TRANSFORMATIONAL LEARNING OF PHYSICAL SCIENCE THROUGH SERVICE LEARNING FOR SUSTAINABILITY

by

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(B.Sc. Ed, B.Ed., M.Ed.)

Thesis submitted in fulfillment of the requirements for the degree

Philosophiae Doctor in Education

(Ph.D. Education)

in the

SCHOOL OF EDUCATION STUDIES

FACULTY OF EDUCATION

at the

UNIVERSITY OF THE FREE STATE

BLOEMFONTEIN

JUNE 2013

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DECLARATION

This is to declare that the study hereby submitted for the Philosophiae Doctor degree in the field of Education Research and Management in the Faculty of Education, University of Free State, is my own independent work. Where help has been sought it has been acknowledged. I further declare that this work is submitted for the first time for a qualification at this university and that it was never submitted at any other university or at another faculty at this university. I also hereby cede copyright of this work to the University of the Free State

TLALI MOEKETSI FREDDIE **DATE**

DEDICATION

I dedicate this study to all people who contributed directly and indirectly towards making this study possible and a success it was. It would not have been possible for me alone without their support and prayers especially given the serious challenges we experienced during the period of this study. A special word of appreciation and thanksgiving goes to my wife Mmakamohelo and our children Relebohile, Thato and ReOrapetse; to my brother Mohanoe and his wife Mathato for being there for us.

ACKNOWLEDGEMENTS

I thank the Almighty God for having graced me with health, wisdom, strength and courage to go through the study.

I express my sincere appreciation and gratitude to all people who contributed directly and indirectly towards the success of this study:

- thanks to my promoter, Professor Mahlomaholo MG and co-promoter Dr. Khabanyane – the SULE and SURELEC teams for their expert advices and guidance, the patience, encouragement and interest they showed and gave me throughout the research.

- A special word of appreciation and thanks giving to Dr. Andrew Graham, for having meticulously edited this work.

- the financial assistance by my sponsors the National Research Fund (NRF) was also pivotal in enabling the completion of this work.

- the Principal, School Management Team, Teachers and learners at Ahanang Secondary school for their contributions and engagement in the study. A special word of thanks to the coordinating team members: Messers. Mokoko, M.S.; Mphosi, T.; Kabi S.J.; and Mesdames Thabane, N and Dikoko, M as well as my grades 10 & 11 classes of 2011 and 2012.

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LIST OF ACRONYMS

ANC	**:**	African National Congress
CDA	**:**	Critical Discourse Analysis
CER	**:**	Critical Emancipatory Research
CHESP	**:**	Community-Higher Education-Service Partnerships
CPA	**:**	Critical Participatory Action
FAI	**:**	Free Attitude Interview
FET	**:**	Further Education and Training band
KXP	**:**	Kwaxuma Partnerships
NCS	**:**	National Curriculum Statement
PAR	**:**	Participatory Action Research
PEST	**:**	Political, Economic, Social and Technological
QUT	**:**	Queensland University Technology
RSA	**:**	Republic of South Africa
SGB	**:**	School Governing Body
SULE	**:**	Sustainable Learning Environments
SURELEC	**:**	Sustainable Rural Learning Ecologies
SWOT	**:**	Strengths, Weaknesses, Opportunities and Threats
UFS	**:**	University of Free State
FSDoE	**:**	Free State Department of Education
GET	**:**	General Education and Training Band (Grades 7–9)
FET	**:**	Further Education and Training Band (Grades 10-12)

SUMMARY

This participatory action research, conducted within the critical emancipatory theoretical framework, formulates a strategy to transform the learning of Physical Science such that it is sustainable. The mode of teaching in many schools currently, including the one where the study is conducted, is mainly teacher centred, traditional and not emphasising on making knowledge functional and transferable. This is a challenge to transformation of the learning of Physical Science such that it is more learner-centred, in keeping with the best practices internationally. This need requires teaching to emphasise knowledge which is responsive to real life needs of the learner and his/her community. In this study I identify and formulate the transformational strategy that is grounded in the use of service learning. This requires learners to provide a service to the community in response to its real life problems. This is in turn based on the theme(s) they are expected to learn as provided for in the Physical Science curriculum statement. I also show the importance of understanding circumstantial factors that make the service learning based strategy to work effectively. I identify potential risks and threats that could distract the strategy from its intended goals. I also show how to incorporate ways of anticipating and responding to them in the strategy itself. Finally the strategy is implemented to ascertain its applicability. This helps to find out whether it leads to sustained and better learning of Physical Science.

Critical emancipatory research (CER) couches this study as a theoretical framework. Thus I illustrate how CER could assist the study to achieve its five objectives, namely; to explore the need for a transformational service learning strategy to make the learning of Physical Science sustainable, to explore what other strategies have been formulated before to transform the learning of Physical Science as envisaged, to understand circumstantial factors making the study to be successful as well as to implement the strategy to find out if it brings about the desired positive changes in the learning of Physical Science.

Critical emancipatory research is also used as the perspective from which I define and understand important operational concepts in the study. From this perspective I then reviewed relevant and related literature which assisted me to develop constructs in order to make sense of the empirical data. This review included looking at best practices relating to making the learning of Physical Science to be sustainable, starting from South Africa, the Southern African Development Community (SADEC), the African continent and internationally.

I then followed the participatory action research methods and designs to collect data. For analysis I used Van Dijk's socio-cognitive discourse analytic procedures. This enabled me to operationalise the theory of critical emancipatory research. For instance, the participants were involved from the beginning through the various phases and steps of the study until its conclusion. Accordingly, I was the facilitator while the participants were co-researchers who drove and owned the research process. This was done in accordance with the theory that argues that people who have the problem are the same people who have the solution. As a researcher, I merely created appropriate contexts for the participants to discover and use the power they have to transform the teaching of Physical Science. As the outcome of this study the strategy entails; establishing a team; encouraging team members' democratic and respectful reflections on the aim of their working together, through brain storming and information sessions; embracing practices that encourage them to contribute and debate issues as equals. These interactions led to the emergence of the vision and strategic plan detailing all priorities with the relevant and respective activities.

KEY CONCEPTS

Transformational Learning

Service Learning

Physical Science

Sustainability

Emancipation

Empowerment

Participatory Action

Community Cultural Wealth

Sustainable Empowering Learning Environments

Critical Emancipatory Research

OPSOMMING

Hierdie deelnemende aksie-navorsingstudie, gedoen binne die raamwerk van die kritiese emansipatoriese teorie, formuleer ’n strategie om die aanleer van Fisiese Wetenskap te verander ten einde volhoubaarheid te bereik. Tans is die wyse van onderrig in baie skole, asook die skool waar die studie uitgevoer is, hoofsaaklik onderwyser-gerig, tradisioneel en nie gefokus om die kennis funksioneel en oordraagbaar te maak nie. Dit is ‘n uitdaging om die aanleer van Fisiese Wetenskap so te verander dat dit meer leerder-gesentreerd is, en terselfdertyd tred hou met die beste internasionale praktyke. Hierdie behoefte vereis onderrig om kennis wat vatbaar is vir die werklike lewensbenodigdhede van die leerder en sy/haar gemeenskap, te beklemtoon. In hierdie studie identifiseer en formuleer ek ‘n verandering-strategie deur gebruik te maak van diensleer. Dit vereis van leerders om, in antwoord op werklike probleme in die gemeenskap, ‘n diens aan die gemeenskap te lewer. Dit is natuurlik ook gebaseer op die onderwerp(e) wat hulle veronderstel is om te leer soos voorgeskryf in die Fisiese Wetenskap-kurrikulumverklaring. Ek toon ook aan hoe belangrik dit is om omstandigheidsfaktore in ag te neem ten einde die diensleer-strategie effektief te benut. Ek identifiseer potensiële risiko’s en gevare wat kan verhoed dat die studie sy bepaalde doelwitte bereik. Verder toon ek ook werkwyses aan om die voorkoming van en reaksie op hierdie risiko’s en gevare te integreer. Laastens word die strategie geïmplementeer ten einde die toepaslikheid daarvan te bepaal. Dit sal ook aandui of dit wel lei tot volgehoue en effektiewe aanleer van Fisiese Wetenskap.

Die teoretiese raamwerk wat hierdie studie ondersteun is kritiese emansipatoriese navorsing (KEN). Derhalwe dui ek aan hoe KEN hierdie studie help om die volgende vyf doelwitte te bereik, nl. om ‘n behoeftebepaling te doen t.o.v. ‘n veranderende diensleer-strategie om die aanleer van Fisiese Wetenskap volhoubaar te maak, ondersoek in te stel na ander strategieë wat voorheen geformuleer is om die aanleer

van Fisiese Wetenskap te verander, die omstandigheidsfaktore wat die studie suksesvol maak te verstaan, asook die implementering van die strategie om te bepaal of die verlangde positiewe veranderinge in die aanleer van Fisiese Wetenskappe bereik is.

Kritiese emansipatoriese navorsing is ook gebruik as die perspektief van waaruit ek die belangrike operasionele konsepte in die studie definieer en verstaan. Vervolgens het ek vanuit hierdie perspektief relevante en verwante literatuur bestudeer wat my in staat gestel het om werkwyses te ontwikkel ten einde die empiriese data te verstaan. Hierdie studie sluit ook 'n ondersoek in na die beste praktyke om die aanleer van Fisiese Wetenskappe volhoubaar te maak, met Suid Afrika as vertrekpunt, asook die Suider Afrikaanse Ontwikkelingsgemeenskap, die Afrika kontinent en ook op internasionale vlak.

Vervolgens het ek die deelnemende aksie-navorsingsmetodes en -ontwerpe gebruik om data te versamel. Ek het Van Dijk se sosio-kognitiewe diskoers-analitiese prosedures gebruik ten opsigte van die analise. Dit het my in staat gestel om die kritiese emansipatoriese navorsingsteorie in werking te stel. Die deelnemers was van die begin van die studie af betrokke, asook tydens al die fases tot aan die einde toe 'n gevolgtrekking gemaak is. Ek het opgetree as die fasiliteerder terwyl die deelnemers opgetree het as mede-navorsers wat die navorsingsproses gedryf en eienaarskap geneem het daarvan. Dit is gedoen in ooreenstemming met die teorie dat die persone met die probleem, ook die persone met die oplossing vir die probleem is. As 'n navorser het ek slegs geskikte kontekste geskep wat deur die deelnemers ontdek moes word en waarvoor hulle die mag waaroor hulle beskik moes gebruik om die onderrig van Fisiese Wetenskap te verander. Die uitkomste van die studie het die volgende strategie aangewys: stel 'n span saam; moedig spanlede se demokratiese en gerespekteerde sienswyses ten opsigte van die doel van die samewerking, deur middel van breinstorm- en inligtingsessies aan; verwys na praktyke wat hulle sal aanmoedig om bydraes te lewer en oor sekere sake as gelykes te debatteer. Hierdie interaksies het gelei tot die totstandkoming van die visie en strategiese plan insluitend 'n gedetailleerde uiteensetting van al die prioriteite ten opsigte van die relevante en onderskeie aktiwiteite.

BELANGRIKE KONSEPTE

Veranderende Leer

Diensleer

Fisiese Wetenskap

Volhoubaarheid

Emansipasie

Bemagtiging

Deelnemende aksie

Gemeenskaps-kulturele rykdom

Volhoubare bemagtigingde leeromgewings

Kritiese emansipatoriese navorsing

CHAPTER 1

ORIENTATION AND BACKGROUND

1.1 INTRODUCTION

This study seeks to formulate a strategy to use service learning to transform the learning of Physical Science such that it is sustainable. This chapter introduces this initiative with a brief background to contextualise the problem statement. It also provides brief outlines of the study design, methodology, and tools and techniques used for data analysis.

1.2 BACKGROUND TO THE STUDY

Physical Science inculcates the comprehension of the nature of relationships that exist among the myriad features of physical environments. According to the South African Department of Education (DBE, 2011b:4), the main purpose is to ensure that people interact meaningfully and usefully with the physical environment. The meaningfulness and usefulness lie in ensuring that the learning of Physical Science is related to the learners' backgrounds (Biesta, 2010:43-45; Koosimile, 2004:483-496; Mahlomaholo, 2010:11-10; Otote & Omo-Ojugo, 2008:654); addresses their community needs and problems; and is collaborative (Rocha-Schmid, 2010:357; Servage, 2008:65-73). Science should thus be taught through strategies that are learning-oriented (Kenworthy U'Ren, 2007:818); learner-centred (see chapter 2 paragraph 2.5.10; chapter 4 paragraph 4.2.10); self-directed and problem-based (Rocha-Schmid, 2010:355). They should be facilitated through "sustainable empowering learning environments" (Mahlomaholo, 2010:11-12), which are lacking in the area of this study and so form the basis and focus of this project. The effects of these are poor learner performance in Physical Science; apparent lack of enthusiasm to learn Physical Science; and disparities traceable to social justice oriented teaching and learning practices.

Critical analysis of teaching and learning strategies for Physical Science are required, and there is an urgent need to change them. The fundamental understanding of the reasons for studying Physical Science is often taken for granted and restricted to theory (Killen, 2010:14). It disregards the socio-cultural realities of, for instance, African learners (Mahlomaholo, 2012:49; Yosso, 2005:77-81) for whom the subject matter appears complicated and abstract.

Killen (2010:14) contends that “we study science so that we can understand the physical world around us [but] science is not a process of finding facts but of constructing and testing theories”. Idowu (2011:139), on the other hand, contends that “the integrated science curriculum is child-centered and emphasis is laid more on learning science as a process than as a body of knowledge. Learning science as a process is not a common practice in teaching science in Nigeria”. This argument is based on the principal reasons of commencement of integrated science, namely that “science itself is not fragmentary”. Unless such concepts as ‘to understand’, ‘constructing theories’, and ‘testing theories’ incorporate useful practical interactions with the environment they remain fundamentally theoretical and divorce science from other aspects and features of the environment and contexts, in turn influencing the usefulness of science to learners and the community. Science that evolves from this understanding perpetuates the status quo (Mahlomaholo, 2012:56-58; Perold, Patel, Carapinha & Mohamed, n.d.:62) at the expense of meaningful practice, and is rendered not only irrelevant to the demands of the time (Parker, Myers, Higgins, Oddsson, Price & Gould, 2009:586-587,592) but also de-motivating and difficult to comprehend. To address this, Salleh (2004:5) recommends that the scope of science extend into socio-ethical-moral dimensions. Members of society are expected to be scientifically literate.

Natural science is highly fragmented (Idowu, 2011:139), with continued perpetuation of this fragmentation and value-free characterisation. This is designed to make sense of complex relationships amongst myriad features of the physical world, but in the process those who purport to understand the relationships or fragments bring in their own cultures and value systems. They are unavoidable and intrinsic, and connected to the inescapable power relations in these environments. Scholars, teachers, researchers and proponents of constructed theories include their own assumptions, contestations and contradictions, further abstracting scientific knowledge. Such absurdities then affect the teaching and learning process.

The performance of Physical Science experiments to elucidate principles and theories is imperative, as it enhances the learner’s ability to apply them to their real life situations and address needs and problems. There are, however, indications of significant numbers of underprepared and socially inactive high school Physical Science graduates. There are also indications of a lack of practical skills, indicative of a gap between experiments performed in the laboratories and what happens in real life situations. It is necessary to create sustainable learning environments to demystify and reverse the abstraction of scientific knowledge. In addition, science itself is not fragmentary, but rather, as developments in modern science have shown, interdisciplinary in nature (Idowu, 2011:137). It is therefore necessary to acknowledge this and reverse trends of specialisation and compartmentalisation.

1.3 PROBLEM STATEMENT

If the teaching and learning of Physical Science in high schools is too abstract and academic it is because it is not related to the learners’ real life situations or their community’s cultural wealth (Mahlomaholo, 2012:49; Yosso, 2005:77-81). If it disregards the learners’ everyday problems and needs it should be challenged because the learners and educators require different capabilities for work, citizenship and self-sustainability (Chaka & Ramothea, 2010:137). Teaching and learning of Physical Science is confined to the often under-resourced classroom and laboratory and so limits comprehension of concepts and knowledge. Incomprehensible abstractions are produced, as opposed to meaningful and useful scientific knowledge (Akiri & Ugborugbo, 2009:107; Biesta, 2010:54; Department of Basic Education, 2011b:4). This impedes the achievement of the envisaged purposes of interacting with and using the environment responsibly and with care. This needs attention, especially during the early developmental stages of learners.

1.3.1 Research Question

Against the above background, the study thus poses the question:

- How can service learning be used to transform the learning of Physical Science such that the learning of Physical Science is sustainable?

The response to this question relates to teaching and learning strategies that should help learners to address their real life needs and problems, while at the same time enhancing their affective and cognitive development.

1.3.2 The aim and objectives of the study

The study aims to use service learning to transform the learning of Physical Science such that it is sustainable. This is to be achieved through the development and implementation of service learning to transform the learning of Physical Science such that it is sustainable. Service learning, as mostly used in institutions of higher learning in the Republic of South Africa (RSA), has proven successful, but community service in the high school has no clear framework or model in the curriculum (Hatcher & Erasmus, 2008: 49-51; Perold *et al.*, n.d.:62). There is therefore a need to broaden the service learning application to high schools and consider the democratisation of society through the inculcation of principles of social justice. In order to achieve this, the aim is broken down into objectives.

The objectives are to organise the empirical data so as to refute or confirm the knowledge and information obtained from the literature. This is done by identifying the constructs and aspects that represent simple low level actions and activities that render them measurable, achievable, realistic and time-bound. The study will demonstrate a need to change Physical Science teaching approaches to achieve the following: (i) to transform the learning thereof; (ii) to identify key aspects that are critical to enhancing the desired change; (iii) to outline and describe the conditions that should prevail in order for the new strategy to function optimally; (iv) to anticipate potential risks and threats that might hamper the operationalisation and functioning of the strategy; and (v) to provide evidence that the strategy is not only theoretical, but also practical.

1.3.2.1 The need for the use of service learning to transform the learning of Physical Science such that it is sustainable

The study's first objective demonstrates and justifies the need for the use of service learning to transform the learning of Physical Science such that it is sustainable. This is approached by revealing disparities between the preferred teaching and learning strategies and the use of service learning as a transformational learning strategy. The issues and constructs that are considered and for which the disparities are revealed in this study, are: the public mandates as expressed in the teaching and learning related legislative imperatives; mediation efforts and mechanisms for transformation; contextual strategic collaborations; a vision for transformation; strategic partnership; reflective moments; collaborative learning opportunities; and learning facilitation through sustainable empowering learning environments.

The study uses the socio-cognitive model of critical discourse analysis (CDA) (Van Dijk, 2008:85-87; Sheyholislami, 2009:4), which provides an opportunity to transcend the boundaries of the school. It engages the community and most importantly gives voice to the apparently subjugated views and perspectives of the parents and learners (Hickling-Hudson, 2006:5; Stein & Mankowski, 2004:23; Steinberg & Kincheloe, 2010:145). Also, the interactions between and among the participants, namely parents, learners and teachers, receive special attention pursuant to improving and building relationships of mutual trust and respect (Rocha-Schmid, 2010:355; Steinberg & Kincheloe, 2010:142-143). These relationships are intended to foster and inculcate a sense of belonging and ownership of the study by the participants, and to support the principles of freedom, equity, peace, social justice and hope (DBE, 2011b:4-5; Mahlomaholo & Netshandama, 2012:43).

Another critical issue of concern to the teaching and learning of Physical Science is the promotion of practices that encourage a balance between depletion/use and replenishment of the physical environment (DBE, 2011a:4). This balance is not to compromise either the addressing of real life needs or academic rigor but to ensure sustainability. However, observations of immediate physical environments indicate social practices (Liasidou, 2008:487) the results of which are inconsistent with social justice (DePalma, 2010: 220-221; Hertz-Lazarowitz, 2010:271; Mertens, 2010:23; Roschelle, Turpin & Elias, 2000:840). They also impinge on the freedom of other citizens, as for example reflected in scores of water pollution and waste of water as a resource and the illegal dumping of solid waste.

If the teaching and learning of Physical Science curriculum theory were to be balanced with learners' real life environments these practices might change. Each school and therefore community would thus contribute meaningfully and usefully towards sustainability.

1.3.2.2 Components of the strategy to use service learning to transform the learning of Physical Science

The components of the strategy to use service learning to transform the learning of Physical Science are closely connected to needs identified, thus helping to address the prevalent disparities and achieve their objectives. The study discusses the mutual inclusivity and integrated character of the learning environments that Physical Science teachers should comprehend and make comprehensible to the learners. This may not be achieved unless broken down into smaller related fragments (Idowu, 2011:136-137), and as far as practicably possible maintain the mutual inclusivity or integration (Gboku & Modise, 2008:322; Koosimile, 2004:490). This is where the challenge lies for this study.

This second objective is about the identification of the components that make up the structure of transformational learning through service learning strategy for high schools. These components are discussed separately for purposes of comprehension and are not to be conceived of as constructs in contestation with each other. They are all critical to the makeup of the strategy, particularly to the transformational learning through service learning strategy, with mutually beneficial connections between and amongst the components of service learning and transformational learning, as well as critical emancipatory research. This study argues that people cannot be separated from their cultures, thoughts, ideologies, and power relations. There is synergy between these components and critical participatory action, and hence with the study design and methodology.

The data in respect of each component is analysed, interpreted and made sense of (de Beaugrande, 2006:31-32,38; Laisidou, 2008:486-489), and for purposes of this study the following are considered as the components of the transformational learning through service learning strategy: teacher's role and planning (thoughtfully-organised experiences); structured time for reflection; active participation; extended learning opportunities; focus on community needs and school-community coordination; academic curriculum integration; opportunities for application of skills and knowledge; and development of a sense of caring for others. This is a complex and sensitive area and understandably needs special conditions in which to thrive.

1.3.2.3 Conditions conducive to the use of service learning to transform the learning of Physical Science

This third objective seeks to identify conditions that should be prevalent for the strategy to work optimally, namely: supporting (democratic) policy imperatives; democratisation of teaching and learning of Physical Science, through optimal utilisation of resources; enhancing learners' motivational levels; enhancing school-community coordination; and optimal utilisation of resources. Democracy fundamentally makes room for people to contribute towards their own development (Swantz, 2008:33-34), and in its early stages or during its evolution, new ideas and practices are tried out. This creates space for the implementation of democratic teaching and learning strategies, such as transformational learning through service learning strategy.

Service learning has influenced and encouraged students to rely on their respective resilience, and familial or aspirational capital (Mahlomaholo, 2012:52-54; Parker *et al*., 2009:592; Yosso, 2005:79-80) to overcome challenges to transformation. It is implementable and successful in bringing universities to work in partnership with communities to address their respective real needs and problems (Arenas, Bosworth & Kwandayi, 2006:27; Bringle & Hatcher; 2009:39; Hatcher & Erasmus, 2008:56; Kenworthy U'Ren, 2007:818-819). This happened despite resistance and contestation between academics regarding the use of service learning in institutions of higher learning (Hatcher & Erasmus, 2008:50; Steinberg & Kincheloe, 2010:148). The contestations were politically motivated in that the country's universities were called upon to politically transform their practice of working as ivory towers (Arenas *et al*., 2006:30; Hatcher & Erasmus, 2008: 55; Thomson, Smith-Tolken, Naidoo & Bringle, 2010:221,225). They were isolated from their respective communities and society.

Service learning thrived despite the prevalence of disparities in the co-called Community-Higher Education-Service Partnerships (CHESP) (Hatcher & Erasmus, 2008:50-51; Kenworthy U'Ren, 2007:818; Thomson *et al*., 2010:228-229). Service learning embraces the creation of emancipatory knowledge (Parker *et al*., 2009:592) in pursuit of social transformation (DBE, 2011b:4). It befits principles of critical participatory action research principles and is versatile and multifaceted (Kemmis, 2008:127-128).

The schools are still marred by historic scarcity of resources, notwithstanding the possibilities of continuation of practices such as those that either contribute to this scarcity or worsen it. These may be considered as the legitimisation of education resources depletion, as those that existed were neither maintained nor upgraded, as was the case with the school considered in this study. The study further establishes and/or confirms the scarcity of resources for Physical Science teaching and learning, by deconstructing the notion of confining it to the class and the laboratory. A critical investigation of the learners' real life problem areas and needs in their immediate physical environment unravel opportunities for learning while at the same time addressing them. The connections between these and the curriculum and assessment protocol are established, so instead of complaining about resources that are not forthcoming, effective learning can continue.

Service learning counteracted the wide socio-economic gaps that existed between community organisations in the collaboration and cooperation required for social transformation, and forged much needed closer working relations (Bringle & Hatcher, 2009: 38; Kenworthy U'Ren, 2007:816-817). The study thus explores how to use this capacity to foster collaborative learning and teaching within the school, at micro level, and between school and the community, at macro level (Tudge, Mokrova, Hatfield & Karnik, 2009:6; Van Dijk, 2008:87-88). This is intended to contribute to the transformation of the learning of Physical Science by bridging the gap between the school and other public institutions, such as the local municipality, to make it sustainable.

Firstly, focus on community and school needs is realisable, hence the coordination between the two is achievable. Secondly, opportunities for application of learners' attained skills and knowledge are created, in addition to those found in the public services provided by the municipality. Thirdly, academic integration with real life needs, which is between service and learning of curriculum content, is realised. The services that are provided relate to the various themes and concepts in the Physical Science curriculum. This connection is non-existent and there exist gaps between community-based social development organisations and schools, thus necessitating the use of service learning to transform the learning of Physical Science. There are, however, inescapable risks and threats that have to be considered and planned for.

1.3.2.4 The threats and risks for the use of service learning to transform the learning of Physical Science

Five identified risks that relate to this study are: i) conceptual and ii) financial; or related to iii) teaching and learning, iv) power; and v) evaluation.

The **conceptual issues** revolve around "lack of training and misunderstanding of the importance" (Arenas *et al*., 2006:33-34) and the use of service learning to transform the learning of Physical Science. This study thus argues that to be effective, "teachers require not only strong academic background, but also expertise in subject pedagogy knowledge, pedagogy and classroom management" (Tatto, 2006:238). Hickling-Hudson (2006:2) adopts a postcolonial perspective to make sense of their interactions, supposedly a challenge for the learning and teaching of Physical Science (Idowu, 2010:140; Salleh, 2004:10). Evidently, this problem cannot be left with teachers alone, but rather requires a partnership with various stakeholders and partners. The study argues for cooperation and collaboration at school level, which is the micro level, and supports the establishment of similar collaborative efforts at macro level. It involves working with different schools; between schools and teacher training institutions; and with social, public and community-based development organisations and institutions (DBE, 2011b:5).

The inherent power relations struggles in these structures need to be balanced, and there are inescapable ideological and political struggles (de Beaugrande, 2006:42-45:) inherent between provision of service and learning processes. Depending on the influence of the interests and beliefs of the powerful person/s in these engagements, there may be leaning towards one end. Another critical issue that needs to be considered is whether ‘balance’ means ‘equality’, especially with respect to ‘service’ and ‘learning.’ Often, this is controlled by the ‘power of the purse’, and by extension, the political power tends to direct and determine the preferred side of the continuum (Arenas *et al*., 2006:27-28, 30; Thomson *et al*., 2010:225).

Service learning is reported in the literature as **financially expensive** (Arenas *et al*., 2006:34; Parker *et al.*, 2009:593). This could arguably be described as a ‘myth’ because such expenses do not consider the long-term cost implications associated with social injustice and lack of social transformation incurred through uncritical and rote learning strategies. This in turn leads to people considering the easy and inexpensive route, the effects of which over time prove otherwise. Social injustice results from ignorance of social responsibility (Arenas *et al.*, 2006:25-27), with literature recording many Physical Science learners who do not perform as well as expected (Akiri & Ugborugbo, 2009:108; Alexander, Van Wyk, Jaftha & Nkoane, 2010:304; Mahlomaholo, 2012:46). There is also a decline in enrolment of learners in Physical Science as a result of a perceived negative attitude towards the subject amongst learners (Asikhia, 2010:229; Salleh, 2004:8). Accessing some of the service points is expensive today but the rewards later may be overwhelming. When the strategy to use service learning to transform the learning of Physical Science is used, finances are often required for travelling, catering as well as for materials needed to develop models and or learning support material. This is an inherent risk that needs to be mitigated but it depends on the teachers’ knowledge and creativity as well as commitment.

As indicated above, the **role of the teacher** is critical in the development and use of service learning to transform the learning of Physical Science, therefore it is imperative to have teacher preparation programmes that sufficiently prepare them for this (Arenas *et al*., 2006:25-27; Hickling-Hudson, 2006:2; Koosimile, 2004:492-493; Rocha-Schmid, 2010:356-357; Salleh, 2004:10; Tatto, 2006:237-238). The teacher should act and serve as a mediator (Kellner 2000:3; Rocha-Schmid, 2010:345) for the use of service learning to transform the learning of Physical Science, and so have a thorough understanding of postcolonial perspectives in order to be able to facilitate processes of transformation. This would inevitably enhance choice and use of teaching and learning strategies that can help learners to develop critical thinking and relevant social skills. Teachers would identify and use power relations struggles and diverse experiences and backgrounds of learners to the benefit of learning, thus giving voice to the excluded and marginalised. Thus, the role played by the teacher is critical and unless it is given the necessary respect it could be detrimental to the achievement of shared vision.

Contestations for differences in **power and power relations** (Thomson *et al*., 2010:231) amongst stakeholders distracts from teaching and learning processes. These are inherent in situations involving teachers and learners and may be triggered by viewpoints on an issue related to the work at hand. Acceptance of one person's view and disregard for that of another may create negative tension. Other ways through which power differentials may be induced include administrative or positional power as well as financial power (Van Dijk. 2008:). There has to be a way in which differentials in power are dealt with for it not to affect teaching and learning negatively. It nonetheless remains a risk for the use of service learning to transform the learning of Physical Science.

The study coordinating team identified partners and participants as a risk under power differential issues. The participants in this study were learners, parents, teachers, community members, and the local municipality. These participants were identified to strengthen the position of the team and the study in addressing such potential risks as financial and pedagogical issues. Furthermore, the issues pertaining to diversity, lack of supportive involvement and roles to be played by each participant, were also addressed (see Annexures CT 4 A & B).

As there are other strategies that could be confused with service learning, it is critical to **evaluate** the strategies used and how they were applied. In this study this happens on two levels: i) the assessments of learners to establish the extent to which service learning strategy helped them achieve outcomes; ii) to evaluate the process itself. The latter is intended to improve the strategy for optimum benefits for learners.

Learners give feedback on how they have experienced the use of service learning strategy, and this serves as input for further enhancement of the strategy.

The evaluation focuses on both the service and the learning components, and helps to address the question of balance as opposed to equality between service and learning. The coordinating team identified risks for the different aspects of the study and catered for them under the study's risk assessment plan (see Annexures CT 4 A & B). The different aspects are the learners' site visits and the community-based service learning centre. The risk assessment plan is part of the study's comprehensive plan, according to which its functionality is monitored.

