Help us by being honest and sincere when answering the questions below;

1. Pupils should sit quietly & listen to the teacher in a science class.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

2. Science should prepare learners to actively participate in life.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

3. Science should prepare learners for independent engagement in career skills.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

4. Pupils learn best through experience and active engagement.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

5. Science promotes learners to become problem-solvers.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

6. Science must generate communication, critical thinking, collaboration and creativity skills.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

7. Teachers must cover science content using the conventional lecture method in Primary School level.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

8. Problem-based learning approach is ideal for teaching learners to become problem solvers in life.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

9. Teachers find it difficult to change from being the fountain of knowledge to facilitators in the teaching-learning process.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

10. Science must be taught using a learner centered approach.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

11. Current primary science syllabus needs to be changed to instill the use of learner centered teaching strategies like problem-based learning approach.

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

12. In Primary Schools the teaching of science must involve:

☐	☐	☐	☐	☐
just knowledge	knowledge and skills	just skills	skills and attitudes	knowledge, skills, attitudes

13. As a primary science teacher do you use problem-based learning approach in your lesson?

☐	☐	☐	☐	☐
strongly disagree	disagree	not sure	agree	strongly agree

14. What advantages does using a PBL approach have for teaching primary science?

……
……
……
……

Appendix 12

Interview questions; for Primary Science teachers' understanding and experience of problem based learning approach in the Shiselweni district.

1. What is your understanding of problem based learning (PBL) approach?
2. To what extent do you use PBL approach when teaching primary science in the Shiselweni region?
3. Is problem-based learning of crucial importance in the primary science curriculum? Please explain. What are the challenges associated with the use of problem based learning approach in the teaching of primary science curriculum?
4. How do you promote PBL approach in your science lesson?
5. How does the use of problem-based learning approach impact learner's performance in science?
6. Why will you make PBL approach your choice of teaching instructional strategy in your future lessons?
7. Will you decide to change your daily instructional teaching strategy to PBL approach? Why?

Appendix 13

Evaluation form for participant (teacher)

Name of school ……Participant: (tick) teacher ☐ / Learner ☐ Name of constituents:…….Form of settlement: urban ☐ semi-urban ☐ rural ☐ Gender: male ☐ female ☐

Please answer each of the following statements by ticking in the space in table below if you: Strongly agree (4), if you agree (3), disagree (2) and strongly disagree (1)

	Participants' responses regarding the statements below:	**4**	**3**	**2**	**1**
1.	My teaching/learning has improved after taking part in the research.				
2.	I have developed a deeper understanding of the subject matter.				
3.	I have become sensitive to use learner-centred teaching approaches.				
4.	The research has contributed to learners' needs & teacher's professional development.				
5.	The study has improved my understanding of PBL approach				
6.	I have learnt a better way to teach lessons				
7.	I have learn that it is important to provide activities that encourage learners to gain Higher order thinking Skills (HOTS)				
8.	Experience and knowledge about PBL, I gained is very valuable and important to make me a better learner/teacher.				
9.	I learnt a better way to teach				
10.	I will change my instructional strategy after PBL study				
11.	I will plan to engage learners in more hand on, mind on and active learning activities.				
12.	It is important to provide activities that encourage students to think critically and creatively.				
13.	Students can recall and apply what they have already learnt				
14.	Willingness to facilitate learning and relinquish position of being source of learning.				
15.	Problem given by teacher and learner's striving to solve it.				
16.	Teacher walks around, observes and helps children solves given problems.				
17.	The learners develop collaborative and communication skills.				
18.	Learners are made to experience the wonder and joy of learning.				

Turn it in Originality Report

Good afternoon Prof.

I ran the thesis you sent this morning "Primary Science Teachers' Experience and Understanding of Problem Based Learning Approach in the Shiselweni Region"

through *SafeAssign*, chapter by chapter, and the results are as follows:

Chapter	Matching percentage	Interpretation
Chapter 1	5%	No evidence of plagiarism
Chapter 2	3%	No evidence of plagiarism
Chapter 3	6%	No evidence of plagiarism
Chapter 4	5%	No evidence of plagiarism
Chapter 5	1%	No evidence of plagiarism

According to this there is no evidence of plagiarism in all the chapters because their matching percentages are all below 15%.

Thank you.

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*Without goals, and plans to reach them, you are like a ship that has set sail with no destination. -**Fitzhugh Dodson***

From: Jotia, Agreement I. (Prof.)
Sent: 02 February 2017 08:54 AM
To: Motshegwe M.M (Dr.)
Subject: RE: Thesis for Plagiarism Check

Turn it in Editor's Letter

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2 March 2017

University of KwaZulu-Natal

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Science, Mathematics and Technology

To Whom It May Concern:

This letter serves to confirm that I, Karen Ferreira-Meyers, have edited Mr. Ncamiso January Shabane's MA thesis entitled *Primary Science Teachers' Experience and Understanding of the Problem-Based Learning Approch in the Shiselweni Region*.

My work consisted in language-editing the thesis.

Signature :

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