1.3.2.5 Evidence of applicability of the strategy to use service learning to transform the learning of Physical Science

An example used for the **context** for the use of service learning to transform the learning of Physical Science strategy was potable water care and management. This is a service that the local municipality is obliged to provide to the public in terms of the law (Constitution Act 108 section 152) in the Republic of South Africa (RSA) (RSA 1996a, s152). The challenges to the provision of this service are immense, and include water scarcity; provision of potable water quality; water loss through the networks; and pollution. The provision of this service affords the study a plethora of learning opportunities under the different themes of Physical Science: matter and material; chemical change; chemical systems (water cycles); mechanics (mechanical energy and gravity) and electricity. This context is accessible to learners and the problems and needs to be addressed are better experienced by learners and the community in general.

The overall **purpose** of the use of service learning has been covered succinctly under the study research aim, and the service learning project(s) given learners as part of their formal assessment clarified. The purpose covers both the social and technical aspects in line with the curriculum and the demands of the service component. The purpose of the site visit to the waste water treatment plant was not necessarily the same as that of preventing water loss, however, both converge as the same purpose: to address a real life need or problem and at the same time learn curriculum content related to it.

The above purpose is achieved with participants who have a keen interest in learning and teaching Physical Science. These are **embedded in the use of service learning** to transform the learning of Physical Science. In this case the participants were representatives of the parents and school governance; the municipality through the environmental health practitioner; the DoE through the school management and governance official; the school through the head of the department of Natural Sciences and Mathematics, as well as the Physical Science teacher. These participants constituted the study coordinating team. The Grade 10 Physical Science learners were also participants. Other stakeholders who participated by invitation were a project management unit manager; a waste water treatment plant operator as well as parents.

In order to avoid confusion, each of the participants had specific and **clear roles.** The study coordinating team members were coordinators of curriculum, service provision, governance and management, public participation and service learning. Other roles included development of worksheets, consideration of projects to be assigned to learners, and monitoring the study's progress. The team had an overall oversight role through its performance contract. Learner participants' roles included completion of work sheets and conducting the service learning research project. Others, such as the project management unit manager, made presentations to learners whilst the plant operator(s) explained the purification process.

In order to curb potential power differential issues amongst the study coordinating team members the team developed and signed a **performance charter** (see Annexure CT 1). The study aim was used as the team's major goal (Roschelle, Turpin & Elias, 2000:840) and **vision** and objectives as its **mission** (Bringle & Hatcher, 2009:42). This helped the team to focus on issues that mattered most, and each of the objectives had a set of activities that facilitated its attainment. Also included in the performance contract was a schedule of meetings that the team members committed to attend and through which their contributions were recorded.

Each of the five study objectives served as an **outcome** to be achieved, enabling the study coordinating team to organise data accordingly, and for ease of analysis at a later stage. These outcomes formed part of the comprehensive study plan and were crucial in tracking its progress (see Annexure CT 3). They also enhanced the data collection processes through the free attitude interview (FAI) principles of the broad main question, exploring and clarifying questions fundamentally about the objectives and their constructs, hence these outcomes and their respective activities/tasks.

At the service-learning-project level, the outcomes relate to and cover both the curriculum issues and the service issues. For instance, in the ‘water loss identification and plugging’ project, learners ultimately served by ensuring that the leakages were plugged. These had social benefits of water preservation and curbing pollution in cases of waste, developing as social responsibility activities in pursuit of social justice and social transformation (Roschelle *et al*., 2000:840-843). The curriculum-related outcomes, on the other hand, revolved around chemical changes, for instance, the chemical reactions that take place during the purification of waste water, and which help minimise or address air pollution. Each theme has associated outcomes to which the service learning project is related (Bringle & Hatcher, 2009:42-43). The **tangible products** developed through the study by the coordinating team, with the help and support of teachers and learners, included: comprehensive study plan; learners’ study teams guidelines and monitoring tool; worksheets; standard practical investigation report format; and transformational learning through service learning project.

The study further argues that there should be thorough planning for the use of service learning to transform the learning of Physical Science. It thus suggests the development of a **comprehensive plan** that comprises an operations strategy (performance charter, Annexure CT 1); risk assessment plan (Annexure CT 3); implementation plan (Annexure CT 2); reflection; monitoring; and evaluation. The plan is used to organise collected data and thus to track progress. Its outputs, derived from the five study objectives, help the study to use the limited time at its disposal profitably. It also enhances effective deployment of skills available to the study by allocating such to respective objectives and activities.

A performance contract involving learner participants was informal and unwritten, used to ensure that engagements were relaxed, promoted mutual trust and free of suspicion. Learners engaged with members of the community where there were water losses and/or waste water leakages. They first made contact, introduced themselves and their study to the affected person's premises, and negotiated or asked for permission to work in their areas. They sought support from parents and other people to negotiate where necessary. The learners' collaborative learning was formalised into learners' study teams. As the study progressed, the learners, the parents and the teachers, together with the coordinating team, kept a record of the practices and suggestions of the participants that later informed and devolved into **guidelines and monitoring tool**.

Service learning is multifaceted and collaborative. It is the product of engagements with learners and teachers, and it is enhanced through interaction with parents. The learners' team coordinators and parents team supervisors' workshop clarified some of its aspects further. This contributed to its improvement and its user-friendliness. These experiences were shared with the school management and governance official to influence cooperation amongst the schools (see Annexures CT 8 & 9).

In order to focus the field work on learning and service the study developed and used **worksheets**, as recommended by Bringle and Hatcher (2009:45), for "more authentic forms of evidence such as learners' products or responses to structured narrative reflection prompt, that capture student learning". Thus, four worksheets (Annexure CT 5) were developed, covering ethical issues and asking learners questions based on scientific principles and concepts under the different themes of the curriculum. The other questions are related to social responsibility (Arenas *et al*., 2006:26-27) as well as encouraging learners to think critically (Roschelle, Turpin & Elias, 2000:843). The study coordinating team established that the worksheets could be improved based on the learners' interpretation thereof. The learners' focus on the work is maximised by their working on the answers.

The **practical investigations and experiments** were conducted as far as practicable to enhance the understanding of Physical Science concepts and principles, which had not been the case prior to this intervention. Since the inception of the study, the practical investigations were also made in such a way that learners could relate them to their immediate (local) environments. Subsequent to their understanding of the concepts and Physical Science principles they could apply them to other contexts, in accordance with the 'spiral approach' that follows from the simple and known to the complex and the unknown (Idowu, 2011:138). This was in line with the provisions of the curriculum and on this basis the team and affected teachers scrutinised and adopted the attached standard practical investigation report format (Annexure CT 7). It was discussed with learners for clarifications purposes, after which they used it to compile their practical investigations reports.

Furthermore, learners identified scientific principles involved or used in the transportation of waste water from households to waste water treatment sites. They also identified scientific principles involved in the purification or treatment of waste water or potable water, possible challenges and how they could address them. This also provided some learning experiences for the teacher (Kenworthy U'Ren, 2007: 818; Koosimile, 2004:490; Rocha-Schmid, 2010:356-357), in the same way as the other products (Annexure CT 6).

The mutual learning process was enhanced through **reflective** sessions, as the learner participants discussed their experiences of the provision of water services prior to and after the site visit to the waste water treatment site. The coordinating team members had sessions similar to those of the learners' study teams, putting into practice, commenting about and writing their views on the study as a whole. The coordinating team members also had time to reflect about the study and the transformational learning through service learning strategy.

In addition to the reflective moments discussed above, the study explored the **assessment** of the impact of the use of service learning to transform the learning of Physical Science. The issue is that a lack of assessment tends to blur the boundaries between the use of service learning and other strategies that are often confused with it. The assessment includes other curriculum-related aspects, such as learners' practical investigations and examinations, and tests which constitute learners' formal assessments (see Annexure CT 7).

In summary, the research problem is multi-dimensional, multifaceted and complex. It may therefore not be addressed adequately by one person, but rather requires the engagement of other partners and stakeholders, including teachers, learners, education resources provider(s), the DoE and members of the community. At this stage it is befitting to outline the literature review in view of the myriad issues mentioned above. These include the appropriate theoretical and conceptual frameworks and the engagement of stakeholders from diverse situational backgrounds. The stakeholders bring to this study their power struggles and power relations, as well as their diverse cultural and ideological underpinnings of the view of life and learning in particular (Donald, Lazarus & Lolwana, 2010:15-16, 28).

1.4. LITERATURE REVIEW

Chapter 2 is dedicated to reviewing the literature, and developing an appropriate theoretical framework in which to situate this study on service learning and transformational learning of Physical Science. This section briefly outlines the framework and theories on which it is constructed.

1.4.1 Theoretical framework

This study is not a-theoretical but influenced by a study coordinator and mediator who is not neutral or objective in pursuit of the transformation of teaching and learning of Physical Science. The study coordinating team members' profiles and those of learner participants presuppose a similar profile. Our aim of transformation of Physical Science is based on sustainable empowering learning environments that respect learners' backgrounds, prior knowledge and experiences. These are the Physical Science learning environments that embrace learning-oriented partnerships (Kenworthy U'Ren, 2007:818), characterised by problem-based, learner-centred (Niemi, 2002:763-765), self-directed and cooperative learning (Mahlomaholo, 2010:11). The impediments include, but are not limited to, curriculum and policy-related challenges; teachers' preparation programmes; and constraining power and power relations amongst and between parents and teachers, and between teachers and learners. These will be discussed in detail in Chapters 2 and 3.

1.4.1.1 Critical emancipatory research

The views expressed by the people affected by the problem at hand, as well as their resultant actions and solutions thereto, are unavoidably subjective. The study advances an argument for the choice of critical emancipatory research (CER) as an appropriate theoretical framework for this study. CER may take one or a combination of its four formats: critical race theory, critical feminist theory, postcolonial and critical ethnography. The critical race theory format is more appropriate when power and power relations are defined more along racial lines, whilst a critical feminist format is assumed when power and power relations contestations are predominantly gender-related. In instances where ideological and political power is central, CER takes the postcolonial format. For communicative spaces such as those experienced in this research, where there are possibilities of prevalence of these variant formats of power and power relations, CER assumes the critical ethnographic format. This enables CER to be flexible to accommodate the diverse power relation issues.

The convergence or synergy between the study and CER, to be discussed further in Chapter 2, relate to centrality of praxis towards democratisation and demystification of knowledge creation and processes; the subjective nature of reality and truth; accommodation of diversity; collaboration with the affected partners; firm location of researcher in the context of research; as well as the values of trust, respect (Mahlomaholo & Netshandama, 2012:38), humility, care (Arenas *et al*., 2006:27) and trust (Dominiquez, 2008:4; Steinberg & Kincheloe, 2010:142-143). The argument for the choice of CER as a suitable framework involves a discussion of the four main theoretical frameworks: positivism, interpretive (phenomenology), postmodernism and critical theory, then relates CER to the study by integrating it with the explication of the research question, the aim and objectives. Chapter 2 provides the historical background of critical theory to consolidate the explication of the choice of CER.

1.4.1.2 Conceptualisation: conceptual theories

The participation of partners with diverse situational experiences (*e.g*., cultural and socio-political backgrounds) in this study was imperative, and must therefore be fully conceptualised. This happened during the CER's first but reiterative step, namely, the interpretive step. The critical participatory action research (CPAR) as espoused by Kemmis (2008:125-126), benchmarks participation of stakeholders and partners in this study. The participants' critical participatory action was given expression by and derived its theoretical basis from CER. Conversely, this critical participation and the actions by the participants make this research contextual, which adds to the point made in Chapter 2 on the synergy that exists between the CER and CPAR (Swantz, 2008:33). Furthermore, Chapter 3 shows how CPAR consolidates the transformational character of this study, also in line with the aim of the study.

The data collected from the various views of the partners in respect of each of the five study objectives is unavoidably ‘messy’ or ‘haphazard,’ which is understandably attributable to the technique used to collect it as it asks for broad open-ended questions and encourages participants to express their views freely in response. This results in possibilities of numerous explorative questions that pursue clarity and mutual understanding of responses/views. The data is thus organised systematically in order to facilitate a coherent argument. To this end, it uses the study objectives and respective constructs, and learning facilitation engagements such as learner-teacher; learner-parent, learner-teacher-parent, as well as learning process orientations (Donald, 2010: 43; Kenworthy U’Ren, 2007:818; Leu, 2008:17-22; Rocha-Schmid, 2010:355; Tudge, Mokrova, Hatfield & Karnik, 2009:3;). Again, this is conceptualised during the interpretative phase of CER to inform and be informed by the study operations.

The actual process of organising data according to respective objectives and constructs initiates the analytic step of CER. This step may also involve follow up confirmation and verification of collected data. The technique(s) used in respect of data collection, *viz*., free attitude interview (FAI) was helpful and it is imperative to understand FAI in the context of this study, as well as to conceptualise the appropriate tool of analysis and the critical discourse analysis (CDA). As the data collected is mainly textual it is imperative to comprehend CDA in the context of this study and be able to apply it accordingly. Van Dijk’s socio-cognitive model of CDA was found to be appropriate in this case, advocating analysis on textual, cognitive and social levels.

1.4.2 Operational concepts

The operational concepts are defined with the intention of easing readership and further enhancing comprehension of the study and what it seeks to achieve. The operational concepts are learning; transformational learning; service learning; Physical Science; and sustainability. The synergy between the study and

transformational learning resides in their quest for less dependence on false assumptions, hence the emancipation from distorted ideology (Biesta, 2010:43-47; de Beaugrande, 2008:42-45; Kiely, 2005:7; Liasidou, 2008:486; Merriam & Ntseane, 2008:183-186). Their connection is in the search for empowerment, for example, social responsibility towards and for lives that enhance value adding environments. This is clear in the study's consideration of transformational learning as an integrative and reflective process that seeks to empower learners to be more socially responsible, self-directed and less dependent on false assumptions. It enables the generation of beliefs and opinions that guide action towards changing social structures and character for the betterment of people's lives. The demands of the curriculum that is geared towards transformation place on teaching and learning strategies are great, hence the study's focus.

In the same vein, **service learning** is conceptualised and operationalised differently as a result of its wide and variant contexts, as may be seen from the different countries and nations. The concepts that are often used interchangeably with service learning are community service, civic engagement, community engagement, volunteerism, and charity (Arenas, Bosworth & Kwandayi, 2006:24; Bringle & Hatcher, 2009:38; Terry & Bohnenberger, 2004:15-31). There is sufficient information on service learning in the literature, albeit for institutions of higher learning or universities (Bringle & Hatcher, 2009:37; Parker *et al*., 2009:587-588; Thomson, Smith-Tolken, Naidoo & Bringle, 2010:218-222).

The concept of **sustainability** is understood as pursuance of social practices that are beneficial to people over long periods of time. It thus has to do with teaching and learning that endeavours to develop learners who can practically demonstrate attainment of the critical cross-field outcomes (Mahlomaholo, 2010:14-15). This description considers value as critical in and during social practices, presupposing well thought out and critically assessed social practices with benefits for all concerned and lasting the longest possible time. Where practicable, the use and or depletion of resources should be accompanied by commensurate rehabilitation efforts, which suggest a teaching of Physical Science that embraces and is embraced by sustainable empowering learning environments (Mahlomaholo, 2010:11-12). Such teaching respects the learners' backgrounds, prior knowledge and experiences, whilst accommodating and inviting contributions, active engagement and participation by parents, teachers, learners, public institutions and organisations.

In this study, therefore, diversity in respect of cultural, ideological, and personal traits and preferences such as values, principles, gender and age, are understood as unavoidable. The study considers mechanisms that can be used by teachers and learners to synergise and harmonise them, such that teaching and learning could derive meaningful and useful knowledge. Attempts are made to reconcile the diverse understandings and to harness the efforts towards a common goal, in turn optimising performance of the study coordinating team. This explains the significance of the study's critical efforts, including a study coordinating a teambuilding exercise and the study coordinating team's performance contract (Donald *et al.*, 2010:16-19). The participants' free consent letters augmented the efforts being made in this direction.

The meaningfulness or otherwise of the concept of sustainability rests more on the balance to be struck amongst the diverse categories of sustainability hierarchy. However, the concept 'balance' is not necessarily always congruent with the concept of 'equality.' This being the case, it is argued that the meaningfulness or otherwise of 'sustainability' may not be attributable to the fourth category only. This study contends that it is unthinkable to divorce people from their preferred value systems and beliefs. The contextual factors are implicitly and explicitly connected to people and so the study considers these contexts as significant in determining the focus of transformational learning through service learning strategy. The exclusion of the context renders teaching and learning for sustainability inconceivable. It is thus worth considering the quality of engagements in teaching and learning environments for sustainability as inclusive and accommodating all people and their preferences (Donald *et al*., 2010:19).

The choice of **service learning** as a transformational strategy is based on the understanding that: it is a multifaceted and developmental and critical teaching approach; it connects classroom curriculum with service projects; it integrates meaningful and personally relevant service activities to meet specific learning goals and community needs; it enhances content knowledge of the learners and the levels of awareness of their civic responsibility as citizens of a democratic country; and it develops social responsibility in students (Akiri & Ugborugbo, 2009; Alexander, Van

Wyk, Jaftha & Nkoane, 2010 Arenas & Boswortha, 2006; Howard, 1998**;** Magill, 2002:978-981; Van Niekerk, 2010).

1.4.3 Related literature

A further search of the literature pays attention to the five study objectives as they relate to the use of service learning to transform the learning of Physical Science such that it is sustainable. The best practices that are considered are from the RSA, Botswana, Nigeria, Tanzania and Australia. Other parts of Africa in which significant strides in the area of service learning have been made are also considered.

1.4.3.1 Manifestation of the need for the use of service learning to transform the learning of Physical Science

In the RSA there is a challenge of “failure to achieve dramatic improvement in the quality of teaching and learning in schools” (Departments of Basic Education & Department of Higher Education and Training, 2011c:1; Mahlomaholo, 2012:46-47). Donald *et al.* (2010:15-16) contend that quality in the process of education is achieved when “social interaction” is “really meaningful to those involved; if it results in the healthy development of whole, competent, and confident persons; and if it empowers all, and not only some.” This seems not to be the case in the area of this study, with its high rate of poor performance in Physical Science; a high rate of youth unemployment; and lack of youth participation in community-based development programmes or initiatives (Koosimile, 2004:486; Mahlomaholo, 2010:11-12, 15).

The physical environment presents an opportunity for social interaction that is geared towards addressing problems that threaten its sustainability, but which has not been noticed by learners or out-of-school youth. Amongst the many contributory factors towards this are the currently preferred teaching and learning strategies, which confine learning and teaching to the classroom and/or laboratory. There is a need to revert to strategies that encourage integration of social contexts and civic-responsibility-promoting values with teaching, as advocated in Botswana and Nigeria respectively, and to achieve appropriate learner identity construction, as in Australia

(Koosimile, 2004:484-486; Otote & Omo-Ojugo, 2008:322, 324-326; Parker *et al*., 2009:591-593), These needs are evidently attributable to socio-economic, political and pedagogical disparities (Arenas et al., 2006:2628; Asikhia, 2010:233-235; Equal Education, 2010; Osman & Attwood, 2007:17, 19; Rocha-Schmid, 2010:346).

1.4.3.2 Components of the strategy to use service learning to transform the learning of Physical Science

Service learning is conceptualised and operationalised differently. In South Africa it includes thoughtfully organised experiences, structured time for reflection, extended learning opportunity and development of a sense of caring (Osman & Attwood, 2007:16). These principles are similar to those guiding service learning in Nigeria, which emphasises the role of the teacher and accessibility to educational material and infrastructure, as well as cognitive stimulation as major aspects (Asikhia, 2010:234). In Botswana, it highlights integration and community cultural wealth in addition to the above (Koosimile, 2004:483-484). Australia, on the other hand, emphasises prior experience and personal insight as new aspects (Means, House, & Llorente, 2011:1,9).

These components may be conflated with those of transformational learning, sustainable learning environments, sustainability and Physical Science curriculum aims into a definition of transformational learning through service learning strategy. Transformational learning through service learning is a multifaceted, developmental and critical teaching approach that integrates and uses uniquely tailored projects, and personally relevant service activities to meet specific learning goals and community needs (Burr, 1999:6; Kiely, 2005:7; Osman & Attwood, 2007:19; Richards & Novak, 2010:46,50). Implied in this understanding of the concept of service learning is the critical role to be played by the teacher, which the study considers as another vital construct. The study further considers conditions under which the components of the service learning strategy can be operationalised optimally.

1.4.3.3 Conducive conditions for the strategy to use service learning to transform the learning of Physical Science

Donald *et al*. (2010:16) aver that transformation of education process is facilitated by new laws, policies, and structures. In RSA, which also represents a young and evolving democracy, education is the national priority for government and the ruling political party (RSA Presidency, 2010). This is a favourable condition for transformational learning through service learning strategy, as the responsibility for transformation of learning environments continues to be placed on schools (Kiely, 2005:7; Mahlomaholo, 2010:9; Thomson *et al*., 2010:225).

The favourability of some conditions is not meant to encourage mediocrity and perpetuation of social injustice. This study challenges the poor state of education-related infrastructure and resources such as those at the school under consideration. It also questions tendencies that tend to legitimise apartheid education discursive practices and critiques the power and power relations that relate to the introduction of service learning in institutions of higher learning. Finally, it calls for the use of transformational learning through service learning strategy for high schools.

1.4.3.4 Risks and threats facing the use of service learning to transform the learning of Physical Science

The risks and threats identified emanate from the literature search of best practice models. The RSA's CHESP identifies the identification of partners, their contributions and roles, possible blurring of the real purpose of community service and diversity problems that were experienced (Jansen, 1998, Thomson, *et al*. 2010:228). The Queensland University of Technology (QUT) models from Australia identify as risks, a lack of support and resources, including time (Kenworthy-U'Ren, 2007:818-820; Parker *et al.*, 2009: 593; Thomson *et al.*, 2010:229). A critical reading of the literature from Botswana and Nigeria also reflects similarities. The risk inherent in current high unemployment rates among youth in RSA, coupled with the lack and/or depletion of resources, requires transformational learning through service learning strategies and related interventions (Holborn, 2011, Phillip, 2011:13; Naidoo, 2011:8). Risks and threats pertaining to the learners' transformational learning through service learning projects and site visits are identified and planned for accordingly.

1.4.3.5 Evidence of applicability of the use of service learning to transform the learning of Physical Science

Evidence on implementation of service learning in RSA is found mainly in institutions of higher learning and, as the above discourse shows, there is also progress in countries like Botswana, Tanzania and Nigeria. This sufficiently proves prospects of success for transformational learning through service learning strategy, which should therefore be tested empirically. It is on the basis of the above discourse that this study was conducted. Firstly, the need for the use of service learning to transform the learning of Physical Science is ascertained. Secondly, the study establishes structural components of this strategy. Thirdly, it determines the threats and risks that might impede its development and implementation. Fourthly, the study investigates the conditions under which the 'strategy' will function optimally. Finally, it develops and implements the strategy as an envisaged intervention.

1.5 RESEARCH DESIGN AND METHODOLOGY

The study is designed to cater for critical participatory action within the framework of CER, mainly informed by the observation that the problem may not be sufficiently addressed without the involvement of other key partners. It thus recognises the value of their contribution in the midst of a plethora of diverse situational realities and possibilities. These understandably and arguably mark and represent the actual empowering interaction in the teaching and learning environment.

In order to cater for this the design includes the study coordination team as the intervention or design structure; the participants; the study team performance agreement/charter and comprehensive plan. The methodology encapsulates instrumentation and techniques and the data collection process and procedures.

1.5.1 Design

This section outlines the study design, notably the coordinating team that facilitates engagements between and amongst participants; the participants' profiles, tasks and roles; a team performance charter that seeks to enable monitoring; reflection on progress; and the comprehensive plan.

1.5.1.1 Coordinating team

The coordinating team (CT) was set up to coordinate, develop, implement and monitor, and finally evaluate the impact of the use of the envisaged service learning strategy. The CT convened by the researcher is also referred to as the research study coordinator in this report, whilst the other members of the team are referred to as coordinators of their respective sectors, namely: education; curriculum; municipal service(s); public participation and community-based service learning centre and technical support. The study coordinator was a Physical Science teacher in the area of this study, and so coordinated science learners and continued teaching in accordance with the transformational learning through service learning approaches. The school curriculum coordinator focused mainly on curriculum implementation, management monitoring and assessment of the work, as part of official duties. The public participation and community based service learning centre efforts were coordinated through the school governing body (SGB) chairperson and another member of the community. Technical support was coordinated jointly by the research study team coordinator, and the coordinator for municipal services. The oversight role was the responsibility of the research study supervisor and co-supervisor (Wicks & Reason, 2009:244-249).

1.5.1.2 The participants

The other participants were the Grade 10 Physical Science learners, taking Natural Science at Grade 9. The challenges experienced with regard to the Natural Sciences relate to a need for the study as discussed in Chapters 2 and 4. Visiting participants included the municipality's project management unit manager, waste water plant operator(s), colleagues from sustainable empowering learning environments (SULE), principals of the two secondary schools, heads of department (HoDs) and a university lecturer.

1.5.1.3 Performance charter

The performance charter affects the study coordinating team members. Because of the focus on study outcomes and study aim it constitutes the study's strategy to achieve its long-term aim of developing, implementing and monitoring the use of transformational learning through service learning. It thus encapsulates the study problem statement and uses it to influence the entire comprehensive plan. The agreement served as a guide to lead and manage the deliberations. The participants in the best practice service learning projects also signed performance contracts.

1.5.1.4 The comprehensive plan

The comprehensive plan is used as the study design tool to help organise collected data in accordance with the objectives and respective constructs. The operational section of the plan is also used to monitor progress of the overall study, which helps to establish gaps that require further probing and investigation. In the same way, the risk assessment section facilitated the prioritisation and determination of mitigations. A broad range of issues are subjected to risk identification and assessment processes, notably the study coordinating team and its performance; site visits from transportation to actual work on site; and learners' transformational learning through service learning projects.

The above outlined research study design supports and is in line with the research methodology highlighted below. It is described in greater detail in Chapter 3.

1.5.2 Research Methodology

The methodology and research methods are discussed briefly in this section.

1.5.2.1 Instrumentation

Data was audio-recorded and video-recorded, with the permission of the participants. The video recording was preferred for site visits in order to cater for those who, because of unavoidable circumstances, could not undertake them. It was also more suitable than the audio recording, which is more appropriate for meetings. The video recordings provides information in respect of the non-verbal cues and expressions. The conservations that were recorded were subsequently transcribed.

The data collected was arranged according to the identified and agreed upon constructs. Not all data was collected and recorded through the abovementioned devices, other methods being worksheets; transformational learning through service learning projects; schools infrastructure report(s); minutes of subject and departmental meeting(s); learners' written reflective 'records'; practical investigations; and learners' performance assessment(s).

The **free attitude interview (FAI)** technique suited the qualitative character of the study, it being suitable for clarifying, exploring and probing the questions which heightened the quality of data and for luring participants into contributing their views freely. An open-ended initial question was also used to help participants feel less constrained or compelled to think in a particular manner.

As indicated above, for data analysis purposes, the study used the CDA, which is suitable for the design and analysis of qualitative data. Where necessary, text was analysed so as to relate and interpret it in line with pertinent cognitive or discursive practices and social structural arrangements. This socio-cognitive model of the CDA is understood not to be in conflict with CER or any of the conceptual theories used.

1.5.2.2 Procedure and processes

The study requested and obtained permission to conduct the research from the Free State Department of Education (FSDoE) and the Local Municipality (see attached Annexures CL 6). Other requests for permission were made to the respective education district and the school. Participants signed their respective letters of consent and the learner participants' parents permitted their children to participate in the study. The requests stipulated conditions of participation, including that it was voluntary, that the participants could withdraw at any time during the research process. Their confidentiality was assured (Annexures CL 1 - 6).

Data collection processes were directed in full observance and recognition of the values or principles espoused by CER, namely, equity, freedom, peace, hope and social justice (Mahlomaholo & Netshandama, 2010). The participants treated each other with respect and humility, processes also guided by the CER's reiterative and integrated steps, that is interpretive, analytic and educative. Data was collected from and through the strategic plan session; study team coordinating meetings; meetings of parents, learners and teachers; reflection sessions; Physical Science teachers' meetings at school; documents and records analysis; as well as the literature study.

The transformational learning through service learning strategy implementation plan identifies activities for each objective. The devices, tools and techniques used for data collection are decided upon on the basis of these activities and the nature of information sought. During each meeting progress in respect of each objective was measured in order to inform the adjustments of the plan. The FAI was used to facilitate meetings. Special meetings were organised as required, for example, a discussion of the study to approve the proposal with participants, and a discussion of how to use FAI to facilitate meetings (Roschelle, Turpin & Elias, 2000).

1.6 ANALYSIS AND INTERPRETATION THROUGH CRITICAL DISCOURSE ANALYSIS

During the data analysis and interpretation phase, the study coordinating team made use of Van Dijk's socio-cognitive model of critical discourse analysis (de Beaugrande, 2008:29-44; Liasidou, 2008:486-494; Sheyholisami, 2009:4; Stein & Mankowski, 2004:21-30; Van Dijk, 2008). The goal was to make sense of the data in relation to the aim and objectives of this study. Participants' views were collected through written and spoken words and organised according to the different eco-systemic levels of development; study objectives and respective constructs (Donald *et al.*, 2010:15-16; Leu, 2008:17-26). This data necessarily represents discursive practices through which the affected people express themselves. It represents their thoughts or cognitive aspects about issues of concern, which in turn translate into social arrangements according to which or through which realities are addressed or entertained.

The processes of finding connections between and amongst the levels of analysis are thus engaged. The gaps, misalignments and weak connections amongst the multiple levels of learning and teaching process development are identified. These gaps are traced at the textual, cognitive and social levels of analysis, which with areas of weak connection constitute critical points for transformational learning through service learning strategy development. Findings and recommendations in respect of closing the gaps or strengthening the links are thus critical.

1.6.1 Justification and demonstration of the need for transformational learning of Physical Science through service learning for high schools

Pursuant of the justification and demonstration of the need for transformational learning, the study establishes the extent to which learners' real life situations and needs are used and incorporated in the teaching and learning processes of Physical Science. It further assumes that service learning is an appropriate transformational learning strategy for schools, and uses learners' real life situations and needs to learn and develop meaningful understanding of scientific principles and laws while helping address those community needs.

The study further argues that transformational learning through service learning is, *inter alia*, collaborative learning that critically integrates and uses projects meaningfully to meet specific learning goals and community needs. Conversely, an assumption made regarding currently preferred teaching and learning approaches is that they tend to make scientific knowledge abstract, render it meaningless, succumb to the transformation inhibiting inherent power struggles, lack reciprocity with communities they purport to serve, lack time for reflection, and be more competitive than cooperative. The study argues for the critical participatory engagement and action of other partners to empower themselves towards their emancipation through service learning strategies.

Education-related interactions in the context of learning of Physical Science are innately integrated to transformational service learning, the role of the teacher and other partners, and democratic value systems. These are used in order to demonstrate and justify the need for a transformational service learning pedagogy. The education-related interactions that were identified (see section 1.4.3) serve as the constructs and are used later for the evaluation and progress monitoring purposes, which include learner - teacher, learner - parent and learner - learner engagements, learner – parent - teacher engagements, school - community engagements and teachers' pedagogic support engagements. The data collected in respect of each is critiqued from textual through cognitive to social structural levels and further interpreted to make sense thereof. The experiences and knowledge gained through the interactive processes also influenced the discourses.

1.6.2 Components of the strategy to use service learning to transform the leaning of Physical Science

The study integrates the components of service learning with transformational learning in order to enhance the development of the envisaged strategy. The underlying purpose for this is expressly stated in this study under sections 1.3 and 2.5, that is to ensure that the strategy enhances the emancipation of the learners from oppressive teaching and learning practices. The components are identified and confirmed through the data collected, and are critiqued to the extent that their inherent cultural and power differential realities are levelled off. These are discussed in relation to the identified service learning project, which also affords the study an opportunity for their application. The study explicates how these components are associated with and determine the conditions that are conducive for service learning.

1.6.3 Conditions conducive to service learning

The conditions found to be conducive for service learning, as discussed in Chapter 2, are supporting policy imperatives that establish the extent to which the strategy is covered and covers public mandates expressed in the official policies and documents. The democratisation of teaching and learning of Physical Science on the other hand supports the inculcation of democratic principles and as such becomes a condition conducive to the strategy. Learning requires learners to be ready and motivated to learn, a condition that supports the implementation of the envisaged strategy. Willingness to establish partnerships between schools and their respective communities also enhances the implementation of the strategy to transform the learning of Physical Science.

1.6.4 Threats and risks to service learning

Pertinent threats to service learning include conceptual, financial, pedagogical, power differential and evaluation issues. The study indicates how each of these threats can affect service learning and how they could be mitigated against (see sections 2.8 and 4.5). They prompted the study to consider learning- and teaching-related challenges beyond curricular content, therefore seeking mechanisms to integrate them with the strategy such that they would also be considered during the processes of implementation and assessment. These are considered pursuant to identification of authentic issues that enhance their applicability.

1.6.5 Evidence of applicability of service learning

The study used a service learning project identified by the participants to illustrate how the strategy could be implemented in the secondary schools. The project sought to inculcate the skills prescribed by the Physical Science curriculum through a service project. Through their execution of the project the learners addressed their community's real life needs and problems and allowed them to enhance their learning of the curriculum content. The project required that the learners work collaboratively and interact with members of their respective community in which there was a problem. The study shows that the interaction with the community helped with the enhancement of the inculcation of other skills (*i.e*., social- communication- and relationships-related).

1.7 STRATEGY TO USE SERVICE LEARNING TO TRANSFORM LEARNING OF PHYSICAL SCIENCE

Presented in detail in Chapter 5, the strategy to use service learning to transform learning of Physical Science is a critical participatory action that requires the participants to be imbedded in a form of critical participatory action if they are to address their own problems and needs. It also requires that the learning process should happen concurrently. The collaborative action should instil in participants both cognitive and affective skills to the extent that they become self-reliant. Thus, the service learning strategy advocated thorough preparation, especially in view of the myriad issues that it entailed. The **preparation stage** in this regard entailed the identification and recruitment of participants and the establishment of a service learning coordinating team.

The coordinating team brought diverse situational experiences and expertise to the study, in line with the complex nature thereof. The team, on the other hand, had to ensure coordination of its efforts, through the **planning process**. The outcomes in this case were the study comprehensive plan with its different sections, for example, the team performance charter; operational plan and risk assessment plan. In view of the diverse nature of the study it was imperative to ensure that the participants were more or less in the same or similar frames of mind. It was therefore also critical to identify the extent of their comprehension of the study and address any gaps through training or workshops.

The strategy further entailed a component of **prior-training** of the participants on a number of pertinent issues. In this case the strategy focused on the approved proposal as the statement of intent that also included ethical considerations; the theoretical framework couching the study; learners' study teams monitoring tool and guidelines; health and safety during site visits; and the orientation and preparation for field work. The presentations and documents presented were also a product of the collaborative effort of the participants. The reason for training was also to ensure that the intended purposes were achieved, and to create a dissonance in learners through a site visit that stimulated critical discourse regarding their contribution to social injustice.

The **site visit** motivated the learners to do something, such as a ‘critical participatory action’ in which they contributed to redressing the perceived injustice, towards which they also contributed. The site visit linked the service provided with the curriculum content and the learners to a position in which they were actively involved. Following the site visit, as part of the dissonance, the strategy opened up an inter-subjective space in which learners could contribute their views. This was done in the FAI mode, with contributions prioritised and taken up for further consideration by the study coordinating team. The implementation of the plan beyond this point involved the prioritised service learning project from the inter-subjective reflective session with learners and teachers.

It is for this reason that the study considered the **implementation of service learning project** as another critical aspect of the strategy. The implementation stage in this case covered two main aspects, namely the periodic reviews and adjustments. The study recorded the significance of developing a mechanism according to which progress of the service learning project is to be tracked. In this case, aspects of the comprehensive plan were used to develop a reporting template. It is against the activities and key tasks in the template that adjustments were affected after each review of the item on the plan. The review sessions could take the form of critical reflection sessions, which also form an important part of transformational learning through service learning strategy.

The **reflection** sessions were also conducted through the FAI technique, as well as in writing. This was prior to the implementation of the service learning project, during the process of implementation and after it. The choice of the mode through which the reflections were conducted is critical. The chosen mode was in this case sensitive to the extent to which it encouraged the suppression and exclusion of others’ views from the discourse. The suppression manifested itself in different forms, including but not limited to the prevalence of power differences that might have been resident in the participants' status or knowledge. The reflective sessions also informed and enhanced assessment of the service learning project in many ways.

The complex nature of the service learning inherently required the engagement of the participants during the **assessment processes**. It required consideration of multiple factors and levels of the study and the service learning project. It also appeared that assessment of the service learning project had to be aligned and be considerate of the critical reflective sessions. The study coordinating team members had an opportunity to participate in the assessment process through reflective sessions. Furthermore, the study considered the different components of service learning during assessment and an involved participatory action with focus on the service and learning aspects. The assessment process also enhanced re-planning and implementation of the project, thus it established connections between and amongst the various stages of the strategy.

1.8 FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

In Chapter 6 the study summarises the information obtained in respect of each of the study's objectives. The summaries integrate information derived from the data analysed in Chapter 4 with the constructs pertinent to the respective objectives. This integrative process enhances the summaries by relating them to the context of the study to capture the learning and development objectives for the learners. In this way they depict the findings of the study which facilitate the drawing conclusions in respect of each study objective. The gaps identified, as well as the extent of connections between the data and respective constructs, afford the study space for recommendations. The recommendations on the other hand also address issues pertaining to the value of this study.

1.9 VALUE OF THE RESEARCH

The transformational learning through service learning strategy enhances learner performance. It facilitates collaborative learning between and amongst learners and encourages collaboration between teachers and between teachers and parents.

Teachers from different schools are afforded an opportunity to interact and share experiences. Through its collaborative character, the strategy to use service learning to transform the learning of Physical Science increases the chances of its replication to other schools. This happens through interactions between teachers and amongst learners. It also happens through the exchange of plans, assignments, projects and tests amongst learners and teachers. This will in addition enhance the quality of knowledge created and acquired, because the knowledge gained through the use of service learning to transform the learning of Physical Science is meaningful and useful as it addresses the learners' real life problems and needs.

This mutual support and learning is extended to interactions with parents and the community, creating opportunities for parents to realise their responsibility in respect of supporting their children through their learning process. Parents on the other hand bridge the possible gap between the school and the community. They are members of the community who interact on various other levels and platforms, thus their collaborative support of learners' use of service learning projects brings the school closer to the community. In this way the use of service learning to transform the learning of Physical Science enhances the blurring of boundaries between schools. In the long run, learners and teachers will be associated more with their respective communities and their schools and so restore any dignity that the teaching profession and learning has lost.

Other benefits derived by the community from the services rendered by learners are both social and technical, arising from the transformational learning through service learning projects. The social benefits include improvements accruing from learners' development of values of respect for their environment, caring for each other and responsible use of resources. The technical benefits are the cognitive development in respect of comprehension of scientific principles and their relevance to health and life. It thus integrates the various aspects of the environment with learning.

The involvement of people from diverse cultural backgrounds, as in this study, is imbued with potential conflicts and possible chaos. It requires careful attention and meticulous management. Also, learners' participation in projects that involve field work and interaction with members of the public is inherently risky. These may give rise to health threatening situations, thus consent and permission for voluntary participation from respective authorities and participants is imperative.

1.10. ETHICAL CONSIDERATIONS

Some of the issues pertaining to the ethical considerations have been pointed out in this chapter. Information obtained will remain confidential and the participants anonymous, with the data kept in a secure space with the research study coordinator. Site safety inspections were conducted prior to visits and learners were supervised by teachers and parents on site. The learner participants, study team members and other teachers who accompanied learners to site visits were advised of possible risks and challenges beforehand. The risks identified were included in the risk plan and assessment plan and mitigated against accordingly. Amongst the teachers who accompanied learners were two who had trained level 2 first aiders. The ratio of learners to supervisor was 7:1. Some learners pulled out as a result of health-related challenges.

1.11 CONCLUSION

In this chapter, I have presented a background to the study. Information was introduced and elaborated upon, with critiques of the pedagogical challenges and opportunities pertaining to the purpose of Physical Science towards physical environments. The preferred strategies which focus on production of results at the expense of meaningful and empowering knowledge were questioned. This resulted in an explication of the research study problem statement, research question, research aim and research objectives.

The abovementioned takes the discussion to the level of reviewing the literature first in respect of the preferred theoretical framework, which is CER. The other theories (CPAR, CDA) used within the context enhance the study and the theoretical framework. Transformational learning through service learning is conceptualised in order to take cognisance of and critique the power and ideological distortions embedded in the teaching of Physical Science for the creation of sustainable learning environments. The enhancement of convergence of thought around issues raised is subsequently made by way of defining the operational concepts. This is further enhanced by related literature from the RSA, Botswana, Nigeria and Australia. This is in respect of the five study objectives.

The chapter further outlined the research design in terms of design intervention structure, participants, performance charter/agreement, and the study comprehensive plan. This design informs and is informed by the research methodology explicated in respect of instrumentation, procedure and processes involved. The value of this and that of the study in general were then highlighted. The beneficiaries in this regard include the school(s), community and the DoE.

The next chapter is the literature review, which outlines in greater detail the theoretical framework couching this study. It also provides information on theories that are found to be fundamental to the collection, organisation and analysis of data. It provides more information regarding best service learning strategies locally and internationally, in line with the objectives of this study.

CHAPTER 2

SERVICE LEARNING STRATEGIES TO TRANSFORM PHYSICAL SCIENCE EDUCATION

2.1 INTRODUCTION

This study seeks to formulate strategies to use service learning to transform the learning of Physical Science such that it becomes sustainable. This chapter systematically explores the literature to lay a conceptual basis, beginning with a discussion of critical emancipatory research (CER) as a theoretical framework, and its main ideas and principles in relation to the research question, aim and objectives. The appropriateness of the CER is illustrated through its historical background; objectives; formats and steps; relationship between the researcher and the researched; values; and language used.

Next, the chapter identifies and discusses the operational concepts, namely, transformational learning of Physical Science, sustainable learning of Physical Science and service learning in Physical Science. This is done by showing the synergies amongst the concepts and their convergence with the CER principles. It searches the related literature on issues pertaining to pedagogical practices in Physical Science and contrasts transformational service learning to the teacher-centred and learner-centred practices (Kenworthy-U'Ren, 2007:818; Rocha-Schmid, 2010:353-355), to the extent that they enhance sustainable learning.

2.2 THEORETICAL FRAMEWORK

This section considers CER as an appropriate theoretical framework (Agger, 1991:118-123; Groenewald, 2004:2-6; Tudge, Mokrova, Hatfield & Karnik, 2009:3) and the use of its principles in this study on the use of service learning to transform the learning of Physical Science (Mahlomaholo, 2010:9-10; Nkoane, 2009:23-24). Focus is placed on the historical background; objectives; adaptation of the CER principles as a mechanism for the formulation and operationalisation of the study; the relationship between the researcher and the participants in the CER mode; values; and the language used by the CER users.

2.2.1 The appropriateness of critical emancipatory research

The main reason for adopting CER as a theoretical framework for this study lies in its appreciation of the influence of contextual issues on learning, and by implication on learning of Physical Science (DBE, 2011b:5). Also, it articulates the course of emancipatory praxis for social justice and democratisation and transformation of society (Biesta, 2010:43,45; Mahlomaholo, 2012:41-42; Merriam & Ntseane, 2010:187; Nkoane, 2011:113). These values and principles are consistent with the aim of this study (see Chapter 1, paragraphs 1.1 and 1.3).

CER is appropriate because it thematises issues of power, advocates transformation and emphasises collaborative teaching and learning in meaningful contexts (Mahlomaholo & Netshandama, 2012; Nkoane, 2009). The aim is to empower teachers and learners to acquire knowledge which is both functional and meaningful (Agger, 1991:123-125; Itin, 1999:93), and both groups will be considered as reflective practitioners (Molee, Henry, Sessa & McKinney-Prupis, 2010) who can stand outside themselves and critique their practices for purposes of improvement (Koosimile, 2004:489; Rocha-Schmid, 2010:344; Roschelle, Turpin, & Elias, 2000:843). Both will also be empowered since their knowledge will be relevant and useful in the solution of immediate real life problems.

The study is operationalised through the participatory action research principles and it involves planning and implementation of effective community-oriented teaching and learning strategies being continuously refined (Agger, 1991:106-107) and improved by both the teachers and the learners. The participation of community-based and outside-school participants is considered important in CER as it enhances the richness of the curriculum and ensures that it is relevant and compatible with the needs and practices of a broader society (Parker, Myers, Higgins, Oddsson, Price & Gould, 2009:586-587,592).

The study gives expression to this theoretical framework as it advocates the centrality of praxis towards democratisation and demystification of knowledge creation and processes; the subjective nature of reality and truth; and the accommodation of diversity. It also emphasises equality and mutuality in terms of the researcher-researched reciprocal engagements and the notion of researcher being firmly located in the context of the research with respect, humility, care and trust (Mahlomaholo & Netshandama, 2011; McMillan & Schumacher, 1997:427-450). The aim and objectives are thus to advance an argument for the choice of CER as suitable and as having the capacity to direct it towards the topic and ultimately social transformation (Bietsa, 2010:40; 51-59; Mahlomaholo & Netshandama, 2012:40-45; Merriam & Ntseane, 2008:184-187).

2.2.2 The historical background of critical emancipatory research

CER evolved from the critical theory, the origin of which is traceable to the Marxist-oriented Frankfurt School, established in Germany in 1923. This research centre was directed by Carl Grunberg, Max Horkheimer and Jurgen Habermas, with other major critical theorists such as Walter Benjamin, Theodor Adorno, Erich Fromm and Herbert Marcuse being central to its development (Kellner, 2000:2-3; Steinberg & Kincheloe, 2010:140-142). Horkheimer showed respect for his predecessors by praising and acknowledging their legacy and contribution to the development of the critical theory (Steinberg & Kincheloe, 2010:143), thus, respect permeated and continues to guide critical theorists in pursuing the emancipation of individuals in order to better their discursive and social structures (Sheyholislami, 2009; Van Dijk, 2008).

Horkheimer nevertheless led the Institute to undertake a ‘new start’ directed at ‘new tasks’ in what became known as ‘dialectical materialism’ (Kellner, 2000:3). Thus, Horkheimer, became courageous and continued to contribute respectfully to the evolution of critical emancipatory theory. Under his leadership, the Institute pursued what could be described as the ‘new vision’ of the Institute, introducing a multidisciplinary programme that would raise issues of “interconnections between the economic life of society, the psychic development of the individual and transformations in the realm of culture” (Kellner, 2000:3). Other key tenets or views of dialectical materialism of relevance to this study were that: “the theoretical activity of humans, like the practical, is not the independent knowledge of a fixed object, but a product of ever-changing reality; concepts and theories provide representations of the socio-material world and not any absolute or indubitable knowledge" (Kellner, 2000:5). This is further critical by virtue of its "focus on human needs and suffering; and the changes necessary to eliminate human suffering and to increase human well-being" (Kellner, 2000:6).

Habermas elaborated on critical theory by differentiating between i) work, that is, empirical-analytic sciences using hypothetical-deductive theories; ii) interaction or practical knowledge, that is historical – hermeneutic disciplines, (e.g., descriptive social science); and iii) power or emancipatory knowledge, that is self-knowledge or self-reflection (e.g., feminist theory and critique of ideology), as three primary generic cognitive areas for people's knowledge production. The emancipatory knowledge is fundamentally developed by the persons who experience oppressive conditions by reflecting on issues pertaining to them and their situations so as to find causes of their problems. In other words, those affected adversely need to ascertain, *inter alia*, their respective contribution to their state of affairs. They also need to engage others' contributions with a view to finding solutions (Mahlomaholo & Netshandama, 2012:43-45; Steinberg & Kincheloe, 2010:140-142).

CER focuses on possibilities of radical change to oppressive structures, practices and theories (Biesta, 2010:43; Kellner, 2000:6; Mahlomaholo, 2012:40-42; Nkoane, 2009:22, 2011:112), and empowerment with knowledge and insights into power relations. This is emancipatory knowledge that drives people into critical actions for attainment of their freedom. Conversely, these insights fundamentally lead the participants to engage in practices that address their needs and solve their own problems. The main objective is thus to emancipate themselves from oppressive situations, practices and theories.

2.2.3 Objectives of critical emancipatory research

The objectives of critical emancipatory research are derived from Biesta's (2010:43) claim that:

> …there could be no individual emancipation without a wider societal transformation. This became the central tenet of critical approaches to education. …the emancipatory interest of critical pedagogies focuses on the analysis of oppressive structures, practices, and theories. The key idea is that

> emancipation can be brought about if people gain adequate insight into the power relations that constitute their situation - which is why the notion of demystification plays a central role in critical pedagogies.

Nkoane (2009:22) enriches these views by referring to the sensitivity of critical pedagogies to the “plight of all human beings,” especially those who have been oppressed, excluded and marginalised, as fostering modes of inquiry that convert information into actions that address problems. From this and the above exposition of CER, the following objectives can be derived:

> … to transform the participants’ world and reality for the betterment of their lives; to produce relevant and valuable knowledge; to encourage collaboration, cooperation and teamwork; to emancipate humans from all forms of bondage including ideology, poverty and powerlessness, and to discourage passivity and fatalism (Biesta, 2010:43; Mahlomaholo, 2012:44; Merriam & Ntseane, 2008:185; Piper & Piper, 2009:99).

In line with these, the aims of this study amount to the transformation of reality of the learners and teachers alike, to bring about improvement in the quality of their lives. The services to be performed and from which the participants will learn are envisaged as resulting in new knowledge production that responds to the individual learners’ preconceived misconceptions in the learning of Physical Science and the physical environments. To operationalise these goals and objectives, mechanisms are required that are in line with the principles and values espoused by CER.

2.2.4 Critical emancipatory research and operationalisation of mechanism to transform learning

The use of service learning to transform the learning of Physical Science is operationalised through CER mechanisms, that is, its principles, formats and steps have been adopted and adapted to ground the use of service learning as espoused in this study. This is achieved through formats that are in line with issues related to power differentials, intricately and delicately interwoven and thus often difficult to separate in a practical sense (Mertens, 2010:238). Mahlomaholo and Netshandama (2012:43-44) illustrate this integration in discussing the subaltern organic intellectual and transformative character of CER, using critical race, postcolonial, neo- and critical feminist theories. These have power bases of race, politics (ideology), socio-economics, and gender. The CER is therefore implementable in three iterative and closely connected steps or phases, namely, interpretative, analytical, and educative (Mahlomaholo & Netshandama, 2012:43-44).

This study thus adopted and adapted the principles of CER in its endeavours to use service learning to transform the learning of Physical Science. The aim was to unearth and understand the issues of power, ideology and culture that impede social change and the creation of emancipatory knowledge (Liasidou, 2008:486; Steinberg & Kincheloe, 2010:141). This would in turn enhance the formulation and implementation of strategies based on the views and aspirations of the affected participants, and give voice to those hitherto excluded from the Physical Science learning discourses (Hickling-Hudson, 2006:3-4; Stein & Mankowski, 2004:21; Swantz, 2008:34). The principles thus adopted would sensitise the study to issues of emancipation or purported emancipatory knowledge creation that accommodates diverse backgrounds, situational experiences and knowledge, competencies, gender, race, and cultural and political differences of the people concerned (Koosimile, 2004:485; Shumba, 2010:337,347-348; Steinberg & Kincheloe, 2010:143). The CER is reliant on the participants' collaboration and cooperation (Golightly & Bracket, 2010:49-50; DePalma, 2010:215-216; Kemmis, 2008:125-130). Therefore, in order to level off the inevitable inherent power differential realities amongst participants, the study adopted the CER values of humility, moral decision-making, trust and respect (Dominiquez, 2008:4; Steinberg & Kincheloe, 2010:142-143).

The CER principles and values were to make the study more flexible in addressing diverse strengths, weaknesses, opportunities and threats (see Annexure T1), with issues uncovered including those that emanated from the wealth of the participants' community culture (Hickling-Hudson, 2006: 3-4; Yosso, 2005:77-81) and school-based Physical Science learning environments. Those were about learning and teaching strategies (Alexander *et al.*, 2010:290-292; Golightly & Bracket, 2010:49-50; Hammond *et al.*, 2001:14-19; Nel, 2009:53-55; Van Niekerk, 2010:272-274); learners' individual learning styles (Akiri & Ugborugbo, 2009:107;112; Passarelli & Kolb, 2012:4; Shumba, 2010:337); and issues pertaining to learning support resources and social structures (Asikhia, 2010:231-235; Koosimile, 2004:485).

Using CER the researcher ought to be firmly located in the context of research (Mahlomaholo, 2012:37-38; Piper & Piper, 2009:96-100), a principle that has positive effects on a myriad practices recorded in the literature. For instance, this happened in Tanzania, when the country needed academic people who were not divorced from their background and who would bring wisdom and knowledge of the grassroots to the academy (Swantz, 2008:33). Here researchers were fundamentally integrated in their respective communities and research areas, whilst in Botswana it was achieved through basic extension skills training (BEST) (Gboku & Modise, 2008:322). In Australia the painting *To Hold Our Earth Firmly* was used to influence and stimulate White Australian students to respect Indigenous Australians as their cultural equals, rather than as victims of history to be pitied, defended or despised (Hickling-Hudson, 2006:4).

The discursive practices and social arrangements have been imbued with values of humility, respect, moral decision-making, and trust. In the *Jipemoyo* ('*Take Heart*') project in Tanzania, for instance, researchers lived amongst the population and rented houses from villagers, signifying humility on the part of both. The researchers mediated between citizens and authority, the result of a relationship of trust and respect they had built amongst themselves (Swantz, 2008:34-35). Conversely, the mutual respect helped balance the immanent academic knowledge power differentials, ideology and cultural realities. This was imperative in that the participants had to make sense of what they did in real culturally significant situations (Biesta, 2010:43-44; de Beaugrande, 2006:42-45; Liasidou, 2008;486-488; Steinberg & Kincheloe, 2010:143-145; Van Dijk, 2008:88-89, 98-99). This may explain why it was possible for Hickling-Hudson (2006:4) to inculcate a view that the cultures of participants (Whites and the indigenous Australian peoples) were equal, and so had to be respected.

CER calls for both deconstruction (Agger, 1991:107-111; Hickling-Hudson, 2006:2-4; Steinberg & Kincheloe, 2010:141-143) and reconstruction (Swantz, 2008:31) of meaning and knowledge production for social justice. Based on a critique of 'distorted ideology' (Mahlomaholo & Netshandama, 2011:7; Van Dijk, 2008:86) it informed the study's attempts to deconstruct the apparent notion that science-centred, teacher-centred (Koosimile, 2004:490) and examinations-driven/oriented (Salleh, 2004:5,10) approaches to teaching Physical Science were sufficient to achieve democratic transformation of learning and ultimately society (Biesta, 2010:43-44; de Beaugrande, 2006:42-45; Steinberg & Kincheloe, 2010:145) (see Chapter 1 paragraph 1.3.3.1 and Chapter 4 paragraph 4.2). Thus, the use of service learning to transform the learning of Physical Science took as its starting point the critique of power differential realities embedded in the Physical Science learning practices. This study considers the use of service learning in such transformation as the reconstruction of teaching and learning.

The study was conducted with the engagement of a coordinating team and learners from diverse backgrounds and with diverse experiences, knowledge and skills, considered critical (Koosimile, 2004:492; Salleh, 2004:5,8) (see Chapter 3, paragraphs 3.2.1 and 3.2.2). Furthermore, the transformation process presupposes engagement and coordination between participants from diverse social backgrounds and with diverse experiences (Kenworthy-U'Ren, 2007:814; Kiely, 2005:5-6; Merriam & Ntseane, 2008:184,187; McBride, Brav, Menon & Sherraden, 2006:315-316), and is in line with the service learning components and their use in transforming the learning of Physical Science. Service learning integrates service with learning such that there is mutual benefit for the two processes (Alexander *et al.*, 2010:290-292; Kenworthy-U'Ren; 2007:812; Richards & Novak, 2010:46; Van Niekerk, 2010:272-274).

The participants in the *Jipemoyo* (Swantz, 2008:33-38) and *Hold Our Earth Firmly* (Hickling-Hudson, 2006:201-218) projects, for instance, had been immersed (Mahlomaholo & Netshandama, 2012:37) in their respective development and cultural transformation projects. The participants were engaged therein through the *interpretive action (phase)* to gain mutual understanding of their situations, and to the *analytic phase* in order to develop their strategies. This prepared them to seize problem-solving opportunities that were at their disposal by ensuring that their voices were heard and heeded by those who had the power and capacity to address their plight. Ultimately, through the *educative phases*, the strategies of the participants in the two projects were operationalised and subsequently changed their situations for the better (Mahlomaholo & Netshandama, 2012:42-45; Steinberg & Kincheloe, 2010:148-149).

For instance, the researchers in the *Jipemoyo* project needed to learn and understand what the people considered as development. Similarly, in the *Hold Our*

Earth Firmly project the students were to give their interpretation and analysis of the painting. This unearthed discursive practices and social arrangements that encouraged suppression of indigenous cultures and created a space in which to give voice to some for purposes of blurring the cultural divide (de Beaugrande, 2006:31; Sheyiholaslami, 2009; Stein & Mankowski, 2004:21; Van Dijk, 2008).

In both projects the ultimate goal was to make sense of the information so that it would be meaningfully and usefully integrated in real life situations (Hickling-Hudson 2006:4; Koosimile, 2004:490; Swantz, 2008:33-35), to address real life needs and problems. The *Jipemoyo* project needed to integrate the academic with the excluded and marginalised villagers in order to help address their development needs, whilst the *To Hold Our Earth Firmly* project sought to address the need for mutual acceptance and respect of diverse cultures on an equal basis. These projects had been imbued with power and ideological issues, and were transformational and emancipatory in character (Biesta, 2010:43-45; Koosimile, 2004:485; Merriam & Ntseane, 2008:185)

They could not have been fragmented and thus could not be divorced from the cultural practices of the people or from the environments in which they lived. There had been a reconstruction or construction of social structures in order to support the projects, as evidenced by the researchers who deemed it fit to be humble and went to live with the marginalised village people. The extent of their respect had led to their almost complete integration into the village, as expressed by the *Jipemoyo* researcher who was taken to be part of the Maasai people (Swantz, 2008:35).

The participants' efforts that focused on mutual comprehension of pertinent issues regarding their respective problem and needs constituted the interpretative phase, embracing Habermas's principles of communicative action (Rocha-Schmid; Agger, 1991:111; Van Dijk, 1995:21), and opening of communicative space (Wicks & Reason, 2009:244) (see Chapter 3). The efforts of the participants to gain mutual understanding of their problems and needs were therefore not once off but rather evolved and matured with the processes of project development and implementation. These efforts were therefore geared towards enabling the participants to share common strategic views regarding possible solutions, asking them to work simultaneously on the development of multidisciplinary programmes (Kellner, 2000:3,7-8) and the establishment of collaborative structures that would enhance the integration of the academics with the people in the village. This was akin to what Salleh (2004:5) referred to as the collaboration of experts and the novice. They explored the use of their inter-subjective spaces and opening of communicative space efficiently to realise the team members' engagements (Kemmis, 2008:130; Wicks & Reason, 2009:244-249).

Researchers who took part in the *Jipemoyo* project acted as mediators between the people and the authorities, and had been influenced by internalisation and owning up to the problems or sufferings experienced by the people (Kellner, 2000:3; Swantz, 2008:35). Conversely, it could be said to have been influenced by their understanding of development from the perspective of the people. It is apparent that the researchers made analysis of the situation and subsequently deemed it fit for them to mediate (Mahlomaholo & Netshandama, 2012:37; Rocha-Schmid, 2010:345). This had given voice to the people in respect of their own development (Stein & Mankowski, 2004:21). Similarly, in the *To Hold Our Earth Firmly* project, the role of a mediator in giving voice to the indigenous Australian people (Hickling-Hudson, 2006) was achieved through analysis of the painting.

The respective analyses involved texts which were the voices of the Maasai people regarding development and those of the Australian students about the painting. It was finally influenced by and in turn influenced prevailing social structures, related to the need for academics to work closely with the people and the students to practically and meaningfully relate positively to diverse cultures (Laisodou, 2008:486; Sheyholislami, 2009:3; Van Dijk, 2008:88). These discourses involved self-reflections and reflections between and amongst the participants, happening simultaneously in a reiterative and unified manner (Steinberg & Kincheloe, 2010:140-141) (see Chapter 3 paragraphs 3.2.1; 3.3.2.4; 3.3.3.2; and Chapter 5, paragraphs 5.4 and 5.5).

Similarly, the act of mediation by the researchers in the *Jipemoyo* project represented the researchers' ability to associate with the people (Swantz, 2008:33-34). The mediation was indicative of the fact that the researchers made sense of the Maasai people's notion of development. That was similar to the students in the *To Hold Our Earth Firmly* project who developed an improved understanding and acceptance of the culture of the indigenous Australian people. This influenced the "school to be like Garma, a public ceremonial area" in which "everyone can participate in and enjoy" (Hickling-Hudson, 2006:8-9). The educative phase in these projects culminated in emancipatory actions that sought to address the needs of the downtrodden (Biesta, 2010:55-56; Kellner, 2000:5; Krause, 2007:227-230; Mahlomaholo, 2012:44). The participants in these projects had been actively engaged and firmly located in their respective projects.

The students were organised in groups or teams through which they shared their views and experiences about painting (Hickling-Hudson, 2006:3-4). Their activity was structured in a way that enabled them to analyse and interpret the painting from diverse perspectives, saying what it was and what resources were used to interpret the meaning and message (Hickiling-Hudson, 2008:3; Niemi, 2002:766). This was akin to what Kellner (2000:5-6) referred to in Horkheimer's dialectical materialism, regarding increasing human wellbeing through changes that could eliminate human suffering and make intricate connections between philosophy and science. Thus, these phases were executed reiteratively and involved critical participants who shared responsibilities among themselves (Biesta, 2010:45; Hertz-Lazarowitz, Zelniker & Azaiza, 2010:271; Sanginga, Kamugisha & Martin, 2008:699).

2.2.5 The relationship between researcher and study participants

The participants in the projects mentioned above could evidently be categorised into those who wielded power and those in less powerful positions. They were the students and the experts as well as those from cultures perceived as 'superior' or 'inferior' (Hickling-Hudson, 2006:2-4; Rocha-Schmid, 2010:354; Tatto, 2006:235-237). The participants of one project were from a class of experts, researchers and academics while those of the other were marginalised villagers, the Maasai people (Swantz, 2008:33-35). Botswana's BEST project consisted of people from the rural areas and those who wielded positional or administrative power as government officials (Gboku & Modise, 2008:322). The relationships between the researchers and the participants in all these projects were evidently imbued with a power differential in cultural, knowledge and administrative issues (Steinberg & Kincheloe, 2010:140-141; Stein & Mankowski, 2004:21; Van Dijk, 2008:88). The participants' cooperation and collaboration in these projects had been strengthened by the values they cherished and observed (see Chapter 3, paragraph 3.2.2), consistent with the democratic principles that also buttress the CER theoretical framework.

CER is premised on the principles of hope, social justice, freedom, equity and peace (Mahlomaholo & Netshandama, 2012:43), focussing on an emancipatory and transformative trajectory with the marginalised and downtrodden (Hertz-Lazarowitz, Zelniker & Azaiza, 2010:271; Kellner, 2000:6-8; Liasidou, 2008:486; 487). It endeavours to progressively bestow human dignity to the dehumanised and restore hope, collaborating to restore social justice through democratisation and transformation of society (Mertens, 2010:238; Steinberg & Kincheloe, 2010:142-143). It advocates and tends to rely on freedom of expression of people, the speaking beings (De Palma, 2010:218-221), in order to better comprehend and make sense of their cognitive practices, and influence their social structures to the extent of their respective emancipation and subsequent social transformation (Biesta, 2010:43). These principles are in line and compliant with RSA's constitutional imperatives (RSA 1996a, s9, s10; s15, s16, s24)

The relationship between the researcher and the participants in CER are fundamentally built on *trust*, *respect* and *humility* (see paragraph 2.2.4), critical to balancing power issues that are inherent in the participants' engagements (Mahlomaholo, 2010: 19; Mahlomaholo & Netshandama, 2012:37,38; Rocha-Schmid, 2010:355; Steinberg & Kincheloe, 2010:142-143; Swantz, 2008:34). The participants' diverse experiences, knowledge, cultures, belief systems, socio-political variations, and economic status are viewed as complementary, and are considered more important as a whole than the sum thereof.

The participants' differences are thus considered as a powerful tool that filters and clarifies basic issues and/or realities pertinent to their challenges, wishes and aspirations. They become a useful enhancement for the interpretive-analytic-educative mechanism outlined in paragraph 2.2.4 (above), and facilitate mutual comprehension of the issues at hand. They furthermore enhance processes geared towards development of solutions and achievement of their common goals. In this manner, they enhance achievement of equity amongst the participants, thus the notions of giving voice (Stein & Mankowski, 2008:21;23) and of mediation between the variant groups (Kellner, 2000:3; Swantz, 2008:35) become possible and achievable. Under such conditions the participants' views and contributions are equally considered and equitably synergised through the interpretive-analytic-educative process of critique and logic (Hickling-Hudson, 2006:7-9; Howard, 1998: 26; Mahlomaholo & Netshandama, 2012:43-44; Stein & Mankowski, 2004:24-26).

The relationship between the participants and researchers in the CER tends to be characterised and informed by common vision, purpose and actions, affording the former an opportunity to explore their collective strengths so as to complement each other's weaknesses. This they do in order to jointly develop strategies and determine actions and activities (de Beaugrande, 2006:31) through which they can address their social needs and problems. They act as a team that insists on unity (de Beaugrande, 2006:31), and their actions and activities are emancipatory (Biesta, 2010:43), as they progressively serve to change and transform their individual thinking and attitudes towards and about their own situations and problems (Liasidou, 2008; Salleh, 2004:10). This spurs on practical actions that ultimately results in changing situations for the better (Mahlomaholo & Netshandama, 2012:35,37), that is attitudes that "explicitly formulate their (oppositional) stance" (Van Dijk, 1995:19) to mediocrity and inferiority.

In this study the relationship between researcher and participants seek to transform the learning of Physical Science, occupying an inter-subjective space (Kemmis (2008:128-129) of mediators for transforming (Agger, 1991) the learning of Physical Science for social justice and hope. The aim is to help learners regain their confidence in their performance in Physical Science, extending beyond the bounds of the school. The participants wished to contribute as mediators to the transformation of learning of Physical Science, with humility, respect and trust. Thus, this relationship seeks to contribute towards transformation rather than "fighting against the state" (Swantz, 2008:31-32).

2.2.6 Values

The transformational service learning strategy of Physical Science is located in a more all-encompassing sustainable learning environment initiative which privileges principles of equity, social justice, freedom, peace and hope (Mahlomaholo & Netshandama, 2012:43). It enhances the transformative nature of this study and addresses historic inequalities prevalent in the country's learning institutions and schools. This study therefore values mutual respect for and amongst the participants

(Agger, 1991:108; Rocha-Schmid, 2010:355), whilst fostering a spirit of caring, humility and trust. It is these values that influence the research in that a service learning strategy should enhance learner performance, increase co-operative learning and working between stakeholders, *viz.* the school, local municipality and community in general, and improve the quality of knowledge acquired. It is relevant, meaningful and related to real life problems, and the community benefits from the services rendered by learners in line with service learning elsewhere (Wallace, 2000).

This study adapted the values of the critical emancipatory research discussed in the paragraphs immediately above in order to achieve its purpose as outlined in Chapter 1 paragraph 1.3. This meant that the participants had to conduct themselves accordingly and address each other appropriately. The language use is unique and needs to be highlighted for purposes of, *inter alia*, consolidating the appropriateness of critical theory.

2.2.7 Rhetoric: language used

CER acknowledges that humans are speaking dynamic beings and not things or objects, and any research that involves humans should take this into cognisance. The questioning of early critical theorists such as Habermas and the Frankfurt School, and the rigidity of Soviet Marxism compared to capitalism's humanity (Mahlomaholo & Netshandama, 2012) is therefore carried through in this study, coordinating a team and community-based service learning centre executive committee members who participated on an equal bases as stakeholders in the processes and activities. All stakeholders agreed and committed themselves to the observance of the values of mutual respect, care and trust, which were cascaded to learner participants during interactions and engagements in the study.

The views and aspirations of the learner participants enjoyed similar and/or equal status to those of the other participants, and constitute the crux of the study. It is through the learner participants' actions, behaviour and language that the extent of transformation is established, as these are fundamentally the reflection of their interpretation of learned experiences through service learning (Bringle & Hatcher, 2009:38, 40; Molee, Henry, Sessa, McKinney-Prupis, 2010:240-243). It is however in the spirit of the CER principles and values that learner participants, because they are humans, are not referred to as ‘the researched.’

2.3 DEFINITION AND DISCUSSION OF OPERATIONAL CONCEPTS

The operational concepts are defined and discussed for ease and smoothening of readerships. This also helps with the facilitation of convergence of thought and subsequent action. The operational concepts that are considered here are: transformational learning; learning; service learning; Physical Science and sustainability.

The concept of transformational learning is conceived as fundamentally critical learning or learning for emancipation (Kiely, 2005:19; Merriam & Ntseane, 2008:195; Nkoane, 2009:22; Servage, 2008:72-73), where *transformational* is an adjective derived from the verb ‘transform’, which means: to change (something), radically, for example, in structure, appearance or character (*The Penguin Dictionary*, 2004). It refers to an act or action that attempts to change either one or a combination of the structure, appearance and character of something. Furthermore, such change is fundamental, innovative, and radical. In this study the radical change is geared towards the learning practices and techniques of Physical Science.

Mezirow *and Associates* (2000:7-8) view transformative learning as the process by which people transform their taken-for-granted frames of reference (perspectives, habits of mind, ways of thinking, mental models) to make them more inclusive, discriminating, open, emotionally capable of change and reflective. In this way the people are enabled to generate more dependable beliefs and opinions of their experience by considering them in the context of their lives. They are also enabledto improve their decision-making based on their insights. Similarly, Kiely (2005:7) supports this view by saying that, regardless, the ideal end result of transformational learning is that one is empowered by learning to be more socially responsible, self-directed, and less dependent on false assumptions. Servage, (2008:67-68) adds that the cultivation of sound reasoning and democratic participation skills is essential, both for an individual’s personal growth and learning and for his or her contributions to social transformation.

The transformational learning principles were thus imperative to the study, as it aimed at establishing meaningful and practical connections between academic curriculum and social transformation (Koosimile, 2004:489). This requires diverse situational experiences, knowledge and competencies, hence the need for transformation of learning of Physical Science presumes engagement of other partners, who are key to ensuring that their educational and social transformation needs are addressed through learning.

The *learning* process, meanwhile, involves the acquisition or gaining of skills or knowledge through experience, example, practice, study or by being taught. This is according to the Concise Oxford English Dictionary (C. Soanes, & A. Stevenson, [Eds]; *Collins Concise Dictionary & Thesaurus, (2003*). Learning thus involves learners, that which must be learned by the learner, and the facilitator of the learning practice or process. The *New Penguin Encyclopaedia* (D. Crystal, [Ed.], 2003) adds to the definition of learning the acquisition of "behavioural tendencies as a result of specific experiences in an individual's life. It is distinguished from behavioural changes due to motivation or maturation".

The *International Encyclopaedia of Psychology* (1996:978-981) states that learning is the "acquisition of knowledge which results in a change of behaviour in the learner; that a person forms concepts about objects and events that create expectancy that events can be predictable". It however warns that though "this type of learning is useful it can cause a lack in creativity, in problem solving [and that] people may compensate for this by having a sudden insight into the problem." The change in behaviour that comes as a result of learning is understood to be inclusive of the learners' innovative ways of solving the problems that confront them. It reflects the positive and responsible manner in which learners relate with one another, their community and their physical environment (DBE, 2011b:4).

The theoretical conceptualisation of learning is traceable to the philosophy-based, psychology-based and progressive learning theories, but the choice and use of strategies that are informed by any one theoretical conceptualisation depends on the kind of learning desired and its purpose (Hammond, Austin, Orcutt & Rosso, 2001:2-15). The progressive learning theories were considered suitable for this study because they are more inclusive and subjective. For instance they recognise the role of experience and reflection (Kottkamp, 1990:127, 132, 137) in knowledge creation; are considerate of the role of culture, politics and other influences on people's experiences of knowledge creation and development of their abilities; they recognise the importance of content (Biesta, 2010:43; 45-51; Hammond *et al.*, 2001:7-9; Merriam & Ntseane, 2008:194-196).

Evidently, transformational learning requires the involvement of many participants and resources. These definitions presume that learning is more about the learners acquiring knowledge that can enable him or her to benefit from the environment, therefore the skills acquired should further enable them to take care of their physical environments. Furthermore, they should be able to preserve their physical environments, an ideal the achievement of which should be collaboratively supported by the learning facilitators or teachers, educators, researchers, education administrators and policymakers. It tends to make learning fulfil its intention, that is, to be meaningful and useful.

Thus, school-bound participants and resources may not be adequate in addressing the issues of the transformational learning of Physical Science. Conversely, the theoretical framework that purports to objectify and prescribe the truth and reality may not be suitable. CER is suitable as it accommodates diversity that is focused on the emancipation of the concerned and affected participants and partners. It seeks to bring about radical change for the betterment of life and living in their respective situations and environments. It is also considerate of the partners' wellbeing and that of their physical environment.

In this study, transformational learning of Physical Science encapsulates fundamental or innovative enhancements of the learning strategies of Physical Science. These would involve changes of respective social structures for the purposes of changing the character or quality of learning of Physical Science. The changing of social structures being referred to may include but not be limited to the re-structuring or the establishment and operationalisation of learners' study teams, parent-supervised study teams, community-based learning support structures, school partnerships with local business, local and regional governance (political) structures, and community-based development organisations in support of learning. As a result, the transformational learning of Physical Science has emancipatory implications for learners within both the instrumental and communicative areas of learning (Kiely, 2005:19).

Critical to the changes in these social structures would be the quality of engagements amongst key partners, through which, for instance, knowledge is produced and/or mutual understanding of policy and knowledge is enriched (Osman & Attwood, 2007:20). It is these engagements that will restore and sustain a sense of belonging and ownership of learning and teaching processes to the rightful owners, namely, learners, parents and community. It is incomprehensible how the quality of the partners' engagements can be improved without trusting, respectful and caring engagements as equal partners.

Thus, the transformational learning of Physical Science in this context is collaborative in character, viewed as "a variety of ways that individuals work together to produce or obtain some defined goal" (Magill, 1996:471-473; Kiely, 2005:6-7). The literature search in this regard asserts that research supports the effectiveness of cooperative learning strategies in areas of achievement, positive interactions with others and development of self-esteem. The power differential realities embedded in these engagements are thus levelled off by couching the study in CER (Alexander *et al*., 2010:290-292; Mahlomaholo & Netshandama, 2011:9; Mahlomaholo, 2009:234). This study considers service learning to be appropriate for use in transforming the learning of Physical Science.

The concept 'service learning' is composed of two other concepts, with *service* described in the *Penguin Dictionary* (2004) as work or duty that is carried out for a person, organisation or country, in contribution to the welfare of others rather than personal gain. This is in agreement with the meaning given in the Collins *Concise Dictionary and Thesaurus* (2003), which defines it as an act of help or assistance. As with the concept of participation, it is heavily imbued with political connotations (Perold *et al*., n.d.:53-54; Osman & Attwood, 2007:18). In the current democratic dispensations in the RSA for instance, the concept features greatly in the public discourse. For instance, the teachers have to render teaching (DBE, 2011b:4-5) as a service to learners and the public, with the ultimate purpose of transforming their community and society (Hatcher & Erasmus, 2008:50, 56-57). Evidently, teaching practices as service is expected to result in the empowerment and thus emancipation (Biesta, 2010:43) of the learners so as to ultimately transform society. The roles played by different participants in the delivery of the envisaged transformation of learning tend to be saturated with power relations issues (Osman & Attwood, 2007:17). Perold *et al.* (nd: 53-54) support this by arguing that the concept of service for RSA has “changed to be developmental, with service taking a variety of forms in different sectors, and involving a wide diversity of participants.” Thus, this power relations issue tends to be aggravated by the quality of relationships between and amongst them, as well as in the quality of ‘service’ each has to deliver.

The quality of relationships and services rendered by ordinary members of the public, such as parents and community-based organisations, policymakers, education administrators and teachers, are imperative, as they will evidently impact on the transformation of the learning of Physical Science. The role of the public appears to have degenerated more to that of spectator, notwithstanding supporting policy provisions. The reasons tend to be political, due to prevalence of power differential realities, and academic, due to, *inter alia*, inequalities in the knowledge, skills and competencies. These may arguably be historic challenges, however they tend to be legitimised (Mahlomaholo, 2010:46, 2012:47).

The learners’ execution of services beyond the school and classroom boundaries is a very contentious issue, and one that is highly regulated and controlled. It is understandably geared towards protecting minors against abusive labour practices, and affects teachers who are also workers and/or servants whose labour is unionised and thus politicised. These boundaries are critical, however they are blurred because of a need to transform society and emancipate the learners, two groups that may not be divorced.

Osman and Attwood (2007:25) describe ‘service learning’ as “essentially an experiential education *approach* in which students receive academic credit for performing community service” (emphasis mine). In the same vein, Kinsley (1994:37, 41) indicates that service learning is:

> an education *process* - *not a program* - that involves students in service experiences with two firm anchors. Firstly, their service experience is directly related to academic subject matter and it involves them in making positive contributions to individuals and community institutions (emphasis mine).

Secondly, it no longer limits teaching and learning situations to the school to provide a full educative experience for the youth, because there is a need to “develop values and attitudes for our students toward their life roles, their careers, and their perception of society”, therefore, new avenues of approach must be developed. In the RSA, service learning is predominantly for institutions of higher education whilst community service is for secondary schools, geared towards the promotion and development of social responsibility in learners. For community service, “no single model is indicated in the curriculum framework for grade 10 to 12” (Perold *et al.*, n.d.: 62), therefore it is in its infancy stage.

The study considers service learning as a potentially impactful strategy for transforming learning of Physical Science, however it is not necessarily transformational but can be co-optive (Osman & Attwood, 2007:19), and like transformational learning is also collaborative. Burr (1999:6) regards basic elements that are true to collaborative learning as integral to service learning, namely:

> … a positive interdependence as students need to be linked to others who would ensure success; a promotion of interaction with each other to learn; an individual accountability for the group’s work; the social skills developed when placing people together as a team; and the group evaluation process that will occur in a collaborative environment.

The service learning that is earmarked for transformation of learning of Physical Science should thus be multifaceted in character. Richards and Novak (2010:46, 50) contend that it

> … sets the stage for lifelong commitment to civic duty, social awareness, and engagement while providing a unique learning experiences that focus on building citizenship, cultural diversity, community partnerships, knowledge of community resources, critical thinking skills and respect for humankind.

Kiely (2005:7) argues the practice of service learning may be augmented by providing possible contexts within which it is practiced. These tend to converge in the perceived development-oriented nature of service learning, contexts given as approaches to community development that it draws from, and including ‘asset-based’; ‘community-based’; ‘community-based health interventions’, and ‘participatory action research’. These approaches are also said to be dependent on, and customised according to the context and short-term nature of the programme. The synergy between the concept of transformational learning and service learning is thus important, but lacking from these approaches and conceptualisations is how to deal with the myriad inherent issues of power. This study therefore places the synergy between transformational learning and service learning within the CER in order to address its impact.

The study identified and purposely levelled off power differential issues that were inherent in the use of service learning to ensure that its use in transforming the learning of Physical Science would be collaborative. This was considered critical to its being 'sustainable', that is conserving an ecological balance by avoiding depletion of natural resources (*Revised & Updated Illustrated Oxford Dictionary*, (2003) and continuing, keeping alive, keeping going, keeping up and maintaining (*Collins Concise Dictionary and Thesaurus*, (2003). The two are not in conflict with each other as they both emphasise the principle of preservation or conservation. Similarly, the *New Penguin Encyclopaedia* (2003) defines the word as used in conjunction with 'development', and therefore the environment. The term 'sustainable development' describes economic development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Kelly (2009:1), on the other hand, views the concept of sustainability as fundamentally about education, because it "continually presents questions of value and practice by asking what is best and why for the long run." In this study the value of learning Physical Science lies in the extent to which it is meaningful and useful to learners and the community. It should be consistent with 'continual' addressing of real life needs and problems through which learners' academic learning is simultaneously attained. In other words, such learning empowers them not just for academic benefit but also for the sustenance of life beyond their formal schooling. Thus, in order to be sustainable, the use of service learning to transform the learning of Physical Science is to be facilitated through sustainable empowering learning environments (Mahlomaholo, 2010:11-12).

Also, the practice (Kelly, 2009) and use should inevitably "operationalize problem-based learning, resources based learning, cooperative learning, collaborative learning and outcomes-based learning" theories (Mahlomaholo, 2010:11), with strategies that still respect other modes of teaching and learning and so augment the learning of Physical Science. Evidently, the participants should be fully embedded in the practices, in order for them, *inter alia*, to jointly and collaboratively facilitate processes that would enhance the creation of emancipatory knowledge (Servage, 2008:65-73). Such knowledge is imperative for the process of transformation of learning of Physical Science.

These values can thus be instilled through the use of CER, which is appropriate in that it will simultaneously help address the multiple purposes of the study, including those pertaining to the embedded power differential realities and the creation of emancipatory knowledge (Servage, 2008:65-73). These will ultimately enable the participants to create knowledge that will sustain the transformed Physical Science learning environments. Equally, they will enable and enrich engagements amongst them, whether teachers, learners or parents, which in turn are imperative for the sustenance of the reciprocal relationships between theory, as at school, and practice, as in real life situations.

This study argues for the use of service learning in recognition of the need to "meet multiple, simultaneous goals [that include] student goals addressing cognitive or academic learning, intellectual development, spiritual and ethical development, and civic engagement as well as goals addressing community impact" (Bell, 2007:148-150**;** Bringle & Hatcher, 2009:38, 40, 44) These statements confirm the views shared by Koosimile, (2004:483), who states that "studying science concepts in contexts involving outside-of-school experiences of learners is consistent with the notion of humanising science and promoting meaningful learning in culturally and cognitively appropriate ways."

2.4 RELATED LITERATURE AND DEVELOPMENT OF CONSTRUCTS

The use of service learning to transform the learning of Physical Science derives lessons from related best practices from the RSA, Botswana, Tanzania, Nigeria and Australia. These include the RSA's Community-Higher Education Service Partnerships (CHESP) (Hatcher & Erasmus, 2008:49-61; Bell, 2007:147-155); Botswana's basic extension skills training (BEST) (Gboku & Modise, 2008: 315-331) and 'Out-of-school experiences in science classes' (Koosimile, 2004:483-496); Tanzania's *Jipemoyo* '*Take Heart*' project (Swantz, 2008:33-54); Nigeria's 'teachers' effectiveness and Students' academic performance (Akiri, 2008:107-113); 'Developing Nigerian integrated science curriculum' (Idowu, 2011:134-145) and Australia's *To Hold Our Earth Firmly* project (Hickling-Hundson, 2006:201-218).

The following best practices and lessons learnt from these projects are fundamentally drawn against the background of the clarifications, definitions and discussions of the operational concepts. Thus, this study explores, *inter alia*, how these projects operationalised their respective problem-based, resources-based, cooperative, collaborative and outcomes-based solutions and learning. This exploratory exercise related the observations made with the principles of CER as expounded under the literature review, paragraph 2.2 above. The underlying purpose for this is to identify and to develop constructs for each of the study's objectives, and to work out possible organising principles to guide the formulation of an appropriate strategy.

Exploration of the CHESP project revealed its vision to be similar to the goal of the participants in the *Jipemoyo* (take heart) project in Tanzania, though the latter was in the realm of development as envisaged by the affected villagers, the Maasai people (Swantz, 2008:33-35). It had transformational objectives that were fundamentally both political (Mahlomaholo, 2009:226-227, 233-235) and economic (Akiri & Ugborugbo, 2009:108), and was about the development of the Maasai people with whom they were also actively engaged. The BEST project in Botswana had a vision similar to the Tanzanian project, however it was led by and engaged the services and resources of government (Gboku & Modise, 2008:324-326). There were therefore supporting legislative imperatives for the formulation and implementation of both BEST and CHESP projects.

The *Jipemoyo* project offers the study an opportunity to appreciate the power of values- and principles-driven research. The humility, trust and respect that researchers and participants showed towards each other and their respective responsibilities was extensive, and enhanced the teamwork, collaboration and participatory actions that the participants displayed and cherished. These values were imperative and the extent to which the participants were embedded in their respective projects strengthened the success of the projects. For instance, researchers were from different nationalities, cultural backgrounds and experiences, including Finland (Finnish) and Tanzania (Tanzanians), working and staying with the Maasai and Kwere people (Swantz, 2008:34).

The actions/activities in the *To Hold Our Earth Firmly* project in Australia were also geared towards addressing issues of cultural differences, apparent between the indigenous and White Australian people (Hickling-Hudson, 2006:2-5). Other objectives targeted were collaborative learning skills, with students working in teams, sharing their views and experiences, and influencing each other's thinking; students' academic achievement, and critical thinking (McCrink & Melton, 2009:2005-2006) or social skills; and integration of art with philosophy and science (Hickling-Hudson, 2006:3; Kellner, 2000:1,3; Niemi, 2002:765). Similarly, through the processes of self-assessment, guided actions, analysis and reflection, the weaknesses relating to similar participatory approaches to research were addressed through the implementation of the *Jipemoyo* project (Swantz, 2008:34)

It was apparent that all these projects had initiators and/or 'champions', mainly from privileged positions of power (Osman & Attwood, 2007:18-20). They were however inclined to support and mediate (Kellner, 2000:9; Mahlomaholo & Netshandama, 2012:38) for the emancipation (Biesta, 2010:46-55) of the downtrodden and the transformation (Merriam & Ntseane, 2008:186-187) of their situation. The government officials in the BEST project and researchers and academics in the CHESP, *Take Heart*; and *To Hold Our Earth Firmly* projects used power to the benefit of the dominated groups. Such empowerment is also seen in the light of the projects that resulted and were based on the backgrounds of the respective dominated groups (Biesta, 2010:43-45). They became a legacy in the hands of the dominated groups for their sustenance.

Such legacies gave them hope that they would improve their situations and instilled in them the knowledge and attitude (Gboku & Modise, 2008:325; Swantz, 2008:38) towards learning from and through others, despite their poor level of formal education. Furthermore, the issue relating to the integration of cultural variables and knowledge acquired through schooling processes is enriched through collaborative efforts and teamwork. In order to ensure sustainability, continuous participatory monitoring (Gboku & Modise, 2008:326; Swantz, 2008:39) was imperative, also enhancing promotion of peace and motivating them to work progressively for the attainment of social justice (DePalma, 2010: 220-221; Hertz-Lazarowitz, 2010:271; Roschelle, Turpin & Elias, 2000:840)**.** Thus, the learning of Physical Science needed to be a social process, with the teacher a 'leader of group activities' as opposed to a ‘boss or dictator’ (Hammond et al., 2001:8). The next section attempts to make sense of participants’ collective experience (Stein, & Mankowski, 2004: 24, 28).

2.5 THE NEED FOR SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE FOR SUSTAINABILITY

The need for service learning to transform the learning of Physical Science is fundamentally a democratic imperative, with the ultimate focus on the transformation of society (Arenas, Bosworth & Kwandayi, 2006:23; Idowu, 2011:139-141). This should understandably commence with the emancipation of the individuals through their acquisition of emancipatory knowledge and skills. Service learning affords such opportunity as it brings the learning of Physical Science closer to the community. The need for academics and researchers (Swantz, 2008:33-34) as well as experts in physics (Salleh, 2004:5) to work closer with and engage their respective communities for purposes of transformation, enjoys public support and legislation (Hatcher & Erasmus, 2008:59; Mahlomaholo & Netshandama, 2012:43-45).

2.5.1 Implementation of educational legislative imperatives and public mandates

There is a need to work towards fulfilling the learning-related public mandates as contained in official and legal documents, which are often also informed and aligned with changes taking place in other parts of the world (Parker *et al.,* 2009:586). They also tend to determine the direction of social change. For instance, it is apparent that a democratic dispensation would direct social change democratically towards the attainment of a socially just society (RSA Constitution, s23). The learning related public mandate and legislative imperative in the RSA for:

> Equipping learners, irrespective of their socio-economic background, race, gender, physical ability or intellectual ability, with the knowledge, skills and values necessary for self-fulfillment, and meaningful participation in society as citizens of a free country; facilitating the transition of learners from education institutions to the workplace (DBE, 2011a:4).

This mandate and legislative imperative is based on the principles of 'social transformation; active and critical learning; human rights, inclusivity, environmental and social justice; valuing indigenous knowledge systems.' Furthermore, policy provides the aim of the National Curriculum Statement (NCS) Grades R-12 is, *inter alia,* to produce learners that are able to:

> identify and solve problems and make decisions using critical and creative thinking; work effectively as individuals and with others as members of a team; organize and manage themselves and their activities responsibly and effectively; collect, analyze, organize and critically evaluate information, communicate effectively using visual, symbolic and/or language skills in various modes; use science and technology effectively and critically showing responsibility towards the environment and the health of others; and demonstrate an understanding of the world as a set of related systems by recognizing that problem solving contexts do not exist in isolation (DBE, 2011a:4).

Based on the above, Mahlomaholo and Netshandama (2012:37) regard the legislative and policy frameworks as favouring the underclass communities in the RSA, although they allude to "the shadows of our horrific racist apartheid past still lingering in practice and, as such, holding progress towards transformation captive." This statement confirms the view that schools today are still unable to carry out their obligation towards transformation and community development (Mahlomaholo, 2012:46-47; Perold *et al.*, n.d.:53; Thomson, Smith-Tolken, Naidoo & Bringle, 2010:214-237). The captivity of progress of transformation in practice is from personal experience also traceable to the learning and teaching practices that take place in the Physical Science learning environments. These are neither transformational nor producing of emancipatory knowledge.

In the RSA, these manifest in learners' apparent inability to apply the knowledge they acquire from high school Physical Science learning environments to their real life situations. Reasons include the exclusion of modes of learning that appeal to the learners' cultural and social backgrounds, which is tantamount to social injustice (Hickling-Hudson, 2006:4-5; Mahlomaholo, 2012:46-48). This challenge is then depicted in the literature in the form it manifests, namely, the decline in learners' achievement or performance, particularly in Physical Science, as noted in Botswana and Nigeria (Asikhia, 2010: 229).

Koosimile (2004:483-496) investigated the extent to which progress had been made towards the transformation of science education in Botswana's schools. To this end an integrated science curriculum which is an amalgam of biology, chemistry and physics topics was implemented. The integrated science curriculum recognised and pursued the teaching and learning practices in the learners' immediate environment. Koosimile (2004:485) states that this was to "facilitate understanding and ease of transfer of skills and knowledge to real life situations". Gboku and Modise (2008:316) as well as Moxham, Dwyer, Happell, Reid-Searl, Morris and Wheatland (2010:1436), add that training should be culturally specific and flexible so as to cater for changes in the participants' situation. In the same vein, Merriam and Ntseane (2008:185) emphasise that transfer of skills and knowledge should be conscious of the cultural specificity of the learners. *Hammond et al.* 2001:2,11-15), Rocha-Schmid (2010:345-346) and Tatto (2006:239) contend that in order to further enhance the understanding and efficient transfer of skills, the power of self-reflection and critical thinking are worthwhile.

The study seeks to incorporate the principles of cultural specificity, flexibility, self-reflection and critical thinking. The transformational learning outcomes that correspond to the ones for RSA and that are relevant to this study are cited as to develop:

> an understanding of the basic principles and concepts of science as they are experienced in everyday life; positive attitudes towards scientific skills such as curiosity, open-mindedness, creativity, objectivity, integrity and initiative and an awareness and appreciation of the interrelationships between science, technology and society in the context of science and everyday life (Koosimile 2004:485; Ministry of Education (Botswana), 1995: i-ii).

A phenomenon similar to both in the RSA and Botswana was perceived in Nigeria, with Asikhia (2010:229), stating that around the country there is consensus of opinion about the fallen standard of education in Nigeria. This he traces to poor secondary school students' performance in different subjects, in turn attributed to, *inter alia*, the role played by teachers and the attitude of some to their work (Akiri & Ugborubo

2009:107,112; Asikhia 2010:234). Asikhia (2010:231) further categorises the causes of poor performance as the learners themselves, the home, school location and resources, interpersonal relationships, and relationship and society.

The secondary schools and therefore teachers and other key stakeholders in Nigeria need to transform the schooling system for the better. Otote and Omo-Ojugo (2008:654) indicate that schools are pressurised to make their "impact on society through the development of values that promote civic responsibility", and the centrality of the teacher's knowledge in this regard is to bring about educational reform. The challenges depicted are pedagogical, with an implied connection between how learning takes place and social problems, and therefore the needs of the people. The implied learning engagements include teacher-centeredness; performance-oriented and learners-centeredness, with an apparent need for transformational learning.

2.5.2 Team establishment for the mediation for transformation

The transformation of learning of Physical Science needs mediators (Kellner, 2000:3) who embrace CER principles, that is people who would not assume a neutral or disinterested role, but would declare their stance on the side of the oppressed and the downtrodden (Rocha-Schmid, 2010:355). This mediation should aim at and focus on rendering support and assistance to the government, community and society, declaring a transformational agenda (Mahlomaholo & Netshandama, 2012; Steinberg & Kincheloe, 2010:140-143), as has been the practice throughout history. Salleh (2004:5) made a similar observation, that throughout history the physics community has given assistance to the government, industry and society. A bold statement is also made expressing a view that people cannot be empowered unless they are scientifically literate, and that civic participation is required.

This study pursues the issue that people need to be scientifically literate through the participatory approach followed in the *Jipemoyo* (*Take Heart*) project. The study interpreted this as having been through the establishment and building of a mediating team for the transformation of learning of Physical Science through the use of service learning. In the *Take Heart* project, for instance, all seven team members had clear roles based on their areas of competence and skills. They also used these to the benefit of the project and community, with the team working with all participants through smaller teams (e.g., through Parakuyo Maasai and Kwere artisans, ethnomusicologist and an artist; geographer and an ethnologist). Neither working in smaller focussed groups or teams nor working according to the variant skills and competencies rendered the broader team effort disjointed. The coordinating team remained intact and united in its mission.

Idowu (2011:137) and Salleh (2004:8) depict the curriculum development team in Nigeria, and professional working teams in Malaysia, as having been established along similar principles to those in the *Take Heart* project. Hickling-Hudson (2006:4-7) in the *To Hold Our Earth Firmly* used what can be referred to as 'learners' study teams' through which they engaged with learning material. Emerging from these projects are two possible inter-subjective spaces for collaboration, namely, the interdisciplinary and school-community coordination. These depict internal processes of engagement or micro-level engagements (*e.g*., within the school) and external efforts or macro-level engagements (*e.g*., between the school and the society) (Van Dijk, 2008: Tudge *et al.*, 2009:6).

It can be argued that our inability to transform our situations for the better is indicative of the quality of our collaborative commitment thereto (Rocha-Schmid, 2010:357). The use of the CER principles in transformational service learning of Physical Science affords us an opportunity to "contextualize or historicize ideas in terms of their roots within social processes" (Kellner, 2000:7), which in turn compels us to support each other despite our shortcomings and hindrances. In turn we resort to our respective social and community capital, as familial and navigational, in order to combat our problems (Yosso, 2005:79-80). The use of service learning to transform the learning of Physical Science is geared towards support of the transformation agenda. It targets and relies on the community cultural wealth capital of learners deprived of their resilience, navigational and linguistic capital, to enhance their learning of Physical Science (Yosso, 2005:77-81).

2.5.3 Situational and contextual analysis for strategic collaboration to enhance the transformation of learning of Physical Science

The need for transformational learning is global, with Arenas, Bosworth and Kwandayi (2006:23) pointing to a Global Service Institute report that was published in 2003 that involved 57 countries, including Australia, Botswana and Nigeria. They indicate that educational reform should be geared towards the introduction of teaching approaches that foster closer working relations between schools and communities, and that: “the call for fostering community engagement through civic service has been embraced by governments, the non-profit sector and secondary schools worldwide” (Arenas *et al.*, 2006:23).

A further literature search for possible approaches to use for purposes of this study revealed service learning as effective yet underutilised. Parker *et al.* (2009:585-596) note that service learning has until recently been under-utilised within the Australian higher education system, despite its benefits. The specific model(s) from which this study seeks to draw best practices reveal(s) a need for transformation as laying emphasis on the appropriate learner identity (Gilley, 2005). In the RSA, service learning is predominantly utilised in institutions of higher learning and little, if at all, in secondary schools (Perold *et al.*, n.d.:53; Thomson *et al.,* 2010:221-227).

The above discussion addresses the need for transformation of learning based on the need to serve the people that the education is designed to serve. The poor learner performances at schools are merely an outcome of a much deeper problem, resident more in the quality and content of engagements among key partners in the learning environments. To achieve transformation the study argues for a critique of power relations that directly and indirectly affect the quality of the Physical Science pedagogic engagements. Rocha-Schmid, (2010:344-345) advocates a participatory approach to teaching in which affected individuals take charge “of transforming their lives through an awareness of the power relations present within their societies and of the role they play in these dynamics”.

In order to operationalise this transformational participatory learning facilitation process, clear objectives and action strategies become imperative, which should in turn be contributed to by the participants and the affected society, if they are to be authentic. As such, Rocha-Schmid (2010:345) advises that a situational analysis be conducted for the "identification of a context for analysis, which should be directly relevant to learners' concrete reality." This is evidently pursuant of addressing prevailing school-community needs and problems, in line with the realisation of learners' own contexts, cultures and experiences'.

2.5.3.1 The learners' pertinent contextual issues

The policy imperatives in the RSA oblige a learner to learn to "use science and technology effectively and critically showing responsibility towards the environment and the health of others" (DoE, 2003:5; Mahlomaholo, 2012:48). This has direct implications for the learning of Physical Science and requires that the learners ultimately be able to use the physical environment sustainably, as they and the society would benefit from this. Furthermore, it addresses the need to sustain life.

To use science and technology effectively, the learner requires the support and resources that are supposedly available, and the requisite skills and competencies, and presupposes that such are to be organised in one way or another. The potential shortcomings in organising or providing such resources are however not to be conceived as excuses for uncritical and irresponsible acts towards the environment or the health of others. However, there remain challenges, thus the impact of historic societal inequalities and cultural exclusions justify using service learning to transform that of the Physical Science. The learners' emancipation and social transformation are thus imperative (Biesta, 2010:43; Nkoane, 2011:112-113; Mahlomaholo, 2012:48-49; Merriam & Ntseane, 2008:187; Osman & Attwood, 2007:17-18).

The learner's aspirational and navigational capital is thus pivotal to overcome the immanent learning barriers created by inequality, and will help the learner to forge his/her way towards self-empowerment and ultimate emancipation from the effects of social injustice (Hickling-Hudson, 2006:6-7; Mahlomaholo, 2012:49, 52, 54; Yosso, 2005:77-81). This is based on an assumption that neither the African learner's culture nor his/her intelligence is inferior to those of his/her counterparts, thus, the prevalence of potential for emancipatory knowledge derived from the community's cultural wealth (Biesta 2010:55). The learners' innate traits are critical to his/her learning for emancipation.

The other innate contextual factors that are recorded as having an influence on academic performance of learners include gender, ethnicity, motivation, intellectual aptitude, personality of the learner, and self-confidence (Akiri & Ugborugbo, 2009:112). Salleh (2004:10) writes that it is the psychological cognitive interaction with the socio-cultural influence that affects students' readiness to learn physics. These and other extrinsic contextual factors tend to be the basis for ideological and power differentials in the learner's empowerment process. Their combined influence, the study contends, manifests in the learner's underperformance in Physical Science as well as in the physical and social environments. This, Mahlomaholo (2012:48) contextualises as a form of social injustice traceable to the exclusion or marginalisation of the African learners' ways of knowing and being, in the curriculum.

The learners' ways of knowing are fundamentally to their multiple engagements with their parents/families, other learners/peers and members of their respective communities and society. This creates space, therefore, for the participation of other partners in the empowering knowledge creation processes. Learning is fundamentally a collaborative effort (Hickling-Hudson, 2006:9), inescapably imbued with ideological, cultural and power differential realities that need critical consideration.

2.5.4 A vision of transformation

It is of paramount importance that participants decide upon and commit to their mutually agreed goal or aim, derived from and based on legislative imperatives and public mandates. The participants' situational and contextual analysis processes take cognisance of the strengths and opportunities resident in the legislative and public mandates, juxtaposed with addressing the weaknesses and threats that may be found to prevail in their situation. The goals that emanate from these processes should then serve as their vision. In order for this to be attained they have to decide and agree upon sets of principles and values that will guide their collective conduct and the processes. The focus on attainment of vision developed in this manner influenced the success of the above discussed projects, namely *Take Heart* and *To Hold Our Earth Firmly*.

This was the drive behind the persuasive attitude of the project champions, such as Hickling-Hudson in *To Hold Our Earth Firmly* and the seven team members in the *Take Heart* (see paragraphs 2.4.1.3). They focussed their attention on the goals of their respective projects and used this to steer them accordingly. In the process they ensured that the participants were not on different sides of a socio-economic, technological or cultural divide (Idowu, 2011:138), but rather that they took critical stances on their respective programmes and challenged discourse practices and power relations by stepping outside their familiar areas of control to confront disempowering environments. Their aim was the empowerment of the downtrodden community and equitable recognition of the suppressed indigenous cultures (Koosimile, 2004:490-491; Rocha-Schmid, 2010:346). Thus, these projects can be said to have had reapective teams of people who led them (Hammond *et al.*, 2001:8; Koosimile, 2004:490; Tatto, 2006:238).

2.5.5 Strategic partnering: support for transformation

Transformation is strengthened and made possible when people from diverse backgrounds work together and learn from each other (Nkoane, 2010:119), and service learning strategies afford such diversity space for engagement (Mahlomaholo & Netshandama, 2012:38) of issues relating to Physical Science. Evidently, transformation seeks to allow the affected downtrodden participants to participate critically in their own liberation (Biesta, 2010:55), as confirmed by Salleh (2004:10):

> … the physics experts and teachers are not really in touch with one another, physics learning boils down to acquisition of facts rather than training and development of cognitive skills needed for knowledge understanding and content acquisition, mathematical skills needed for practical and theoretical work, and skills needed for development of the right attitude towards physics and learning of the subject matter.

This sheds more light on the reason institutions of higher education in the RSA were made to move closer to the communities (Hatcher & Erasmus, 2008:53), that is to ensure that experts were closer to and worked with the teachers, that is the experienced worked closer with the novice (Salleh, 2004:4). It is evident from the literature that there were power differential realities experienced in the attempts to operationalise this politically motivated transformational agenda (Arenas *et al.*, 2006:27; Parker *et al.*, 2009:592). Regrettably and understandably, there were some difficulties experienced in levelling or balancing these power relations, therefore this study's attempt to trace the inability to its root cause becomes irrelevant. It is a matter for further research, leaving this study to enhance and foster the establishment of such strategic collaborations to support the use of service learning to transformation of learning of Physical Science. The *Jipemoyo* project offered some guidance in synergising diverse experiences of the willing and available strategic partners (Howard, 1998:25-27).

2.5.6 Alignment of strategic partners' programmes

The alignment of programmes of participants and strategic partners with the aim and objectives of the study serves to ensure mutual benefit, because the alignment process considers and respects their backgrounds and instils hope that their viewpoints, aspirations, desires, interests and expectations are given equitable consideration, as happened in the *Take Heart* project. The participants' diversity converged as mutual understanding of the concept of development from the Maasai peoples' perspectives.

For instance, the *Take Heart* project was steered by a multicultural and multidisciplinary team, through which the community of the Maasai were engaged and actively participated in the processes of their own development (Swantz, 2008:34). Their engagements in the project appear to have been from its concept stage (conceptualisation) through its planning and implementation. There also appeared to have been constant close contact and engagements amongst the participants. The diverse issues that needed to be aligned emanated from their cultural backgrounds because some were of Finnish and others Tanzanian origin. They also had various skills and competencies, as could be deduced from their status as artisans, an ethnomusicologist, an artist, a geographer and an ethnologist.

Evidently, these were reflective of diverse interests and aspirations, and meant that their points of view on the issues of development would be different and be influenced by their background knowledge, belief systems and values. As they also used a participatory action research approach their engagements have been characterised by moments of reflection and self-reflection. For instance, the researchers acknowledged their lack of knowledge of what the Maasai considered development, a realisation understood to have been a result of reflection, that is, self-assessment, self-evaluation and self-reflection, arrived at by the researchers and the academics. These had been built in the *Take Heart* processes and contributed to the alignment and synergy of diverse experiences and knowledge.

2.5.7 Moments for reflection

The concept of reflection is understood to be indicative of mechanisms or methods and or processes that are used in order to establish the extent to which learning has taken place. It is as such part of learning (Molee *et al.*, 2010:240-241), and the reflective processes and mechanisms or methods tend to be imbued with power relation issues. Education and therefore learning cannot be divorced from politics (Osman & Attwood, 2007:17-18), as argued by Agger (1991:119) when critiquing the concept and use of methodology in research. The method of reflection, for example, "is not simply a technical apparatus but a rhetorical means for concealing metaphysically and politically freighted arguments in the densely technical discourse/practice of quantitative analysis and figural gesture" (Agger:1991:119). This suggests that reflective practices and/or processes should also be subjected to critical scrutiny as they may influence the quality and extent of attainment of learning outcomes (Molee *et al.*, 2010:241). The notion is illustrated by referring to reflective practices that relate to the transformation said to be brought about through service learning. In this regard, Kiely (2005:17-18) states that:

> those who uncritically accept the hegemony of the constructivist reflective tradition, particularly in terms of justifying normative claims regarding the "value" of service-learning as transformative practice, are missing important non-reflective components that might better explain how service-learning leads to long-term perspective transformation [and that] researchers should also generate knowledge of, and develop theories about, the contextual, visceral, emotive, and affective aspects that enhance transformational learning in service-learning.

In the same vein, Liasidou (2008:487) advises in relation to the focus of analysis during such (our) 'critical' reflective processes that:

> in particular the analyst should focus primarily on a social problem which might be rooted either in the activities of a social practice, in the social practice *per se*, or in the representation of social practice. Not being restricted to text but extending to the interrogation and dismantling of the subjectivities construed in the text.

Evidently, the reflective process involves the active participation of those who were targeted to learn (learners) as well as the ones who were to facilitate that such learning should take place (teachers). The process extends beyond the people involved by including their social contexts, namely social problems, social practices, and interrogation of subjectivities embedded in the texts. The engagement in such rigorous reflective praxis is "key to strengthening the power of service learning" as it provides "rich sources for documenting students' descriptions about what they are learning in a course, the depth of their learning, and how critically they are thinking about it" (Molee *et al.*, 2010:241). Thus, reflective practices are imperative and inevitable**.**

2.5.8 Collaborative learning opportunities

This section discusses opportunities that the social structures at school afford the learners of Physical Science. They manifest as learner-parent; learner-learner; learner-community; and learner-teacher engagements, all of which are inherently imbued with power relations (Idowu, 2011:135,137; Koosimile, 2004:490); cultural disparities; socio-economic; and a plethora of learners' variant contextual issues (Rocha-Schmid, 2010:354-355; Salleh, 2004:4-5), all of which affect the learner. Gboku and Modise (2008:325) remind us that learners bring with them experiences and values from different backgrounds and walks of life, as well as different expectations about the learning process and patterns of learning acquired from previous situations. In the same vein, Rocha-Schmid (2010:355) indicates that critical teachers, researchers (Nkoane, 2009) and, by extension, parents bring to the interactions ideological positions as critical educators. They also bring their "views about perceptions on patronizing practices imposed by the school," which consolidates the view expressed by Hickling-Hudson (2006:2) about teachers' understanding of postcolonial perspectives, by which to make sense of their engagements with learners, parents and the broader society.

2.5.8.1 The learner-parent engagements: as support structure for the use of service learning to transform the learning of Physical Science

The learners are to be empowered to "work effectively with others as members of a team, group, organization and community" (DoE, 2003:2-5), a legislative imperative that confirms the participatory and collaborative character of learning (Magill, 1996). There is a connection between learner attainment and the support the learner receives at home. Yosso (2005:79) discusses the significance of familial capital through which cultural knowledge is nurtured, regarding it as a mode of knowing that is conceptualised in this study as being critical to the enhancement of learning communal and social values and principles. These principles have the power to enable the learner to work effectively with others, confirmed by Asikhia (2010:231), for whom the family is the primary socialising agent.

2.5.8.2 The learner-learner engagements: as support structure for the use of service learning to transform the learning of Physical Science

The school offers the learner an opportunity to socialise with other learners (Asikhia, 2010:231), who are often faced with tasks and challenges that require their engagement with each other in teams and groups that are established spontaneously, however this need not be taken for granted. They tend to define the teams' establishment and variability, for instance, along the lines of race, ethnicity, gender, age, grade and resourcefulness. The synergy of learners' familial, linguistic and resistance capitals help entrench collaborative learning (Hickling-Hudson, 2006:2-4; Mahlomaholo, 2012:56-58; Yosso, 2005:78-81), therefore it is important that the facilitation of learning of Physical Science takes cognisance of this and seeks to obtain their deeper meaning for possible beneficiation of the Physical Science learning environments.

2.5.8.3 The learner–parent (community) engagements

The familial and social capitals entrenched through learners' social and learning teams have the potential to extend to the community (Mahlomaholo, 2012:57; Yosso, 2005:79-80). The learners could be enabled to interact with members of the community with respect and care, thus enhancing the achievement of the legislative requirements in respect of sustainability of the physical environments. The achievement in this respect spirals out to influence the broader society, however it requires the organisation of physical and human resources in such a way that they enhance effective learning. Rocha-Schmid (2010:353, 356) provides evidence of an attempt to engage parents in discussion of interactions with their children's teachers, and to raise awareness of teacher and the school responsibilities on issues commonly attributed to their children's failure. Past studies point to a failure to acknowledge the parents' views as an opportunity to debate these issues. A power relation struggle is not only an issue between teacher and learners.

2.5.8.4 The learner-teacher engagements: as facilitation of transformation of learning structure

The learners have to "demonstrate an understanding of the world as a set of related systems by recognizing that problem solving contexts do not exist in isolation" (DBE, 2011b:5), which requires facilitation by the teacher. For this to happen, the context within which learning takes place and from which the content is derived should be fully understood. The emphasis may differ from one situation to another on the basis of the specific priority agenda item(s), as illustrated in the preceding paragraphs. It is logical that the critical emancipatory research informs these engagements, because it encourages: transformation of people's worlds and reality for the betterment of their lives; the production of relevant and valuable knowledge; collaboration, cooperation and teamwork; emancipation from all forms of bondage, including ideology, poverty and powerlessness; and it discourages passivity and fatalism (Biesta, 2010:53-56; Mahlomaholo & Netshandama, 2012).

This presupposes a need to reorganise the learning environment in ways befitting this achievement of purpose. An organisation should also consider its sustenance for future use, as learning is a process not a once-off event. The skills can be learned through teaching and training as well as through practical experiences to which the learner must be exposed (Arenas, Bosworth & Kwandayi, 2006:23-40; Gboku & Modise, 2008: 322; Koosimile, 2004:486; Mahlomaholo; 2012:52-55; Merriam & Ntseane, 2008:185; Otote & Omo-Ojugo, 2008:655).

2.5.9 Learning not facilitated through sustainable empowering learning environments

The choice and use of teaching strategies tends to be influenced by factors such as the aspirations, expectations of learners and the public, often regarded as mandates to be executed and incorporated into curriculum policies (Idowu, 2011:135). The vision and purpose of learning often determines the methods of teaching (Idowu, 2011:139; Koosimile, 2004:485-486), which in the area of this study were inclined to be examination-oriented, inconsiderate of learners' immediate backgrounds and teacher-centred. Through these practices, the learning of Physical Science was thus outside the scope of sustainable empowering learning environments (Mahlomaholo, 2010:11-12).

2.5.9.1 Examination-oriented teaching practices

The achievement of agreed upon outcomes and outputs as indication of performance is natural and inevitable (Salleh, 2004:10), and the teacher's performance is arguably pitched at the learning outcomes achieved by the learners (Akiri & Ugborugbo, 2009:108; Asikhia, 2010:234; Koosimile, 2004:484). This is determined on the basis of the average pass percentages that learners attain in tests and/or examinations (DBE, 2011a:), and that are critical to parents, the public, policymakers and administrators (Koosimile, 2004:484; Perold *et al.*, n.d.:53-55; Servage, 2008:65). The determination of learners' pass rates as teachers' performance indicators often disregard contextual realities, which encompass but may not be limited to learners' cognitive capabilities in Physical Science and related subjects; input and role of other partners in the learning of Physical Science; and lack of basic Physical Science resources.

The result of this discursive practice tends to influence the teachers' choice of learning facilitation strategies, thus the approaches that focus on the number of learners who should achieve set outcomes as per the predetermined target tend to be preferred. This leads to the exclusion of slow or weaker learners from the learning facilitation processes and the setting of lower standard tests and examinations aimed at gaining higher pass rates. These two observed practices compromise the learners' understanding of Physical Science principles and concepts.

Such practices were manifested in or on technical aspects of the assessment of the learners' work. In this regard they focused on Physical Science examinable material to the exclusion of the prescribed non-examinable material. This created gaps in learners' creation and acquisition of potential emancipatory knowledge, and tended to exclude the inculcation of social skills in learners (Niemi, 2002:764-765). It involved focusing on how marks are allocated with a view to showing learners how to gain 'easy' ones. They also encourage learners to memorise and 'regurgitate' facts, such as definitions of concepts and scientific principles and laws. This too requires thorough critical engagement on continuous bases with policymakers or curriculum material. The success of these engagements thus lies in the use of CER principles in transformational service learning.

2.5.9.2 Teaching approaches that abstract learning of Physical Science

The Physical Science teaching practice should take cognisance of contextual factors in order to enhance learning (see Chapter 2 paragraph 2.5.3 and Chapter 4 paragraph 4.2.3). Salleh (2004:10) confirms this, as: "… in the learning of physics, the psycho-emotive, motivation, social and cognitive dimension of growth and development cannot be ignored." Thus, the teaching of Physical Science should not focus on facts and practices of physics, for as Koosimile (2004:490) contends, this leads to what is referred to as content-oriented pedagogical problems or a science-centred approach. Idowu (2011:140-141) advises Physical Science teachers to familiarise themselves "with the level of development of the child and adopt the best means of conveying the ideas to be put across", whilst Rocha-Schmid (2010:355) adds issues of teacher-learner, learner-learner and parent-teacher power relations with which the teachers must also grapple.

Clearly, the above has far-reaching implications for the teacher preparation programmes as it relies on their capability and competencies, placing them at the interface between parents' expectations and an education department's policy implementations (Gboku & Modise, 2008:325; Rocha-Schmid, 2010:355**;** Tatto, 2006:239). These expectations are not in conflict with each other on a theoretical level, however, it can be argued that they are misaligned to practice (see Chapter 2 paragraphs 2.5.6 and Chapter 4 paragraph 4.2.6). This is embedded in limitations associated with pedagogical praxis, such as the orientation towards content or completion of the syllabus to the exclusion of the learners' contextual realities (Salleh, 2004:10). This practically means that teachers' focus is removed from learners' understanding' construction and testing of theories of rote learning (Tatto, 2006:237-238:) influencing the way science is conceptualised and hence taught. According to Salleh (2004:10), learning methods that are embedded in real situations are not merely useful but needed, corroborated by Rocha-Schmid (2010:345) who postulates that the way the context should be explored and used as an object of learning by educators and learners is just as relevant as the context of knowledge.

The teacher preparation and hence intervention should help address the Physical Science content-oriented pedagogical problem, espoused above. To this end Tatto, (2006:237-238) contends that:

> in the practical realm it is clear that both professional and technical preparations are important for success in the classroom, teachers must exercise both professional discretion and adhere to bureaucratic rules and standard practices.

Hickling-Hudson (2006:2) states that "students of education need to understand postcolonial perspectives to make sense of their studies," which should inevitably help teachers to rise above their respective situations and open up for support and hence social transformation.

2.5.9.3 The teacher-centred teaching practices

The teacher-centred learning facilitation of Physical Science practices prevails in learning encounters (Idowu, 2011:136), the reasons for their apparent dominance including a tendency to display and show off the subject knowledge he/she commands (Koosimile, 2004:490); voluntary or involuntary adoption of methods learned from others or even from teachers training institutions (Rocha-Schmid, 2010:353); and deviation from or lack of shared vision or common goal. The diversion of attention tends to be as a result of focus on 'subsidiary' objectives, such as need to complete the work prescribed by the syllabus (Salleh, 2004:10). The issue pertaining to the completion of work is in itself not a problem, however it tends to be in conflict with and supersede the learners' cognitive abilities and competencies in Physical Science. Focus is removed from learners' understanding, construction and testing of theories (Tatto, 2006:237) and teachers become bogged down in compiling evidence that they have done the work and treated all topics (Servage, 2008:). This affects their teaching strategies immensely as they resort to rote learning strategies, resulting in learning facilitation of Physical Science geared to the teachers' completion of the work prescribed for the year. Thus, learners are obliged to learn at that pace, based on the assumption that their contextual, physiological and psychological challenges are constant and ineffectual. This tends to reduce challenges into an average that befits the Physical Science content prescribed for a specific grade. Such a positivistic approach will not help the researcher in this study to facilitate transformational learning.

The teacher's responsibility to complete the work as predetermined is generally acceptable (Salleh, 2004:10), and is an inevitable discursive practice that requires the power to decide on the choice and use of enabling learning facilitation strategies. The teacher is thus most powerful in these setups (Servage, 2008:72-73), setting the pace for learning. This is also supported by the official pace-setters or work programmes but must be levelled off and appropriately located. The teacher or researcher is central to empowerment of the emancipatory process (Niemi, 2002:764).

2.5.10 The learner-centred Physical Science teaching practices

The underlying principle for the use of service learning to transform the learning of Physical Science is that it should be predominantly learner-centred, and thus facilitated through sustainable empowering learning environments (Mahlomaholo, 2010:11-12). Its teaching, planning, execution and assessment should pivot on the learners' needs, aspirations and expectations (DBE, 2011a, 2011b; DoE, 2003:2-5)., often identified and addressed through strategies such as problem-based (Whitfield, 1999:106-107), problem-solving and self-directed learning. Often in these setups the learners are encouraged to interact to support one another (Merriam & Ntseane, 2008:196; Niemi, 2002:763-765) as the teacher tends to 'disempower' and facilitate the interaction of the learner with the 'physical' environment or learning material independently to discover and to create knowledge. The teacher's focus is that of a facilitator and an organiser of appropriate resources and materials to support the learner's engagements (Biesta, 2010:53-56; Gboku & Modise, 2008:317-319).

However, the challenge lies in the multiple power differential realities that are associated with and inherent in the organisation. The challenges may be cultural or political, depending on the nature of the resources being organised. Furthermore, there exists a possibility of confusing learner-centeredness with rote learning drilling methods (see paragraphs 2.5.8 and 2.5.10), for instance when learners are given more activities and tasks to serve as evidence that the teacher has actually complied with his/her mandate. This is for the teacher to account in response to the demands of the policy imperatives (Salleh, 2004:10; Servage, 2008:65), an aspect taken for granted and affecting the design of Physical Science learning facilitation strategies and plans (Osman & Attwood, 2007:16).

These power differential related realities require the teachers' or researchers' deeper understanding and critical analysis of the participants' world views and viewpoints. The ultimate purpose is to ensure that the participants' power differentials are levelled off so that their impact on learning facilitation is conceptualised positively (DePalma, 2010:216; Mahlomaholo, 2009:225-226). These strategies are not necessarily transformational or emancipatory (Biesta, 2010:45), therefore it is important that the researcher/teacher should operate within an enabling framework, for instance CER in this study.

2.6 COMPONENTS FOR THE USE OF SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE

The components in this context refer to the actions and activities that constitute the solution to the challenges or needs identified in paragraph 2.4. These are fundamentally the elements of the strategy that can address the use of service learning to transform the learning of Physical Science such that it is sustainable. The literature in this regard has shown that service learning is conceptualised and operationalised differently, as a result of its wide and variant contexts (see Chapter 2 paragraph 2.3). Pertinent components and elements of service learning and the information, lessons learned, and knowledge derived from the best practices alluded to in paragraphs 2.2 and 2.3 above are used to develop the components for the use of service learning to transform the learning of Physical Science.

Osman and Attwood (2007:16) indicate that in South Africa service learning is depicted in the literature as having the following components: thoughtfully organised experiences; structured time for reflection; extended learning opportunity; and development of a sense of caring. In Botswana, service learning highlights the integration and community cultural wealth in addition to the above (Gboku & Modise, 2008:322; Koosimile, 2004; 483-484; 489). These principles are similar to those guiding service learning in Nigeria, though there is more emphasis placed on the role of the teacher; accessibility to educational material and infrastructure, as well as cognitive stimulation as major aspects (Asikhia, 2010:234). The model from Australia QUT, on the other hand, emphasises prior experience and personal insight as new aspects (Gilley, 2005).

Parker *et al.* (2009: 591-593) stress that reflection is a critical component of community service learning and that it intentionally ensures equal focus on both the service being provided and the learning that is occurring. Notwithstanding the differential emphasis of service learning from one country to another there is sufficient convergence of reflection as a critical component thereof. Reflective practice is described by Parker *et al.* (2009:588) as an active, dynamic action-based and ethical set of skills, placed in real time and dealing with real, complex and difficult situations. It assists the learners to link their service with their learning.

From the diverse conceptualisation and operationalisation of service learning in diverse contexts it is evidently concerned with the reciprocity (Bringle & Hatcher, 2009: 38; Gboku & Modise, 2008:322; Osman & Attwood, 2007:16; Young, Shinnar, Ackerman, Carruthers & Young, 2007:346) between learning and serving. All other components are fundamental to the extent that they enhance the reflective practice to the mutual benefit of both serving and learning that constitute learning environments. The participants are central to the success of the reflective practice as they determine actions to be taken, decide on situations to be interacted with, and have their own set of ethical skills. This explains why the role of the teacher is critical to the learning environment (Akiri & Ugborugbo, 2009:107; Koosimile, 2007: 488; Mahlomaholo, 2010: 3-7; Tatto, 2006:237-239; Whitfield, 1999:108). A closer study of the reasons for different conceptualisations lies in the purpose of service learning and the contexts, not in its principles *per se*. These contexts are based on different political, cultural and economic setups that are so close to each other as to converge (Van Dijk, 2008:90).

There is sufficient agreement in the literature regarding service learning's multifaceted character, depicted as not focusing on one facet in the learning environment (Bringle & Hatcher, 2009: 38; Gboku & Modise, 2008:322; Osman & Attwood, 2007:16; Young, Shinnar, Ackerman, Carruthers & Young, 2007:346). Arenas *et al.* (2006:28) address this issue by raising a concern of "questionable practice that affects many school-related civic service programmes that focus solely on the growth of students, ignoring the consequences for recipients or the community as a whole." The uniqueness of service learning lies in its drawing from various theoretical models that include asset-based approaches to community development and approaches to participatory action research that fit the context and short-term nature of the programme (Burr 1999:7-8; Rocha-Schmid, 2010:344; Terry & Bohnenberger, 2004:20-21; Thomson, Smith-Tolken, Naidoo & Bringle*.,* 2010:231-233).

Central to this study is the critical emancipatory theoretical framework, used with the underlying purpose of transforming Physical Science learning environments. It is specifically geared towards changing even those social settings that lead to dependence on false assumptions, and so will ensure that service learning does not degenerate into volunteering and ordinary community service. The notion of noticeable or tangible outcomes as an indicator of change is paramount. It is even more important if such tangible outcomes enhance sustainability of this reflective practice (Parker *et al.,* 2009:587-589).

The Physical Science learning environments are dynamic and multidimensional (Alexander *et al.*, 2010: 294-295, 300; Department of Basic Education, 2011b: 8; Gboku & Modise, 2008:318), not confined to the classroom or the laboratory, and cannot be transformed through the uni-dimensional lesson plans or rigid teaching strategies (Arenas *et al.,* 2006:26; Parker *et al.*, 2009:586-587; Tatto, 2006:236-237). Transformation of learning Physical Science through service learning, as described earlier in this chapter, corresponds with service learning. They both advocate the need for true dialogue between benefactor and recipients in order to avoid perpetuation of forms of oppression and dehumanisation between people (Arenas *et al.,* 2006:28). This consolidates the use of this strategy in this study.

The prevalent synergy between theory, process and practice necessitates the consideration of all the mentioned components as components of the transformational learning through service learning for purposes of this study. The eminent observation that some components may be the same if not for their respective contexts is immaterial and will therefore be clarified in the next chapter(s). The service learning strategies and projects studied were operationalised in different contexts and under different conditions, necessary though not necessarily conducive for the use of service learning to change the learning of Physical Science.

2.7 CONDITIONS CONDUCIVE TO THE USE OF SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE

Thomson *et al.* (2010:227) indicate that in the RSA and the Democratic Republic of Congo (DRC) service learning "evolved under unstable conditions marked with a paucity of resources and opportunities for experimentation and research." Thus, the prevalence of opportunities for experimentation and research as well as availability of relevant resources constitutes critical conditions for implementation. Conversely, their respective scarcity does not hinder its development or implementation. The need to establish collaboration between schools and their respective communities such that learning can be meaningful and useful (transformational) to learners can also be a critical condition for the implementation of transformational service learning (Itin, 1999:97; Koosimile, 2004:490-491; Rocha-Schmid, 2010:344; Thomson *et al.*, 2010:225-229). Therefore the importance of supporting legislative imperatives cannot be overemphasised (Gboku & Modise, 2008:319-321; Idowu, 2011:135-136; Mahlomaholo, 2010:3).

2.7.1 Advancing democratic policy imperatives

The need for the advancement of democratic principles towards the creation of a socially just society has influenced the RSA in developing and implementing relevant policy frameworks. The institutions of higher learning in the RSA, Nigeria and Botswana are said to have been politically and legislatively mandated to be responsive to the local and national development needs (Arenas et al, 2006:23-24; Asikhia, 2010:229-230; Hatcher & Erasmus, 2008:50; Koosimile, 2004:484), which led to the introduction of service learning pedagogy in the universities. In the same vein, community service was later introduced for secondary schools in the RSA (Osman & Attwood, 2007:16; Perold *et al.*, n.d.: 53-60), accompanied by the introduction of the underclass supporting legislative policies and a legislative framework in support of social transformation (Equal Education, 2010; Mahlomaholo, 2012:46-47; Mahlomaholo & Netsandama, 2012:37).

These, however, did not bring about the envisaged results, for reasons traceable, *inter alia*, to perceived legitimisation of the historic social injustices in the learning of Physical Science. Notwithstanding its potential to contribute to the economic and sustainable development of the community and the country, it is amongst the subjects that perform poorly (Alexander *et al*, 2010:300). The exclusion of African learners' modes of learning from the curriculum, and the scant efforts towards the implementation of the legislated critical cross field outcomes and community service, are a manifestation of the perceived legitimisation (Mahlomaholo, 2012:56-58; Perold *et.al.*, n.d.:62).

Similarly, in Botswana, there is government and political will towards social justice, the government having realised a need for engaging with the people over their own development. Gboku and Modise (2008:317) indicate that the present aim is to reduce the dominance of government while increasing the participation of the targeted beneficiaries in their own development projects and programmes. A clear indication of this are the basic extension skills training (BEST) which adopted and adhered to learner-centred teaching and learning principles. Koosimile (2004:484-485) adds that the Revised National Policy on Education of 1994 provided a shift in paradigm and values on education through the provision of locally relevant curriculum. The curriculum advocated that learners be orientated towards social, cultural, political and economic life.

Asikhia (2010:230) reports that in Nigerian secondary schools the government is concerned that the education system is not yielding the desired results. Secondary education is perceived as an investment and an instrument to be used for the country's attainment of economic, social, political, technological, scientific and cultural development. He continues to point out that the national policy on education should foster the worth and development of the individual for further education and development, general development of the society and equality of educational opportunities to all Nigerian children, irrespective of any or marginal disabilities. These legislative provisions are indicative of the political will of government towards transformation for social justice, despite the apparent failure to achieve the desired objective. These statements are corroborated by Akiri and Ugborugbo (2009:107-108).

Such conditions, however diverse, support the implementation of transformational service learning of Physical Science. Furthermore, the difficulties accompanying the implementation of transformation initiatives are connected to power differential realities. The changes, as with government paradigm shifts regarding empowerment of people, are potentially to be met with resistance from those who derive comfort from the distress of the oppressed.

2.7.2 Democratisation of teaching and learning of Physical Science – optimal utilisation of resources

The scarcity of education-related resources is common to the RSA, Nigeria and Botswana, though in varying degrees (Thomson *et al.*, 2010:230-231), and includes the scarcity of good and qualified teachers of Physical Science (Koosimile, 2004:490; Salleh, 2004; Tatto, 2006). This happens even though there are institutions of higher learning with experts and specialists who do not engage each other more in addressing this gap (Idowu, 2011). This results in the under-utilisation of inherent competencies and skills. Researchers tend to record findings and recommendations that do not necessarily involve active participation of respective communities, and lack operationalisation of any sort. The study contends that these conditions should compel education practitioners envisioned as scholars and researchers to interact with their respective communities. They should become members of their communities in the true sense, and identify in communities those projects and services that can be linked to the regular curriculum. This they do in order to pursue service learning while addressing real live problems that confront their communities

(Akiri, 2009:112; Asikhia, 2010:234). The negative impact that goes with scarcity of resources is notably fatal to education and learners, and therefore the nation's future.

2.7.3 Enhancing motivational levels: learner readiness and motivation to learn

Koosimile (2004:489), writes that in Botswana teachers generally assume that learners are prepared for tasks and nothing is done to ascertain or subsequently facilitate their readiness to engage in the activity. Teachers hoped that the teaching episodes would naturally stimulate thought, interest and learning, and so enhance knowledge transfer, application and abstraction. However, it resulted in the weak provision of learning guidance with relatively little or no prospect of learners achieving desired competencies of linking their personal experiences to science taught at school. Idowu (2011:134) adds that teaching of science concepts should be from the known to the unknown, so that learners comprehend them fully and not lose interest.

2.7.4 Enhancing school-community collaboration and coordination

The experience, knowledge and skills in some sector organisations are viewed in this study as potential assets to learning as they are to service. This asset needs to be unravelled using relevant techniques from a myriad of transformational learning, through service learning as espoused in the earlier sections of this chapter (Burr, 1999:9, 13-17). This makes the teachers' roles of researcher and scholar in participatory action research even more fundamental (DoE, 2003:5; Wicks & Reason, 2009:249, 256), because the organisations need to be involved from the outset in the process of identifying critical activities and decision making. These organisations should therefore be part of the operationalisation programmes and processes, akin to reflective practices and/or critical activity, and solutions to their problems, in order to sustain them. They should understand the operations of their social structures, ethical and cultural bases (Wicks & Reason, 2009:245), so instilling a sense of belonging and ownership of the process of community-school integration. True dialogue is key in facilitating these engagements (Arenas *et al.*, 2006:28; Wicks & Reason, 2009:255).

For Parker *et al.* (2009:587), community service learning in Australia has been under-utilised and universities were slow to embrace it as an academic model. Also, it was used on an ad hoc and somewhat reactive rather than proactive basis. There is relative stability of the political, economic and social environments, and these relaxed socio-political and economic conditions favour transformation (Thomson *et al.*, 2010:227). Conditions that are characterised by oppression dehumanise and instil fear in people and are not favourable for a critique of learning environments.

The combined negative impact of these and other conditions (Akiri & Ugborugbo, 2009:108; Koosimile 2004:492; Parker *et al.,* 2009;592-593) serve as a motivation for the study at high school level. The conditions in the RSA universities are generally not different from those that prevail in the further education and training band, which invariably prepares learners for higher education, which therefore affords the institution of higher learning an opportunity to optimise the utilisation of service learning for the better (Van Niekerk, 2010:277-282; Alexander *et al.*, 2010:290-292).

Service learning is amenable to risks and threats when not properly planned for and implemented (Molee *et al.,* 2010:240; Wallace, 2000). It is a new approach that is geared towards transformation and takes place within the relatively unstable and/or dynamic socio-political and economic environments. Embedded within these are elements of uncertainty and fear of the unknown among communities and participants (Roschelle, Turpin & Elias, 2000:843-846) (also see Chapter 4, paragraph 4.5). It is for this reason that the study discusses, in the next section, the potential threats and risks to being proactively mitigated against, in order to enhance successful implementation of transformational service learning**.**

2.8 THREATS TO AND RISKS IN THE USE OF SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE

Arenas *et al.* (2006:33-36) give an international perspective of the main hindrances to the implementation and sustainability of effective civic service, of which service learning is a subset. These authors categorise the hindrances into conceptual, financial, power differential, evaluation and pedagogical issues, discussed below in relation to the RSA, Botswana, Nigeria and Australia.

2.8.1 Conceptual issues

Understandings of concepts such as service learning, participatory action, transformation and emancipation are important to those wishing to contribute to transformation, because it is conceptualised and operationalised differently according to its wide and varied contexts (Arenas *et al.*, 2006:24; Terry & Bohnenberger, 2004:24). There is sufficient information on service learning in the literature, albeit for institutions of higher learning (Arenas, Bosworth & Kwandayi, 2006:31-33; Bringle & H Hatcher, 2009:37; Burr, 1999:8; Itin, 1999:91; Thomson *et al*., 2010:216,218), therefore it becomes more important if it is to be used in the schools.

Conceptual issues have implications to training and understanding (Arenas *et al.*, 2006:33; Bohnenberger, 2004:24) of the importance of civic service, as found in many nations and contexts (Akiri & Ugborugbo 2009:107; Koosimile, 2004:484; Mahlomaholo & Netshandama, 2011; Nkoane, 2009:26; Parker *et al.,* 2009:592). As a result, teachers and administrators confine service learning to such tasks as picking up rubbish and cleaning bathrooms, without relating them to academic learning or formally assessing them. This degenerates service learning to a form of punishment of learners and so creates a condition that might be difficult to uproot from the attitude of learners.

In the same vein, Salleh (2004:10) argues that classroom teachers tend to concentrate on completing the syllabus, ultimately rendering the learning of physics as:

> acquisition of facts rather than training for the development of cognitive skills needed for knowledge understanding and content acquisition, and skills needed for the development of the right attitude towards physics and the learning of the subject matter.

This suggests that teachers need to be well versed in both the technical and professional aspects of Physical Science. Such a balance will probably enable them to facilitate and mediate participants' engagements for transformation of learning of Physical Science, and further assist in the development and use of an appropriate service learning context, activities and project for the transformation of learning of Physical Science.

2.8.2 Financial issues

The dire economic conditions of the RSA, Botswana and Nigeria (Asikhia, 2010:231, 233) create uncertainty to the extent that service learning can yield the kind of civic engagement expected of citizens in Australia (Hickling-Hudson, 2006:7). This is because some forms of civic service can be expensive, for example, transportation of learners to and from sites where the service is provided, and lunches, as is the case in this study. There is also a challenge to identifying partners who can contribute their financial resources without blurring the real purpose of service learning. The RSA Community Higher Education-Service Partneship (CHESP) model encountered a similar problem (Hatcher & Erasmus, 2008:50-60, Thomson *et al.*, 2010:228). In the same way, the QUT model in Australia experienced a lack of buy-in and support, as well as lack of resources such as time (Gilley, 2005; Parker *et al.*, 2009:593).

2.8.3 The role of the teachers

The role of the teacher in facilitating a connection between the service and regular curriculum is imperative (Itin, 1999:92, 94; Koosimile, 2004:493; Parker *et al.*, 2009:585; Thomson *et al.*, 2010:216). Often there exists lack of this much desired connection and "true dialogue between benefactor and recipient" (Arenas *et al*., 2006:28), perhaps as a result of difficulty in understanding (Asikhia, 2010:234; Idowu, 2011:134; Niemi, 2002:763-764, 770; Tatto, 2006:238) principal concepts such as service, civic engagement and community service, as well as "perpetuation of oppression and dehumanization between the haves and have-nots" (Arenas *et al*, 2006:28). It can also be a result of learners' attitude or view that their community activities are something that is done *to* and *for* others, but not *with* them. This in turn could be due to a lack of true dialogue and hence of a sense of ownership and/or belonging**.**

Arenas *et al*. (2006:28) see the most difficult problem about service being that it is not uni-dimensional, and not an easily identifiable task with uniform objectives, as many classroom lessons are. This is critical for teachers, as it consolidates the critical role they should play, and therefore the significance of the quality of training they receive (Akiri & Ugborugbo, 2009:107-108; Koosimile, 2004:484, 486; Tatto, 2006:237-239). Thomson *et al.* (2011:221) add that the RSA's top-down political mandate places implementers in a difficult position when responding, while the use of international experts to facilitate the introduction of foreign US-adopted model of service learning (Hatcher & Erasmus, 2008:50) has ignored the highly influential aspects of language, culture and content. It is therefore imperative to involve relevant stakeholders and allow them to own the decision-making processes that led up to the identification and operationalisation of the activity or project (Rocha-Schmid, 2010:344-345).

2.8.4 Teacher support and development

Teachers need to be supported and developed on a continual basis, because the challenges they face are great and they have to make many decisions. The issues pertaining to the manifestations of power in their engagement may not be so trivial to them, but their impact on the learning of Physical Science is overwhelming. The issues of power in the classroom, for instance, manifest in the form of dominant conceptualisation and knowledge. Koosimile (200:490-491) refers to this as ‘content-oriented pedagogical problem’ or a ‘science-centred’ approach, which may lead to conceptual confusion and possible ‘learner insecurity.’ This tends to be aggravated by the suppression of the learners’ conceptualisation of science concepts and principles, in turn a result of the teachers’ lack of knowledge of the learners’ *Out-of-school* experiences or their under-preparation.

The absence of true dialogue and involvement of actual service beneficiaries in deciding what is best for them is a major contributory factor in contestation of power, leading as it does to the development of a relationship of paternalism whereby beneficiaries are treated as dependents or powerless victims (Arenas *et al.,* 2006:28, 30; Niemi, 2002:764; Tatto, 2006:239-240). It is also possible that money, political and administrative power can be used by those who have them to develop similar paternalistic relationships (Thomson *et al.*, 2010:22, 230). This is why it is critical that all stakeholders be identified and involved in defining their course and social structures in service learning encounters. There is also a need to guard against overemphasis on learning (i.e., school or academic) goals at the expense of service (i.e., community) goals.

There is also a threat pertinent to the RSA that is perceived as a politically motivated imposition of service learning on the institutions of higher learning by the government of the day. Thomson *et al.* (2010:224-225) argue that it created an implementation hindrance for service learning and that the involvement of learners in service learning in less predictable (learning) environments can be dangerous. They see the danger as lying in learners being used to a political agenda and taking sides in politically contentious situations. Koosimile (2004:490) contends that "the worlds of science and *Out-of-school* experiences of learners have to be reconciled." The engagement of experienced people to support and possibly balance the power issues is critical (Koosimile, 2004:492; Osman & Attwood, 2004:17-18; Rocha-Schmid, 2010:344-346, 355).

The threats mentioned and discussed above need to be appropriately critiqued to establish their residence within the service learning encounter, and so establish their real source or cause with a view to identifying appropriate mitigating factors. This process should also be an inclusive critical activity that engages relevant stakeholders. To achieve this, a critical reflective practice through critical transformative participatory action research (Meretns, 2010:238; Rocha-Schmid, 2010:346) is necessary.

2.8.5 Evaluation issues

The absence of the evaluation component of service learning poses a major problem, as without it there exists possibilities of blurring the real purpose (Jansen, 1998, Thomson *et al.*, 2010:230-232). Arenas *et al.* (2006:28) question the practice that affects many "school-related civic service programmes that focus solely on the growth of students, while ignoring the consequences for recipients or the community as a whole." Through evaluation, service learning can be improved and made more interesting to learners. The service learning at QUT had an evaluation component through which the programme received feedback that it was challenging and demanding. These, the students indicated, were not going to bar them from further participation, but rather increased the benefit to them (Bringle & Hatcher, 2009:42-44; Molee *et al.*, 2010:241-246).

2.9 EVIDENCE OF APPLICABILITY OF SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE

This section outlines key aspects that inform and serve as indicators for the successful use of service learning to transform the learning of Physical Science. The aspects or indicators referred to include the extent to which services that were rendered by learners helped address the community problems and needs. The indicators also include the extent to which the learners' curriculum learning needs were addressed or achieved. These indicators can be derived from the reflective sessions of the service learning projects also considering best practices from other countries and institutions, such as RSA, Botswana, Tanzania, Nigeria and Australia. To this end the aspects worthy of consideration would be those from the RSA CHESP (Thomson *et al.*, 2010:227-229), Botswana's BEST and *Out-of-school* experiences in science classes (Gboku & Modise, 2008:321-326; Koosimile, 2004:484-487), and Australian QUT (Parker *et al.*, 2009:587, 593).

The importance of context in learning is clear from the view expressed by Itin (1999:94) that the content being taught is as important as the process by which it is taught and the context in which it is taught. In this study the content is evidently covered by the Physical Science knowledge areas and themes as contained in the curriculum. These themes or priorities included mechanics, which addresses topics on motion, and energy; matter and materials, that consider mixture and nature of material; chemical change, which addresses microscopic interpretation of macroscopic changes; and chemical systems, that focus on the water cycles (DBE, 2011b:15-60). Thus, the use of service learning to transform the learning of Physical Science had to consider enhancing the learning of the concepts and scientific principles in these themes. The appropriate context in this study is also covered in the curriculum statements, initiatives and programmes, namely the water cycles (DBE, 2011a:4-5, DBE, 2011b:4-5, DBE, 2011c: 1-34; Mahlomaholo, 2010:1).

The context within which QUT model operated was health; the *Jipemoyo* project was in the realm of development; the *To Hold Our Earth Firmly*, and *Out-of-school* experiences in science classes were in teaching (education). Similarly, this study used the municipal water services as its context. Notwithstanding that this is a service managed and provided outside school, it does afford Physical Science ample learning and serving opportunities. It also falls within the context of experiencing critical challenges from scarcity, purification, supply and pollution, opportunities that fundamentally embrace sustainability. It is axiomatic that without water there is no life, and with poor quality water there is poor quality living. In this way there will always be a need to care for the environment so that it sustains life. Depletion of water resources should not be left unattended, which requires critical thinking, which schools should help develop through the use of service learning to transform the learning of Physical Science.

There were specific reasons why the CHESP, *Jipemoyo*, *Out-of-school* experiences and the *To Hold Our Earth Firmly* projects were undertaken. Each had a particular purpose and aim to achieve. For instance, the CHESP purpose of service learning at Stellenbosch University was to avoid duplication of existing services in communities that would further fragment the then existing third sector and its organisations, whilst the Australian QUT's purpose was group implementation of a community service project. Similarly, this study seeks to use service learning to transform the learning of Physical Science by ensuring reciprocity between the school and the learners' backgrounds, real life situations and communities. This purpose needed to be derived from and be geared towards operationalising the overarching vision and mission of the people it purports to serve. That means that the purpose and the vision mission should enjoy the approval, involvement and sufficient support of the affected persons. One useful and impactful manner of achieving this would be through the direct engagement of the people in the development of their vision. It should be in a context that is aligned to their aspirations (Yosso, 2005), as their being engaged entrenches mutual trust and gives them hope that their needs and desires will not be suppressed. In this way they tend to participate freely, as happened in the *Jipemoyo* and the *To Hold Our Earth Firmly* projects.

In this way, the participants become firmly located in their respective 'contradictory spaces' (Mahlomaholo & Netshandama, 2012:37), that constituted their diverse experiences and knowledge. These diverse and variant participants' capabilities tend to be critical to the development and implementation of solutions pursuant to the transformation of their situations. The power embedded in such 'contradictory spaces' was confirmed by Steinberg and Kincheloe (2010:145), regarding the establishment of 'a working democracy'. To this end they indicate that "critical theorists make use of voices and perspectives that have been traditionally excluded."

As a result the ‘contradictory spaces’ created in and by the *Take Heart* and *To Hold Our Earth Firmly* projects have engaged the subjugated voices and perspectives of their respective participants in the main democratic discourses. The unity and synergy of such spaces (Nkoane, 2011:119) derived from solidarity that validated and employed a ‘power of difference’ (Steinberg & Kincheloe, 2010:145), that defined them. Thus, values such as mutual respect and mutual trust (Mahlomaholo & Netshandama, 2012:38) are important.

The observance of these values to pursue solidarity that validated and employed the subjugated voices and perspectives also motivated people to become participants, because they were carried through and gave them hope that equity would prevail (Swantz, 2008:33-34). They subsequently availed their skills, competencies and experiences to social justice-oriented projects, as stated by a participant in one of the projects: “the roles of the researchers and the researched interchanged… through which there was mutual development of knowledge and learning to understand people’s problems” (Swantz, 2008:33).

The observation made above further signified that the participants had clear roles. The roles of the student participants in the QUT and CHESP projects included decision-making in matters affecting their respective projects. They also worked together with their respective community partners to agree on the roles and responsibilities of stakeholders. In the case of CHESP, for instance, they conducted a situational analysis themselves in order to determine what to do, with whom and how. The QUT students worked in groups of four to five and were given a list of non-governmental agencies which they approached by themselves to identify relevant agencies to serve and learn from. In order to enhance monitoring and to track progress of performance of their respective responsibilities, they signed a performance contract or agreement for a period of one year. The contract covered aspects of the work and service as well as learning objectives linked to durations. This was their ‘operational plan’.

An operational plan maps out the implementation of the solution to the problem, and follows from the situational analysis and the performance contract or agreement. Thus it reflects clear outcomes that should be achieved in order that an activity can be said to have been fully executed or completed. The lesson that the study draws on in this regard is from the QUT model. In this case the academic programme has weighted components, which appeared to be similar to the weighting of topics provided in the Physical Science curriculum and assessment policy statement (DBE, 2011b:13). The QUT programme outcomes outlined by Parker *et al.* (2009:587) were thus: "group implementation of a community service project (total weighting 45%) which included a final project report (weighting 25%) and individual log (critical reflection – weighting 10%) and an oral presentation (weighting 10%)".

The outcomes that are weighted above indicate a 'final project report', which appears to be an example of a tangible product that can be shown as evidence that the service learning project was conducted. Also the tangible products from the service encounters included development of a range of brochures on drugs (Parker *et al.,* 2009:587). The products that the study identified and developed for use by the coordinating team, and which may also serve as learning experience for other similar projects as well as for the learners are: the study comprehensive plan; learners' study team guidelines and monitoring tool; worksheets; standard practical investigation report format; and transformation of learning through service learning projects. All of these were identified through participants' reflective sessions.

Reflective moments tend to have been useful in assessing the extent to which the participants experienced the transformation of their situations, thus it becomes a critical indicator that should be considered in the evidence for the applicability of the use of service learning to transform the learning of Physical Science. The participants gave critical reflection (Agger, 1991:119; Molee *et al.*, 2009:591-593) of their experiences of their respective social justice-oriented services and project. The reflections can be made at any stage of the service and learning processes, whether through written or verbal communication. It can also involve self-reflection, as well as reflection of the process by others. The Physical Science curriculum provides a similar opportunity for the outcome based on the impact of science and technology on human development and the environment (DoE, 2003:4-5).

The reflective sessions are thus a form of assessment (Bringle & Hatcher, 2009: 42-44; Molee *et al.*, 2010:241-242), to ensure the achievement of both the service and learning objectives. The QUT's final assessment item was a reflective journal in which students were asked to summarise their personal learning within the group setting; to outline the health issue, organisation and the skills and knowledge acquired; and to critically reflect on the health issue, along with their role in the group project. This reflection consolidated the learning from the service learning assessment (Thomson *et al.*, 2010:232). In the case of this study the curriculum statement also offers space for the assessment of the service project (DoE, 2003:17-37).

2.10 CONCLUSION

The chapter has outlined the four broad theoretical frameworks that are often used to conduct research by giving the main ideas and criticisms of each. Based on this explication, the study convener's stance with regard to the theoretical framework is made, *viz.,* critical emancipatory theory. The choice and use of critical theory in this study was motivated and illustrated through a brief discussion of its historical background, to how it contributes towards the response to the study question, aims and objectives. This motivation is pursued further by illustrating the relevance of CER theory by showing its superiority or appropriateness, its objectives (*i.e.,* of critical theory), formats and steps, the relationship between the researcher and the researched, values of the critical theory and the kind of language it uses.

In order to ease the readership and to enhance convergence of thought in respect of the issues being raised, the chapter then discussed the operational concepts: transformational learning, service learning and sustainability. An attempt was made to integrate the concepts with the study to pursue the relevance and importance of service learning as a useful approach for transformation and how it can be sustained. The synergy between service learning and transformational learning was also highlighted.

After laying the theoretical basis for this study by outlining the theoretical framework, the chapter outlined the literature review in respect of the five study objectives. The conceptual theories that are found to be in line with this study and that are further enhanced by critical theory were reflected upon. They, as with the critical theory, are integrated to the extent that they enhance the achievement of the study's aim and objectives. The theories referred to are the learning theories: 'Critical' Participatory Action (CPA), through which partners and participants are engaged in the study; Critical Discourse Analysis (CDA), through which data is analysed; and the Free Attitude Interview (FAI) technique, through which data is collected. Mezirow's theory of transformation was also referred to, and as its principles were largely helpful it was integrated in the discussions. A concerted effort is made in this report to illustrate how these theories are used in this research and in practice from data collection through to implementation of recommendations made by the participants and stakeholders.

Having addressed the issues of theoretical basis and having had the relevant information to draw lessons from the literature for purposes of this study, I turn in the next chapter to the research design and methodology, where I discuss in detail the research methodology and design for data collection and analysis in respect of the study objectives and aim. The data collected is intended to address the reality of linking learning of Physical Science to provision of services in a balanced and mutually beneficial manner. This is done to transform and enhance the way learning and services are provided and perceived at community and school levels. In order to achieve the development of this transformational learning through service learning strategy, the chapter outlines the research design intervention *(i.e.,* study coordinating team) to accommodate active participation of key stakeholders.

CHAPTER 3

PARTICIPATORY ACTION RESEARCH APPROACH TOWARDS THE STRATEGY TO USE SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE

3.1 INTRODUCTION

This study seeks to formulate strategies to transform the learning of Physical Science such that it is sustainable. In this chapter a participatory action research (PAR) approach is considered as a methodology for data collection in terms of its relevance and appropriateness for use in this study. First, the design section outlines the coordinating team in line with the aim of the study and its role, and the tasks and roles of the participants with whom it is established. The participants' profiles are provided to enhance and strengthen the team's coordinating function. These inform the basis of the design, data collection and data analysis. The comprehensive plan maps out the implementation of this study, its outputs, activities, tasks, resource allocation and timeframes, from the establishment of the coordinating team to the five study objectives. The team Performance Charter that forms part of the design section sought to develop a climate of shared leadership of the study; the enhancement of quality relationships amongst participants; and facilitation of team focus on the need(s) at hand (Maton, Perkins & Saegert, 2006:16-17).

The data collection procedure, techniques and tools used are discussed under the section on data. This section further illustrates how the 'critical' PAR principles were used as an approach that informed the data collection methodology. It was thus used to implement the study within CER's ethnography and through its three iterative steps (Mahlomaholo, 2012:44). The section further details how the Study Comprehensive Plan was used as the basis for a data collection progress tracking, monitoring and reporting tool. The data collected were analysed using Van Dijk's (Sheyholislami, 2009; Van Dijk, 2008) socio-cognitive model of critical discourse analysis (CDA). It thus elaborates on how text, discursive practice and social structure levels of analysis of data are used in this research. The data thus analysed is collected from service learning project(s), formal departmental and learning area engagements, parents-learners-teachers engagements and coordinating team engagements. These are used in this chapter to explain how CDA is used. Finally, a conclusion is drawn to the chapter.

3.2 DESIGN

This section outlines a plan according to which PAR principles can be adapted and organised as an approach to use service learning to transform the learning of Physical Science. This CER grounded organisation and adaptation of the participatory action involves and addresses issues pertaining to: the coordinating team (Swantz, 2008:33); planning as a communicative action (Agger, 1991:111; Van Dijk, 1995:21) to open up the communicative space (Kemmis, 2008:130; Wicks & Reason, 2009:244-249); team establishment and building; coordinating team Performance Charter; roles and tasks of participants; and the Study Comprehensive Plan.

3.2.1 The coordinating team

The coordinating team establishment was imperative to mediate (Kellner, 2000:3,9) and to facilitate participatory actions (Biesta, 2010:45; Hertz-Lazarowitz *et al*., 2010:271; Sanginga, Kamugisha & Martin, 2008:699) geared towards the transformation of learning of Physical Science. This involves a situation in which research is used to help address real life needs and/or problems with those affected. The involvement of the affected people, the participants, in such research should be from its start to the finish (Kemmis, 2008:125-130). In this study, the coordinating team comprised people who felt the obligation (Van Dijk, 2008:353) to participate and would most likely be available for a period of at least the duration of the study. Their participation also began with the commencement of the study, then went through the development of the respective plans, agreements and strategies to use service learning to transform the learning of Physical Science, to its implementation.

The reasons for putting together the coordinating team were to enable the engagement of affected participants in the analysis of their situation so as to identify potential problems following the analysis of inherent weaknesses, strengths, opportunities and threats; to facilitate the processes of collaboratively finding and implementing respective practical solutions by the affected participants; to facilitate the coordination of learning experiences from and amongst the participants and the participants; to enhance comprehension of the diverse contextual factors affecting the learning of Physical Science; to facilitate the processes of coordination and integration of the learners' community cultural wealth with academic learning of Physical Science; and to facilitate the monitoring and evaluation of the development and implementation of service learning strategy (see 3.2.2).

The coordinating team brought to the study their diverse experiences, knowledge and skills, critical in ensuring that the study also recognised and respected the learner participants' background knowledge. This would further enhance its sustainability (Hickling-Hudson, 2006:3; Kelly, 2009:1 Mahlomaholo, 2011:16-17; Soanes & Stephenson, 2003; Wicks & Reason, 2009:249). Furthermore, the use of service learning to transform the learning of Physical Science had to anticipate the power related disparities embedded in the multiple participants' interactions (Donald; Lazarus & Lolwana, 2010: 44; Osman & Attwood, 2007:17-18). The coordinating team had to develop mechanisms of identifying them and to address them such that they did not impact negatively on the learning processes.

The coordinating team members, and by implication the coordinating team, had practical leadership and management working experiences in the wider community as well as regional society. The team comprised experienced teachers of Physical Science and Mathematics; a DoE official from school management and governance; a retired school principal; the municipality's environmental health practitioner with exposure to and knowledge of challenges pertinent to the public service (*i.e.,* the context for service learning); and a parent. These members also played leadership roles in the community at church and community based development organisations (see participants' profiles in paragraph 3.3.1).

3.2.1.1. The identification of the coordinating team members

The process of identification of the participants as coordinating team members involved processes of consultation, negotiations, and discussion of issues that pertained to the study. These helped the study to address possible challenges in advance and to clarify issues that could otherwise have consumed much time if they were to be delayed. The issues that pertained to participants' diverse personal traits, personalities, interests, and preferences relating to their socialisation were some that received attention. These were predominantly conducted on a one-on-one basis in this initial and conceptual phase of the study (Kemmis, 2008:133; Wicks & Reason, 2009:249-250).

During the identification process, as study coordinator, I solicited possible participation from potential participants through numerous one-on-one interactive sessions, the content of which followed the aim of the study. This was in turn further influenced by readings on manifestations of social injustices of the past apartheid era, as seen in: the "exceptionally high levels of failure rates and early school leaving…" (Mahlomaholo, 2010:2, 2011), the 'urgent' need to address youth unemployment (RSA Presidency, 2010); and questions on critical roles not played by secondary school graduates in the upliftment of their respective communities. The prospective participants were engaged in these discourses even prior to the commencement of the study.

The coordinating team embraced the view that the individual member's equitable contribution would be respected and considerately discussed (Steinberg & Kincheloe, 2010:145). For instance, the team would, when necessary, solicit support from other stakeholders who may not necessarily be part of the coordinating team, but have the requisite information, knowledge and skills the study required. Also, the team members were asked to contribute their respective knowledge, skills and competencies for the benefit of the study as a whole and agreed that its actions would be guided by logical argument. In that manner it would internalise the principles of "contradictory space" (Mahlomaholo & Netshandama 2012:38) and "power of difference" (Steinberg & Kincheloe, 2010: 145).

The team therefore endorsed the use of a team Performance Charter, which was a component of the Study Comprehensive Plan that sought to align the team members' work schedules and interests with those of the study. It also set out a schedule of meetings and Physical Science transformational service learning activities. It was its value-driven action plan that upheld respect and humility (Dominiquez, 2008:4; Steinberg & Kincheloe, 2010:142-143) as propounded by critical emancipatory research to enhance achievement of its unity of purpose (Mahlomaholo & Netshandama, 2011:43; Maton *et al*. 2006: 16-17). Kemmis' (2008:129) statements aptly describe the teamwork:

> agreements we reached neither negated our individual subjectivity, nor were our conversations completely coherent, fully argued and complete. The topics, themes and circumstances of our communicative action will forever be changing, leaving all our agreements incomplete and partial-halting steps and limited achievements on a path towards an unattainable complete agreement, complete understanding, and perfect consensus about what to do. The quality of the argument, and the ways people participated in it, '*was*' what '*gave*' life to being 'critical.'

3.2.1.2 Fostering common understanding of Physical Science learning related issues amongst the coordinating team members

The process of identification of prospective participants and the coordinating team outlined above was on a one-on-one basis, with interactions mainly conducted through the study coordinator. The participants had possibly not met or discussed before and may not even have known one another, therefore it was imperative that they were afforded an opportunity to introduce themselves to the group, facilitate a process of mutual understanding and know each other's interests, views and perspectives about the use of service learning to transform the learning of Physical Science. In this way the participants' diversity in respect of their experiences, interests, views and perspectives started to be reconciled with the study aim and objectives. It marked the commencement of fostering common understanding of issues pertaining to the need to transform the learning of Physical Science. It also sets the stage for easing of potential tensions, fears and uncertainties that might be associated with their individual perceptions about the study and each other.

Thus in order to 'break the ice'; that is to ensure prevalence of freedom of expression of views, the discussions were rallied around the overall aim and objectives of the study, which also served to promote cohesion and peace amongst the participants. Thus, the team members were engaged (immersed) in the interpretive and analytic process to make sense (Mahlomaholo & Netshandama, 2012:8, 44; Steinberg & Kincheloe, 2010: 143, 148) of their involvement in the Physical Science situation and contexts. The coordinating team members' diverse areas of work would further necessitate action to enhance and share their knowledge and understanding of relevant issues. The discourses that ensued would thus pursue the main study question and problem statement, and came to consider the Physical Science related policy imperatives (DBE, 2011a.:4-5), dominant Physical Science learning and teaching strategies, and roles played by teachers, learners and parents in the learning of Physical Science.

This created "opportunities to explore the boundary-crises by opening communicative space among participants and others involved in and affected by their actions" (Kemmis, 2008:130), and generated informative debates among members. Part of the information from these engagements provided data for the study and influenced the actions taken. The other people who were found to be affected by the actions of the coordinating team and whose voices were heard (de Beaugrande, 2006:31; Stein & Mankowski, 2004:21, Steinberg & Kincheloe, 2010:143) were teachers, parents and the community. The latter showed up through the learners' service learning projects and the community based service learning centre initiative. This encouraged active participation of affected persons, namely the coordinating team members and learners, in addressing their respective challenges (Mertens, 2010:238; DePalma, 2010:216). The underlying purpose was to help transform the learning of Physical Science using service learning strategies such that it was sustainable (Hickling-Hudson, 2006:2-3; Mahlomaholo & Netshandama, 2010:11-12; Van Dijk, 2008:86).

3.2.1.3 Team members' engagement in the study – initial stages

The engagement of the coordinating team members is fundamentally transformative and sustainable (Mahlomaholo, 2010: 11-12; Mahlomaholo & Netshandama, 2012:40-43; Mertens, 2010:238; Nkoane, 2009:22), because the people affected, namely, learners, parents, teachers, were actively engaged in this study. Their active participation was, for instance, in the process of identifying the Physical Science learning problems, needs and potential solutions.

Through the processes described above, the coordinating team members identified the needs and problems experienced in the learning of Physical Science. They indicated, for instance, that the methods that teachers preferred and used for teaching Physical Science were divorced from real life situations. The learner participants corroborated this and indicated that some of the topics they learnt did not have any connection or relevance to their real life situations. The other contribution was that teachers used methods that compromised the understanding of Physical Science and the learner participants later confided that the reasons their performance was poor in Physical Science was because of their lack of understanding of the subjects.

The learners-parents-teachers engagements organised by the coordinating team, identified solutions during their respective reflection sessions. The following were suggested, that: learners should come closer to the kitchen and learn science and mathematics from the food preparation processes, and learners' water management project and manipulation of rates of reaction to address energy/electricity consumption changes determined possible solutions, designed and implemented strategies that best addressed their needs and/or problems. The proposed solutions embraced PAR principles in line with the critical emancipatory theoretical framework. Thus, this study's PAR character was resident in its establishment of a coordinating team of five members, with democratically elected learners' study team coordinators also serving as team members and the Physical Science learner participants. The participation in any of the structures was open to learners from other schools, and persons such as parents, members of the community and officials from the municipality and the DoE, who later became available and felt obliged to participate. The synergy with the critical emancipatory theoretical framework with its formats was important, as were the experiences of opening communication through intervention processes with stakeholders in this study.

3.2.1.4 *Opening the communicative space: planning phase*

The planning process for the opening of the communicative space (Kemmis, 2008:127) was a typical communicative action (Van Dijk, 1995:21) for the study. It also constituted the interpretive phase during which the participants identified key aspects and issues (weaknesses, strengths, opportunities and threats), pertaining to their involvement in the study. For instance, regarding the development of an implementation plan for the use of service learning to transformation of learning of Physical Science, the activities decided upon were, for example, to set up a programme for the planning session, identify key aspects to be part of the plan, and to develop, adopt and implement the implementation plan. The coordinating team was to be responsible for these activities, for an estimated two hours, and the method and resources allocated to accomplish them were the venue and technical (Tatto, 2006:237-238) support from the UFS SULE team and the study promoter and supervisor.

In the same vein the coordinating team also considered the learning of Physical Science that needed attention for them to develop appropriate activities, delegate responsible persons, allocate resources, determine due dates for activities and agree on the methods for collecting data. In this case, they would consider the curriculum priority and theme on matter and materials, and on mixtures and nature of materials where the context was related to chemistry (i.e., waste water management and water management). The activities that the team developed and agreed upon for team members (not learners) were the following: to conduct a site visit safety inspections prior to the learners' field work; prepare learners for the site visit by arranging presentation of technical operations of the purification process and safety issues; and supervise learners on site for possible disciplinary challenges and completion of worksheets. The estimated duration of these activities was two days and the methods for data collection were the learners' worksheets, tests, and observations adapted the use of the free attitude interviews (FAI) technique. The team members worked together during the execution of these activities.

It was critical for the coordinating team to consider engaging the services of persons with the skills and competencies that may be found to be lacking. In this case, the study relied on the municipality's project management unit manager and the waste water treatment plant operators to explain the operations and technical aspects of the purification process. These offered participants an opportunity to advance their cognitive and academic learning and development as these related to scientific principles directly (Roschelle, Turpin & Elias, 2000:840, 843). Thus, this first phase also involved the identification of other prospective key participation in a manner consistent with discussion above. It was geared towards the establishment of common understanding and opening the communicative space between and among participants (Kemmis, 2008:127; Wicks & Reason, 2009:247-250).

These participants formed the coordinating team that facilitated the study meetings and other activities pursuant to the objective using service learning to transform the learning of Physical Science. The team served as the main players who collaborated during all stages of the study. They participated actively, communicated periodically as they arranged reflection sessions and meetings and interacted with other participants as they deliberated on issues such as the development of the action plan and preparations for the site visits (Hertz-Lazarowitz *et al*., 2010:271; Sanginga *et al*., 2010:705-706). Through this process of opening of communicative space the coordinating team was able to involve other participants, such as the other teachers, parents, and municipal officials, namely the project management unit manager and waste water treatment plant operators.

To this end and in relation to the above it became evident that the school had come closer to the municipality through the engagement of these officials to address water care management problems that also affected the school and the learners. It pointed to the opportunities and strengths found to be resident in the collaboration between social structures (Sheyholisami, 2009:4), such as the school and the municipality. It dispelled the notion that schools could not or should not collaborate with their local municipality, conversely illustrating that the two social structures could collaborate and complement each other more than before (Moxham *et al*.,2010: 1435; Portar & Monard, 2001:1-3). Thus, this study, through its educative initiative, further enhanced the collaboration between these structures (Mahlomaholo & Netshandama, 2012:37-38).

It created an opportunity and space to give voice to what could have been naturally subjugated voices (Stein & Mankowski, 2004:23; Steinberg & Kincheloe, 2010:145) of the learners and the community members regarding the learning of Physical Science as well as the municipal services rendered to the public. This was the case because through their water care project the learners were able to engage the municipality to address the water leakages. The process also enhanced their learning of related Physical Science academic and social skills. These mutual engagements were fostered through adoption and observance of values of respect and collaboration between the community, school and the municipality (Porter & Monhard, 2001:1), and gave us hope for success in the light of the equitable contribution and solidarity to the participants' views and perspectives.

The participants' views and perspectives evidently constituted the diverse *life-worlds and systems* of the coordinating team. This diversity necessitated the 'opening of the communicative space' and enhanced leaning towards inter-subjectivity (Kemmis, 2008:128-129). Furthermore, this necessitated the choice and use of an appropriate analytic tool in the form of CDA, especially with its 'cognitive analysis' as espoused by Van Dijk (2008:85-10) and Sheyholisami (2008:4;) According to Kemmis (2008: 128-129), in this critical phase:

> The communicative space opened by communicative action, and by participatory action research undertaken as a kind of process of communicative action, is an intersubjective space that exists between and beyond individual participants. The intersubjective is not somehow 'above' individual understandings or self-understandings. The intersubjective exists in the communicative space in which speakers and hearers encounter one another – in speech and writing.

This confirms and consolidates the significance of the one-on-one and teambuilding sessions. The establishment of the study intervention team, through communicative action, necessarily created the 'intersubjective space.' It thus became imperative to create an accommodating team culture and a conducive environment for the diverse 'understandings' and 'self-understandings' of respective participants. This did not compromise the rigor of the critique that sought to unravel the character of the envisaged transformational learning through service learning strategy. It was through and during these discursive engagements (Briscoe, 2009:256-258) that the participants found common ground in the form of this study project. This is fundamentally based on the need to contribute towards the transformation efforts of the way teaching and learning of Physical Science took place at secondary schools. The duration of the first phase engagements continued even during the study.

The coordinating team had special sessions on the approved research proposal in order to enhance mutual understanding and to facilitate participants' ownership thereof. It subsequently became apparent from the questions that the team also needed to be involved in the data collection and data analysis techniques and tools, thus separate sessions were arranged for the engagement of members on the use of the principles of the FAI to collect data. The coordinating team subsequently agreed to adapt and adopt the principles of the technique to facilitate study meetings and reflection sessions, and discussed the CDA. The agreement in respect of the actual analysis was that the study coordinator should carry out the analysis in conjunction with team members as a follow up, to seek clarity and to confirm or refute information where applicable. Issues pertaining to tape-recording and secrecy were also discussed, as addressed by agreeing that the study records would be kept by the coordinator of the study and dealt with in terms of the UFS ethics committee requirements and stipulations.

The coordinating team meetings were chaired on an alternating basis by members of the team. In order to enhance members' active participation during meetings, agenda items were allocated to responsible persons to lead the meeting. This however was in keeping with the team traits and adopted principles and values of the team's Performance Charter. Where support or information was lacking or needed, the team invited, through respective coordinators, the relevant persons to address it. The interchanging of roles in the course of communication enhanced mutual development of knowledge and learning to understand the problems at hand. It also enhanced the contextual character of this study (Swantz, 2008:33).

The values adopted by the study, coupled with the team traits, necessitated the 'inter-subjective space' (Kemmis, 2008:128-129) that was largely informal, focused, open and critical. The coordinating team meetings were thus conducted in a collegial, spontaneous and continual manner. They were also conducted in line with the pertinent stipulations of the University's ethics committee and the Free State Department of Education's approval of this study. The department outlined conditions under which it granted permission to conduct this study, including that the study would make its arrangements with the municipality and its prospective participants, and would be liable for any costs incurred. It also endorsed observance of safety measures during the site visits.

These stipulations formed part of the coordinating team's agenda and were addressed and complied with accordingly. For instance, the coordinating team members undertook safety site inspections coupled with their preparation for the site visit. Also, parents and learner participants were consulted in advance to solicit the learners' free and informed consent to participate (DePalma, 2010:217-221) by undertaking the trip to the waste water treatment plant. These consultations were facilitated by the coordinating team's coordinator for community participation. The parents and learners were written letters in this regard and were also engaged through meetings (Annexures CL 1 & 2). In the same way, the municipality and other participants were written letters requesting their respective engagements (Annexures CL 2, 3 & 6).

The coordinating team members did not only meet during their scheduled meetings. There were opportunities available for them to interact with learners and with each other in accordance with the tasks that were assigned. This also afforded them an opportunity to interact with other members of the community as they solicited further support where required. For instance, the Physical Science teacher and study coordinator worked closely with the coordinator for services and the coordinator of the curriculum on a task that related to the learners' water project development. These enhanced the participants' full immersion in the study (Mahlomaholo & Netshandama, 2012:37) and created 'social capital' (Sanginga *et al*., 2010:696) for the school, in that the learners' study teams that were supervised by the parents and supported by the teachers persisted beyond the period of the study. Thus, I found the frequent coordinating team engagements to have had a positive and impactful influence on the enhancement of bonding among team members and learner participants.

This was also evident in the e-mail that I, as study coordinator, received from one coordinating team member, Makgabane. She wrote this after their visit to the waste water treatment plant and water treatment plant one Sunday in August 2011. The two had started their orientation trip after having driven around the residential areas and surrounding the area of this research to practically observe, experience and enhance a sense of the direction of the water flow. This was an attempt to explain to each other the concept of two dimensions of force of gravity on the water, namely that it falls as it flows towards the water treatment plants. Makgabane had not visited any of the water treatment plants before and did not have a good command of Physical Science. She thanked the study coordinator for the worthwhile exercise through which she indicated to have personally learned much. During one of the subsequent engagements she further indicated how this had positively influenced her, and how she was now more aware of and took keen interest in water flow directions, locations of water plants and reservoirs.

On the other hand, Ntsoteng, another coordinating team member, saw an opportunity of linking the study and therefore the school with her work related responsibilities. One such responsibility was the need for the development and implementation of the school's environmental plan that could address issues relating to the school's contribution towards the conservation of water and saving of electricity and maintenance of clean environment. Moeletsi added that this would help systematise the voluntary teaching work he was often asked to do by those learners who would like to improve their grades in Mathematics. It was in this regard that the conceptualisation of the study community based service learning (CBSL) initiative was consolidated. The study could rely on the experiences and expertise of retired professionals and community members to sustain the use of service learning to transform the learning of Physical Science. Bohlokwa saw this as an opportunity to improve performance not only in Physical Science, but also in Mathematics and later in other school subjects such as Life Science, Accounting, and Business Studies. As indicated above, these were one-on-one discourses that needed to be reconciled with the study through the coordinating team.

These prospective participants, together with the study coordinator, established and constituted the coordinating team, made up of five members whose respective roles and tasks are discussed under paragraph 3.2.2. The coordinating team had an overall responsibility to facilitate, mediate and coordinate activities for the use of service learning to transform the learning of Physical Science. Because the members of the team did not necessarily know each other at this stage, *i.e.,* they were not acquaintances, and their respective work backgrounds and experiences, attitudes, ages and genders were diverse, it was necessary to bridge the gap between them (Sheyholislami, 2009:3-4; Van Dijk, 2008:86; Wicks & Reason, 2009:249-250). This was done by holding a team building session, during which, and partly during subsequent team meetings, individual members shared with each other their respective attributes that would fundamentally constitute the team attributes. In this way, inherent power (*e.g*., positional) and power relations (*e.g*., between supervisor and the supervised) that team members brought with were levelled off. This became inculcated in the team as it interacted with other participants, namely the parents, learners and teachers.

3.2.1.5 Opening the communicative space: teambuilding phase

The teambuilding phase seeks to address the taken-for-granted personal traits that may otherwise distract the functionality of the team and therefore of the study. These issues also constitute some of the inherent risks and threats to the study, and as such must be identified timely and resolved to protect both the team members and the study (Hertz-Lazarowitz *et al*., 2010:275; Parker et al., 2009:592-593). Thus, the team building was considered as pivotal in this study and referred to as the **second phase** of the opening of the communicative space. It enabled members to know each other better and help with mutual understanding of the evolving team traits. As the process unfolded the team traits that emerged could also be linked with the CER principles and values, giving the members confidence that the values were not imposed but negotiated, adapted or confirmed. Furthermore, the process of teambuilding followed similar SWOT analysis strategy and could be related to the other aspects of the planning processes of the study.

In order for team members to develop a sense of belonging and ownership of the team traits the teambuilding exercise developed as an implementation plan. The aim was to establish and develop common team traits that would enhance team performance from the individual members' traits. The outcome of the plan in this case was to develop a Coordinating Team Performance Charter / Agreement (Parker et al., 2009:588) for use as a guide for the leadership of the coordinating team efforts (Maton, Perkins & Saegert, 2006:16-19). The implementation of this plan involved members' discussion of their personal traits on which the team traits might be based.

This discussion afforded the team members an opportunity to know and to understand how to work with each other. It also created an opportunity to members to support one another on areas of need and challenge as a sign of caring and mutual respect (Arenas *et al*., 2006:27; Hertz-Lazarowitz *et al*., 2010: 275; Porter & Monard, 2001:1).

Members were given the questions during the meeting as this was not meant to be an academic exercise, in line with the FAI principles. Participants were to respond timely and as honestly as possible. The purpose of the exercise was explained and it was accepted by the members. This team building exercise identified the following diverse and common traits (Donald *et al*., 2010:15-16; 28; annexure T1) namely:

> The best attributes: enthusiastic, perseverance, selflessness, patience, humour, diligence, timeliness, good and best listener(s), problem solver, critical; as well as the 'worst' attributes: not a team member, temper/moody, impatience with failure to keep time, don't ask why – defensiveness, reserved, impatient but not short tempered and fear of failure in what one does.

The team members discovered that they had one trait in common, namely, selflessness, whilst the preferred team trait was flexibility. This trait, that is flexibility, is related to the properties of the objects chosen by many members, *viz*. a tennis ball that bounces back forcefully when pressured, and rubber for its flexibility and ability to retain its form and shape. The team, would respond positively to pressure and would maintain its shape and form throughout the study, possibly beyond. The other objects that lost out on numbers but were not necessarily dropped were the water and the elephant. The former was chosen by the members for its fluidity, which meant that the team and the study would flow and take turns with the overall project. The elephant, on the other hand, was chosen for its strength and height and the uniqueness of its feed, *viz*., strong branches of trees which it sometimes pulls and breaks down in order to access its feed. This was likened to the strength in the coordinating team and the high quality work it envisaged producing. The next issue was how team members would work co-operatively with each other, driven by the values and attributes which they shared. The team agreed to dub them as the Coordinating Team's Performance Charter and the Comprehensive Implementation Plan.

3.2.1.6 Performance Charter: team building outcome

The Performance charter was an agenda item during the team's initial strategic planning session. The charter was discussed further and in greater details during subsequent coordinating team meetings. It was envisioned as a guiding document for the team and a tool to be used for coordination purposes. Below I outline some aspects of it, though the whole document will be annexed to the final study report. The aspects given to illustrate the significance of this exercise are: purpose, vision, mission and values as well as the team communication structure thus:

The *purpose* of the performance charter was to enable members to execute the coordinating team's actions and activities punctually, as in the agreed upon programme. The programme became known as the Implementation Plan for the use of service learning to transform the learning of Physical Science. Pursuant to this, the coordinating team reconciled their *vision* with the aim of the study, namely 'transformational learning of Physical Science through service learning for sustainability'. In the same way, the study objectives became the *mission*, to formulate strategies for the use of service learning to transform the learning of Physical Science such that it is sustainable. In order to enhance the cooperation among the participants the team adopted the values of relationship of mutual trust, care, humility and respect. Furthermore the coordinating team viewed communication as pivotal in enhancing the building of relationships of trust and respect. The coordinating team then agreed on an enabling communication and team structure that appealed to the versatility and the dynamic character alluded to earlier. The communication structure that was adopted was a flatter 'communication' and 'work breakdown' structure in which all participants report to the study and depicting participants on equal level. The communication structure that was adopted formed part of the Performance Charter (Annexure AS 1).

It was used circumspectly to guide but not stifle progress, and to ensure performance in line with ethical considerations. The idea was fundamentally to facilitate performance and team unity and cooperative engagement. The strength of the team can be traced to the number of meetings held and the frequency of outside formal meetings engagements. The team members were and continued to be enthusiastic about the study, as evident in their use of their own resources such as time and transport to come to the venues of meetings. It is most likely that these may be traced to this mode of organisation and commitment.

During one of the coordinating team's reflective sessions, the last meeting of the 2011 school year, Ntsoteng expressed her excitement about how the sessions and meetings were conducted:

> I so wish that learners see the positive side of what you are doing… I must admit that there are number of things that I can mention about the study. The concept behind the study, the manner in which meetings were conducted, the relation between team members, the trip to the waste treatment plant and the study groups for the learners. …meetings were conducted in a professional manner… I strongly believe that this story will change our lives for the better.

Ntsoteng had been impressed and excited about the commitment of the coordinating team members to the study. Her amusement tended to have been particularly at the impressive motivational levels that she wished the learners would be aware of. Her impression was that if the learners could be aware, that would motivate them (Maton *et al*., 2006:18) to learn Physical Science. In the same vein, Makgabane, a parent and member of the coordinating team, expressed her experiences to the learners-parents-teachers meeting, the first during the 2012 school year. She said

> I have learned so much from the supervision of learners' study teams. I also apply these principles at my work place to monitor work performance and progress (translated from original Sesotho text.)

Furthermore, Bohlokwa reported his excitement in respect of the study that helped him to have what he referred to as a critical outlook of issues in the department, that referring to the department of Natural Sciences and Mathematics at school. He also indicated that on a personal level and as a manager the study helped him to identify and understand the magnitude of the problems in the department of Mathematics and Physical Science. On the other hand, Moeletsi, the most senior and most experienced member of the team, expressed his amusement at the courage shown by the team's youngest member who was not even in the teaching profession. Moeletsi confided to the team that he had not expected her to be in the team or the study for so long. He expressed his appreciation on behalf of the coordinating team and encouraged her to hold on.

Our coordinating generally survived because it lived up to the qualities of being caring; reverential (respect for one another); dynamic (strategically flexible); responsive (showed respect for time); and diligent (hard working), and having a will to succeed (afraid of failure). These traits helped the team to remain motivated and focused. That the coordinating team members had roles and tasks to execute was pivotal, and gave the researcher the courage and hope for success, notwithstanding the challenges and limitations that were experienced. The belief that Ntsoteng had can be associated with the ‘social transformation’ and peace associated with the ‘change our lives for the better’, as seen by Ntsoteng.

3.2.2 Roles and tasks

This section discusses the roles and tasks of the coordinating team members. It starts by discussing the roles and tasks of the coordinator of this study who is also a teachers. This is followed by to the learners of Physical Science. The next participant to be considered after learners is the coordinator for the curriculum followed by the school management, governance and development coordinator (SMGD). The other roles and tasks are of the community participation coordinators who are the school governing body (SGB) and the retired principal of the school. The last tasks and roles to be discussed are of the coordinator for public or municipal services.

3.2.2.1 The study coordinator

As the study coordinator and subsequently the coordinating team leader, I identified relevant key coordinating team members (Sanginga, 2010:698-700; Swantz, 2008:34). The process of identification involved thought provoking discussions on Physical Science teaching and learning related challenges and problems. These discussions focused on possible reasons for poor learner performances in relation to prevalent power relations, ideological disorientations (Jordan, 2003:186), and possible corrective measures by the respective stakeholders, including us (Jordan, 2003:188-190). That culminated in participants giving their respective informed consent to participate in the study freely (DePalma, 2010:217-219). The participants and coordinating team members signed their letters of consent, which also outlined the ethical issues of the university provisions and requirements. I organised information sessions for the team members to be kept abreast about the study in terms of the theoretical framework, data collection procedures and techniques, and data analysis.

As the team leader I ensured that the study operational issues were attended to. I organised material and resource documents for members in preparation for and as part of the communicative action (Kemmis, 2008:129), and our participatory action (Hertz-Lazarowitz *et al*., 2010:271; Jordan 2003:188-189). These included the UFS approved proposal, ethics documents and the FSDoE's approval of the study. In conjunction with the coordinating team members I also facilitated the identification and recruitment of other people to take part during coordinating team sessions, for example, the municipality's officials, parents and community members. I also kept records of the coordinating team meetings and reports.

I coordinated the development and implementation of the transformational learning through the service learning implementation plan (Annexure T1), throughout the research process, during the reiterative participatory action steps (Sanginga et al., 2010:698) and themes (Jordan, 2003:188-190). These were informed and conducted according to the CER phases which is from the interpretative phase, to analytic through to interpretative (Mahlomaholo & Netshandama, 2012:36-38). I also used the transformational learning through service learning implementation plan as a management tool to track and monitor study progress in conjunction with the coordinating team.

3.2.2.2 Learner-participants

The learner participants gave their informed consent (DePalma, 2010:217-218) in writing, freely as an indication of their willingness to participate in the study (Annexures CL1 & CL5). They also played a role in seeking their parents and guardians' permission to participate in the study, in line with the written request to do so. They helped with the delivery of correspondence and communication between the coordinating team and their parents. The learner-participants engaged and interacted freely with one another to assist with the work under consideration.

The other important roles played by the learner participants included the following: providing possible answers to the questions asked in the site visit worksheets; working collaboratively in teams; contributing to the enhancement of service learning as they experienced it; completing and submitting the service learning research project (Annexure CT 6); cooperating and observing precautionary measures given during site visits; discipline and provision of their respective observations and considerations of the study. The feedback that learners provided based on their visit to the waste water treatment plant informed planning for the subsequent year(s) in so far as their service learning projects were concerned.

There was a learner-learner “power-relations struggle” (Rocha-Schmid, 2010:355) during the learners’ study team meetings and discussions, caused by, *inter alia*, the subjugation of the voices (Stein & Mankowski, 2004:21; Steinberg & Kincheloe, 2010:143) of the learners’ who had been less powerful than their counterparts. The learners’ power bases lay in the perceptions they had about themselves in relation to others. These perceptions related to their individual performances in Physical Science in relation to each other, that is, the prevalence of the spirit of competition amongst themselves. The learners’ individual performance in turn tends to be influenced by a number of factors, such as:

> peer influence; race; ethnicity; gender; motivation; income; intellectual aptitude of the learner; personality of the learner; self-confidence; previous instructional quality received by the learner; house hold environment; and parental education (Akiri & Ugborugbo, 2009:112).

The learners were consequently supported in addressing their respective personal situations regarding their perceptions about themselves as individuals and as members of the team. The factors that pertained to them had to be identified, understood and addressed accordingly. For instance, the identification process could involve observing learners in the process of learning and discussing. Some dictated terms and talked more, others remained silent and appeared to be disinterested. These types of behaviour are examples that parents and teachers could look out for and intervene in time.

3.2.2.3 Curriculum coordinator

The second member of the coordinating team was the head of the Mathematics and Natural Sciences department at the school. He supported the service learning classroom and fieldwork teaching by taking part in the discussions, and contributed to planning of lessons and presentations. He also monitored the implementation of the Physical Science curriculum according to the proposed plan and the school's departmental policy, so that the study should not interrupt its normal activities. The information he reported in this regard during the monthly meetings was considered as data collected and was also analysed with all other data. It related to insights into aspects of the planning of Physical Science lessons. He was fully immersed (Mahlomaholo & Netshandama, 2012:37) in the study and activities relating to the teaching and unlike his predecessor was concerned about the activities of the department, pointing out how the study also helped him to play an improved oversight role

Through his support the coordinating team managed to successfully introduce the study to other teachers. He facilitated informal discussions during lunch with other teachers, at which he challenged us about our inefficiencies in the roles we played as teachers (Hammond et al., 2001:8; Tatto, 2006:237). This discussion formed part of the debate during his departmental meetings on how to improve our respective contributions through teaching. Subsequently, the teachers participated in the study, helping to supervise and provide tuition support to learners' study teams. They supervised the visit to the waste water treatment plant and some even sponsored it and helped with transport. Evidently, teachers participated in activities that worked out the solution to their own problem (Hertz-Lazarowitz *et al*., 2010:271-272; Rocha-Schmid, 2010:344-345).

The second member supported the attempts made by the rest of the coordinating team to have the study introduced to the neighbouring secondary and high schools. This ultimately happened through collaboration of programmes of this study and the education district support team (DBE, 2011b:3-5). The coordinator served in the preparatory committee of that collaboration, thus the study depended on his positions of power as HoD and member of the committee to align its activities. He further facilitated discussions about the role of the Physical Science and Mathematics teacher at the school in which the research was undertaken. This helped the study and the school's Natural Sciences department in particular to identify interesting opportunities and areas of improvement from the discourses on the role of the teacher. The school's Natural Sciences and Mathematics departmental meetings subsequently served as a data gathering method, and the development of the study worksheets and related documents found direct expression and ownership in these meetings. The meetings therefore afforded the study an opportunity to engage issues and realities for the study, through the service learning components, to the threats, conditions and monitoring of the model implementation.

The study further attracted the interest of the staff members especially from Geography, Technology, Mathematics, Life Sciences, Agricultural Sciences and the school management team (SMT). These teachers helped with the supervision of learners during site visit and also with the development of the worksheets and other data collection tools. This led to other spinoffs, such as the desire and willingness to integrate and incorporate other subjects where such opportunity existed. During the team engagement sessions we also had other participants, for example, the municipality's project management unit manager, who also made a presentation to the learner participants assisted by the environmental health practitioner who was also our coordinating team member. His contribution enhanced the creation of an inclusive space (Nkoane, 2011:119; Passarelli & Kolb, 2012:5-6; Steinberg & Kincheloe, 2010:145), where diverse participants contributed equitably, freely and at peace with each other.

Finally, he ensured that planning for Physical Science in 2012 took cognisance of the programme of this study project and as far as practicable included and /or was aligned to it. The plan incorporated site visits to the water treatment plant, electricity generating plant and the fertilizer manufacturing plants. Attempts were also made to align the learners' service learning projects with the assignments or projects of other subjects. This further enhanced the engagements of other teachers and parents, as well as the integration of various subjects with service learning. The transformational learning through the service learning implementation plan, therefore, was introduced and aligned to the school as a whole through the departmental meetings planning process akin to the one reported in Chapter 4.

3.2.2.4 School governance and management coordinator

The third member of the committee was the school management, governance and development (SMGD) official of the FSDoE. He was once responsible for the oversight functions of the schools in the area of this study, and so had sufficient knowledge, experience and information about the performance of these schools. He worked with the parents, principals and teachers on aspects relating to management, governance and development, involving them and the school. The functions he performed were in terms of the South African Schools Act, number 84 of 1996 (RSA 1996 b, hereafter referred to as SASA). For instance, he supported schools by organising and facilitating training, induction and development of principals (SASA, section 16A); school governing bodies (SGB) (SASA, no.84, sections 8, 9, 16, 18, 19, 20, 21, 36, 37, 38); and learners (RSA 1996 b: s10 & 11). He also performed tasks such as monitoring, evaluation, and assessment of performance of schools in these various areas. This made his engagement in the study more strategic as he coordinated the study with the education district office and by extension the FSDoE.

It is evident that his coordination efforts of the study with the Department of Education were strategic and enhanced liaison (or communication) between the study and official education structure outside the school (Liasidou, 2008:486-487). This helped, *inter alia*, to elucidate the context of this discursive practices and social structural setup (*i.e.*, the inter-subjective space) (Kemmis, 2008:128). In this way he unblocked potential inhibitors that were resident in the school governance and management related practices, namely policy and ideological distortions. The study further accessed pertinent information and resources through this strategic arrangement.

The coordinator's role is central to the establishment of the study's community-service-learning-centre (CSLC) and he also coordinated resources and facilities that could be made available for use by learners and teachers for the further enhancement of teaching and service learning. This strategic role included possible networking of the study with private and public institutions with which he had been involved. This meant that he would lead the coordinating team in the development of strategic partnerships and or agreements relating to resources sharing. This was significant in order not to divert service learning from its mandate and purpose.

Another critical role he played was to support the team with logistical issues such as the venue for meetings of the coordinating team and administrative resources where possible. Most of the meetings of the team were held at the venue he arranged, and he liaised with the school and/or the district office when necessary. He also had to arrange presentations from teachers, lecturers or parents on specific curriculum related topics to be identified by affected teachers, such as the research convener and coordinator, and the coordinator for curriculum in this study. This programme was however flexed to align the study with the joint programme that accommodated other schools. The presentations were to be held at school or the local teacher/education centre.

3.2.2.5 The **community** *participation coordinator(s)*

The study considers public participation as critical (Hickling-Hudson, 2006:9; Swantz, 2008:33-34), and the diverse nature of this aspect required coordination that would ensure engagement of identified key participants such as the school's parents community, out-of-school youth, business people, faith-based institutions and other community-based development organisations (Idowu, 2011:8; Salleh, 2004:8;10). This function was therefore earmarked for coordination by the fourth member, the chairperson of the SGB. This diversity of the members required the study to manage through progressive engagements, depending on the availability and relevance to the study.

The coordinator also ensured that parents meetings were held to introduce the study; solicit parental support and engagement in service learning; give progress reports on learners' performance; and provide further learners support. She participated in the learners' study team sessions as supervisor, together with other parents and teachers. These interactions afforded the team an opportunity to identify areas of parental support and engagements (Racha-Schmid, 2010:353), namely, learner discipline, homework supervision, work performance and communication in general.

Following the report on the learners' performance at one of the parents meetings by the Physical Science teacher, parents were encouraged to help with the supervision of the learners' study teams (see Annexure T 3). This took place for a period of two weeks and the feedback was presented in full later. The parents and teachers who attended the meeting seized the opportunity and committed to the view that the learners' study teams should be continued from the beginning of the year and monitored regularly. In consultation with the SMGD she helped identify and facilitate the recruitment of parents and members of the community who could participate through the CSLC for the sustenance of service learning beyond the study (Sanginga et al., 2010:696-697). The data collected enhanced the service aspect of learning as well as the model component relating to community cultural wealth and civic responsibility (Burr, 1999:2, 5-7; Hertz-Lazarowitz et al., 2010:270-271).

Another member of the community, a retired school principal, was involved in this role, not only bringing his management and teaching skills and experience, but also conducting extra classes for Mathematics and Physical Science. He was also teaching in these sessions. This was in line with one component of service learning, namely extended learning opportunity. He was to mentor young people who might be identified for the co-management of the CSLC and to be available for assisting with the school laboratory work.

3.2.2.6 Coordinator for service provision

The fifth member coordinated the study with the municipal water care and management as well as the environmental health services. This was to initiate and facilitate engagement sessions for, *inter alia*, access to municipal physical facilities such as the water purification plants and solid waste disposal sites. The resources that were to be organised were mainly the municipal plant operators (operations) and officials (technical), who were directly involved with the daily operational activities of these services. The main focus, therefore, was on sharing information, knowledge, experiences and skills with the participants (Hickling-Hudson, 2006:4-5; Sanginga *et al*., 2010:699-700). This afforded an opportunity for the coordinating team to further analyse the situations of the municipal services and so facilitate decisions on the context of the study (Koosimile, 2004:483-486). It helped her decide on the municipal services that were linked to the academic learning of Physical Science.

Bringing to the study experience and knowledge of municipal water services and environmental health issues, she prepared and presented information on safety whilst visiting the waste water treatment plant. She also touched on issues of pollutants as they related to the curriculum (academic aspects) and the environment, particularly issues related to social responsibility (Kenworthy-U'Ren, 2007:814; Young *et al*., 2007:345-346). She also organised and arranged with her colleagues, namely the project management unit manager and the plant operators, presentations on both technical and operational aspects of the water purification processes (Annexure P). This afforded learners an opportunity to learn and to apply their minds to social practices that led to pollution. It also challenged and aroused their interest and thinking on how to combat and curb such practices (Richards & Novak, 2010:46, 50). This information and knowledge was also asked for in the learners' worksheets (Annexure CT 5).

Her other task involved liaison of the study with the municipality, through which the study identified a number of potential service learning projects. She also ensured that the study, through the school, was invited to attend the municipality's planning session in 2011. In this way it raised the projects that learners thought about and that required the corporation of such stakeholders as the school, the municipality and the community in general. A project such as the development and implementation of the school integrated environmental management plan stood out among others. Another role of the coordinator was to facilitate service provision engagements relating to water purification from water sampling to physical parameters and microbiological testing. These also had sufficient curriculum related content and could thus be linked (Hammond *et al*., 2001:9-14; Passarelli & Kolb, 2012:2-6).

The coordinator facilitated an information session that was addressed by the municipality's project management unit manager and herself. This challenged many of our learner participants to the point that some expressed their interest and saw career opportunities in water services, especially after their visit to the plant. The view that learning should be related to real life situations (Passarelli & Kolb, 2012:2-6) and be used to help us address our needs, emerged very sharply. Furthermore, apparent and inescapable myriad possibilities of power and power relations, cultural and ideological distortions were to be harnessed. The study used a comprehensive plan that participants developed to address these issues.

3.2.3 The Study Comprehensive Plan

The Study Comprehensive Plan consisted of three main sections: the coordinating team Performance Charter; the Implementation plan; and the Risk Assessment plan. Each of these sections was aligned with the five study objectives and respective constructs, which are discussed hereunder.

3.2.3.1 Performance Charter

The Performance Charter was developed to serve as a guide for the leadership of the coordinating team and the study as a whole (Hall, 2005:7-8). It set out the long-term view of the study through the vision and mission, and directed delivery modes and strategies through the values. It provided guidance on communication and study structure while broadly outlining the roles, responsibilities and envisaged conduct of participants. In this sense the Performance Charter bestowed a strategic character upon the overall Study Comprehensive Plan (Kenworthy-U'Ren, 2007:813; Olum, 2004:18; Yarger, 2006:1,6).

3.2.3.2 The development and implementation of the 'transformational learning of Physical Science through service learning' strategy

The development and implementation of the plan to 'use service learning to transform the learning of Physical Science' is the study's operational plan. It operationalised the study objectives which were set out as outcomes in this section of the plan. The coordinating team embarked on a strengths, weaknesses, opportunities and threats (SWOT) analysis (Yarger, 2006:6) which the team executed over three meetings, inviting participants from various sections/sectors to attend the inaugural planning meeting (Annexure T1). The sectors that were represented were Physical Science and Mathematics teachers; (senior) school management team members (*i.e.*, principals); HoDs at school; colleagues and researchers from the sustainable learning environments team (UFS); local municipality: environmental health, community member, school management and governance as well as education specialist. This was to facilitate the collection of a wide range of relevant data and to enhance the comprehension of the extent and nature of the problem in the area of research. It also aimed at giving voice to the subjugated voices (Hickling-Hudson, 2006:3-4; Stein & Mankowski, 2004:21; 23); to create space for inclusive discourses (Liasidou, 2008: 489; Nkoane 2011:119); and provide an opportunity for their participatory action (Sanginga et al., 2010:696,698-699) in addressing their problems and needs (Kellner, 2000:5; Thomson et al., 2011:216) regarding the learning and teaching of Physical Science

Using the FAI technique (Mahlomaholo & Netshandama, 2012:45), broad and vague thought provoking and 'participatory action triggering' questions were asked. Participants were all asked to express their views freely and to share their experiences on any matter that was raised. The participants were also made aware they were free to seek clarity where necessary and to ask exploratory questions on any issue raised. This was to pursue the achievement of the purpose of gathering data in respect of the state of teaching and learning in the Physical Science learning environments. The vague and broad questions were implored by the coordinator through a story which also constituted his personal experience:

> *Ke bona bana ba rona ba sa sebetse hantle science failure rate ya science e bonahala e ntse e phahama. Ke eng seo le bonang eka ke bothata hona ho ka etsuwa eng ho bo rarolla?* (Our children tend to perform poorly in Physical Science and this seems to be continual. What do you consider to be the cause of this and how can we addressed it?)

An observation that the question makes is that of the gradual decline in the learners' achievements or performance in the Physical Science (Alexander *et al*., 2010: 300-304; Mahlomaholo, 2012:46). It asked participants to identify possible causes of this state of affairs and suggest means through which it could be addressed. The second part sought to establish progress of those who passed matriculation, both their performance at tertiary and their roles in their respective communities, to identify possible challenges they face. Finally, participants were asked to share their experiences of the matter in the broader community and at regional and continental levels, and what could be learned from them.

The responses to these questions as well as the team's observations were subsequently categorised into strengths, weaknesses, opportunities and threats. A further categorisation the team agreed upon was that it should consider the political, economic, social and technological (PEST) nature and aspects. These were considered relevant and in line with the critical emancipatory theoretical framework and the nature of the study. The SWOT/PEST categorisation culminated in the study developing a grid (Annexure CT 0) that matched opportunities and strengths with weaknesses and threats that were more likely to be addressed thereby. It can be stated that this exercise characterised the interpretive and analytic (Mahlomaholo, 2012:42-45; Steinberg & Kincheloe, 2010:148-149) stages of CER.

As indicated above, these and other questions could not have been addressed in full in one session, hence the number of meetings and the plan that evolved. Some information still needed to be obtained from the learner participants and parents, also pursuant to proposed solutions. This is in addition to the process of listening to the voice recordings and further engagements amongst the participants, to confirm the messages or data received. A number of issues pertaining to the study objectives that were captured in the plan as outputs emerged very clearly. These were then developed into activities that gave expression to relevant outputs, and the activities were simplified into their respective lower level sub-activities and appeared in the plan as key tasks. The team identified resources, for example funding, responsible persons and timeframes, required for the execution of each key task. Potential funding sources were also considered. Without the operational plan (Annexure CT 2) the team might have lost focus on its mandate and timeframes.

3.2.3.3 Risk Assessment Plan

The last section of the Study Comprehensive Plan was a Risk Assessment Plan. This was developed also in observance of the University's Ethics Committee considerations. Its main purpose being to make sure that the coordinating team was sufficiently prepared. The safety of learners and participants during fieldwork trips, during the practical investigations sessions in the laboratory or classroom and during their execution of the service learning project(s) was paramount. It was thus imperative for the coordinating team to have a session on this aspect to identify potential risks for each of the aspects mentioned. The coordinating team described the risks they identified, allocated responsible persons for each risk to attend, estimated the impacts and frequencies of possible occurrence of each identified risk, determined appropriate mitigating circumstances and prioritised them accordingly (Olum, 2004:17-19; Yarger, 2006:1).

For prioritisation purposes the team used criteria propounded by Maxwell (2002:30-34) and Covey (2002:37:39), and divided them into four main ones namely: *priority A:* those with high occurrence likelihood and high risk impact; *priority B:* those with low occurrence likelihood and high risk impact; *priority C:* those with high occurrence likelihood and low risk impact; and *priority D:* those risks with low occurrence likelihood and low risk impact. The team discussed and agreed on the interpretation of the criteria and followed the suggested strategy in respect of the attendance of such priorities, for example, whereas one might have been tempted to cover the priority D risk last, the criteria suggest that they should be worked in daily routine on set deadlines. The priority C risks were those involving busy repetitious work in half-hour segments every week; for priority B risks, quick and efficient ways were to be found without much personal involvement; while the priority A consisted of those risks that were tackled first (Annexures 4 and 4A).

3.3 DATA AND METHODOLOGY

In this section participants' profiles are given, with details of how the data was collected and analysed. Data was enhanced by paying attention to the extent to which it was relevant (Sanginga *et al*., 2010:699) and accessible, and the participants fully engaged (Kellner, 2000:7-8; Mahlomaholo & Netshandama, 2012:38).

3.3.1 Participants

The participants' profiles are as follows.

3.3.1.1 The study coordinator

For purpose of this study I was referred to as the study coordinator (see paragraph 3.2.2.1). I am a Physical Science teacher at the school in which this study was conducted, and a community member who freely volunteered my services and expertise to the community. I was a participant in two community based development organisations and/or projects which I also helped to establish. I consider myself as having diverse situational work experience, ranging from teaching (teacher), subject advisory services (subject advisor), education physical resources planning and special projects coordination, and management of a municipality's technical services department. I often participated in local political activities through party political structures and programmes at local and wider community levels. I therefore consider myself as having been sufficiently aware of the situation in the area of this study. As a teacher I interacted regularly with the learner participants, teaching them Physical Science that is Physics and Chemistry. I also served the community through a faith-based institution (i.e., pastoral care), though to a relatively limited extent. I was thus conscious of the important role these institutions could make to transformational learning, especially considering the integration of social justice, freedom and hope related issues and imperatives.

3.3.1.2 Physical Science learners

The learner participants were the Physical Science entrants at the further education and training band, *viz*., Grade 10 (see paragraph 3.2.2.2). The study subsequently attracted interest from Grade 11 learners and parents. At Grade 9, these learners studied Physical Science which was part of the Natural Sciences learning area. The latter is an amalgam of Physical Science (i.e., Physics and Chemistry), Life Science, Agricultural Sciences and Geography. These learners came from different systems of education and different feeder schools, and some from Lesotho. Their learning conditions in Grade 9 were reminiscent of those of the previous regime of apartheid. The learner to class ratio was 60:1. They performed few practical investigations in Physical Science and the infrastructure of the school included fragile prefabricated material intended for primary school children. The school had one classroom size laboratory that was used by Grades 8 to 12, to be shared by all the science subjects, *viz*. Physical Science, Life Sciences, Agricultural Sciences and Technology.

The age groups of the learners ranged from 15 to 22, with 36 out of a total of 74 at the age that corresponded with their grade, while 38 were over age for Grade 10.

Their gender representation was evenly balanced, with 38 boys and 36 girls, all from previously disenfranchised families. The impact of the historic disparities on their socio-political, cultural and economic backgrounds prevailed. Similar features of 'dire' tended to be existent in Australia's 'take heart project' (Hickling-Hudson, 2006:5-7); Nigeria (Asikhia, 2010:232-233) and the BEST project of Botswana (Gboku & Modise, 2008:317). These gave us hope that the use of service learning to transform the learning of Physical Science would bear positive results.

Their learning experiences coincided with the curriculum changes that were geared towards the attainment of, among others, the principles of social transformation, active learning (Niemi, 2002:763-765) and critical thinking (McCrink & Melton, 2009: 205-206; Roschelle, Turpin & Elias, 2000:840, 843), as well as high knowledge and high skills (DBE, 2011b:8). The research into the endeavours towards the attainment of the principles of social transformation, active learning and critical thinking recorded more challenges. The challenges that were notable were the exclusion of both teachers and learners in the development of and changes to the curriculum (Msila, 2007:147-148; Jansen, 2008:321-328). These learners would experience further changes in the form of the curriculum and assessment policy statements (CAPS). For instance, those who repeated Grade 10 were affected by these changes in 2012, while their counterparts continued unaffected to grade 11; otherwise they would be affected in Grade 11 in 2013 and Grade 12 in 2014 (DBE, 2011b:3). The data collected in respect of these issues with learner participants helped the study to establish the extent of achievement of the envisaged outcomes.

3.3.1.3 Curriculum coordinator

The curriculum coordinator was a mathematics teacher and HoD of Mathematics and Natural Sciences at the secondary school (see Chapter 3 paragraph 3.2.2.3). He also taught Physical Science at other schools in the province (*i.e.,* wider community) and in Lesotho (*i.e*., regional level). He was a time-conscious person and a good listener who liked solving mathematical problems. He was a diligent person who spoke his mind, with experience in the teaching of mathematics and physical science, as well as having problems solving skills that were beneficial to the study. He supervised, as HoD, the work of the study coordinator (*i.e*., Physical Science teacher), and facilitated a number of coordinating team meetings, also attending all other meetings for subjects of which he was not a facilitator. The coordinator was also a community leader who, in his area of residence, was a member of the committee given the responsibility for ensuring unity among the residents in their newly established residential area. His community engagement experience in this regard was critical as it enhanced the coordinating team's unity and unity building capacity.

3.3.1.4 School governance and management coordinator

The school management, governance and development official in the education district of the area of this study served as a coordinator in this regard (see paragraph 3.2.2.4). He served schools in the area of this study in his official capacities as Agricultural Science and General Sciences teacher; teachers' centre manager and lately school management, governance and development official. He was thus well versed in education related challenges in this area. He also formed part of his local church leadership in which he served and offered his expertise and knowledge. He was a diligent time-conscious leader and manager who motivated other people. He was willing to work extra hours to complete tasks to which he committed his services and was also a fellow researcher in the sustainable learning environments. The research project he coordinated sought to address the lack of education related resources through strategic resources sharing approaches. This influenced this project immensely as it afforded an opportunity for the establishment of a community service learning centre.

3.3.1.5 The community participation coordinator(s)

The school governing body (SGB) chairperson was a human rights lawyer by profession (see paragraph 3.2.2.5). She was also a mother and social activist whose consciousness about the politics of racial dominance was aroused early during her upbringing. She was very critical of and sensitive to gender equality or equity and empowerment, as well as the emancipation of the girl child. She considered this study as appealing to her passion for freedom of the 'under-class'. She was a 'pusher' who did not give up easily and would not allow her focus to be diverted from what she regarded as a good cause. Her inclination in this regard enriched the emancipatory character of the project. She particularly focused on the significant role and support of learners by their parents.

The coordination of the activities that pertained to the community service learning centre was carried out by a retired Mathematics and Physical Science teacher. He was also one of the successful and experienced high school principals. His cumulative work experience of 38 years in 2010 offered an opportunity to learn more about teaching and learning experiences from apartheid, through the transition period to the democratic dispensation. It also afforded the study an opportunity to understand commensurate cultural, ideological and power relations changes. He was a diligent community worker, with practical and demonstrable instances when he used his knowledge of science and mathematics to solve real life needs. For example, though not trained as a contractor he had built his own house and helped with the mission house building.

His philosophy of life as a leader and teacher was entrenched in the principle of ‘leading by example with humility’. This he used to defuse and level off power relations. He practically built a house for the church and dirtied the principal’s hands with dagga and mortar and continued to do so for others where practicable. His practical experiences and commitment to the application of gained knowledge to addressing real life needs and problems was very helpful to the study. The study considered him to be ideal for the coordination of activities, resources and facilities for the community service learning centre. His continuation of voluntary teaching of Mathematics forms part of the community based service learning centre. His contribution and data collected through his involvement enabled the study to focus on the issues of its sustainability and the component of time.

3.3.1.6 Coordinator services provision

The coordinator for service provision was a municipality’s official in the capacity of environmental health practitioner (EHP) (see paragraph 3.2.2.6). She was passionate about environmental health issues and sought to establish strategies that would enhance positive change of ‘erroneous mindset and attitudes’ towards the physical environment. The challenge was the attitude and belief that seemed to be embraced by communities in black residential areas that compartmentalise environmental care and management. This view was that the municipality and not the general public was entirely responsible for environmental health and care, thus illegal dumping was job creation. This she viewed as distorted reality and cultural practice that needed to be curbed within the meaning of the current democratic practices and provisions.

Her work-related responsibilities required her to interact with various stakeholders, including business, schools and other public institutions. Her interactions included induction of student EHPs, organisation of environment awareness campaigns and monitoring of environmental pollution activities. This placed her in a strategic position for the study that forged working relations with the municipality (Hall, 2005:2; Yarger, 2006:1,6). She also supported the study by providing samples of potential pollutants that could be related to the study through chemistry themes for learners. These were identified from everyday solid waste disposal practices by the community and were subsequently used to trigger in learner participants and the coordinating team members an urge to serve.

This related and linked the study directly with the environmental health related service and culminated in the need to develop and implement the school's environmental plan as a possible transformational learning through service learning project. Other potential transformational learning through service learning projects identified through her efforts and her organisation of the visit to the waste water treatment plant as well as her colleagues to present and engage with learner participants, included awareness campaigns about water care and the currently unused sludge to make fertilizer for economic and educational benefits.

3.3.2 Instrumentation

This section discusses instruments and tools that were used to collect data in this research study. The choice and use of an instrument and/or tool was determined by the nature or type of data to be collected.

3.3.2.1 The audio recordings of participants' engagements and minutes

Records of minutes of parents, teachers and learners meetings were transcribed verbatim. The data obtained from the transcribed material could easily be coded and/or arranged according to the study objectives and their respective constructs. Another advantage was that if issues transcribed were not clear they could be noted and raised for clarification during the next meetings or engagements. This enriched the process of analysis and helped make sense of data collected. This was also what was carried out with the minutes, such as those of the learning area and department of Natural Sciences and Mathematics, as well as meetings with parents, learners and teachers.

3.3.2.2 Worksheets and learners' study teams

The worksheets were specifically designed for fieldwork visits to the waste water treatment plant, the purpose being to collect curriculum-related data in respect of the respective curriculum themes and concepts. This was perceived as an attempt to directly link curriculum and therefore theory that was taught in class with the real life service. The worksheets included questions that related to the identification of problems and challenges experienced during the provision of the service under consideration. They were also to identify possible causes thereof as well as the possible steps that learners would take to address the identified problems. In this way service learning projects were identified. Learners worked in teams for purposes of supporting each other, which led to the establishment of learners' study teams. These were subsequently systematised and invoked the involvement of parents as team supervisors. The roles of parent supervisors and team coordinators as well as those of teachers were to be clearly spelt out. The data collected also addressed relevant and respective constructs linked to the study objectives, as would be seen later.

3.3.2.3 Service learning project(s) and curriculum related assessments

The coordinating team searched for community based development and services-related projects that offered learning and service opportunities (Kenworthy U'Ren, 2007:811-812; Parker *et al*., 2009:587). The search included the municipal water care and water management services. This municipal service offered the team sufficient potential service learning projects. The coordinating team decided to commence its search with some form of orientation of its members (participants) (Sanginga *et al*., 2010:699). This orientation was aimed at the empowerment of team members with necessary tools for purposes of intervention and support for learner participants. Team members visited the waste water treatment plant and water treatment works prior to learners' visits in order for them to be aware and to prepare accordingly. The visits commenced at the community residential area, where issues regarding the direction of flow of rain water were identified. Team members were to understand and explain why the flow was in one direction, that is, down slope, using scientific principles. They then followed the direction of the flow up to the waste water treatment plant and the potable water treatment plant. As team members travelled down slope to the water treatment works they identified needs and problems that affected water care, for example, community pollution related practices and water management, for example, water supply and demand.

The needs and problems identified were categorised into social and technical categories (Kenworthy U'Ren, 2008:816), elucidated by the plant operator(s) and municipality's project management unit manager, as well as the environmental health practitioner. This afforded members an opportunity to understand the problems experienced from the perspectives of both the service provider and the served (viz., the community). One member of the study coordinating team sent the study convener an e-mail that expressed her appreciation of a learning opportunity that was afforded her by the study. The following coordinating team meeting reflected on the visit with a view to prepare for the learner participants. The meeting concluded that there should be worksheets for learners as there were more learning aspects and conducted a risk assessment based on the visit in line with the requirements of the ethics committee for this study. The next visit was by the learners, followed by a meeting to reflect on their learning experiences.

The coordinating team subsequently identified, aligned and integrated aspects of the curriculum with those of the identified ‘service learning projects’ (Bringle & Hatcher, 2009:40; Roschelle et al., 2000:841). For instance, the toilet cistern and how it operated (service) was used to explain concepts such as weight, mass, gravitational acceleration, pressure, and mechanical energy (academic learning). Learners were to use the knowledge gained to explain how these concepts and principles could be used to help parents with the choice of an efficient and effective cistern (critical thinking and application of knowledge) (Roschelle et al., 2000:843). The worksheets addressed other themes as they related to the different components of the water care and management services system.

Thus, discerned projects were those that addressed real life community needs and problems (Kenworthy U’Ren, 2007: 816; Thomson et al., 2011:216,221). The scope of this study as illustrated by the discussion of operational concepts of transformational learning and learning for sustainability required that the discerned projects be service and development oriented projects. The alignment of curriculum with service and of learning with serving were a “communicative action” that was carried out through “iterative and complementary processes” (Kemmis, 2008:127-130; Sanginga *et al*., 2010:698). These processes involved teaching and learning processes; parental engagements in the learning encounters; interactions with the municipality; and collaborations with the Provincial DoE on extended teaching and learning opportunities for Physical Science.

These processes needed to be organised systematically through their alignment with official systems. As a result, the coordinating team facilitated and guided them through preparations and planning; actions represented by training and induction of participants prior to the actual implementation of the project; analysis or monitoring of the implementation processes through the use of agreed monitoring tool/system (Annexure CT 3); and the use of reflection and self-reflection (Parker *et al*., 2009:588; Roschelle et al., 2000:842; Swantz, 2008:34). The other issue that the coordinating team focused on in this regard was to ensure that the use of real life community service learning projects augmented the limited teaching and learning resources that were available. The team ensured that the projects offered learners the opportunity for extended learning and practicing of learned skills. Finally, the service learning project enhanced learners' civic responsibility (Osman & Attwood, 2007:13).

Following the learners' visit to the waste water treatment plant they were given a service learning project as part of their formal continuous assessment. The service component in the project involved the identification of water leakages and the determination of the cost of such leakage to the affected community member and the public. The cost was to be extrapolated to a period of a month and a year. They also engaged the concerned families and the municipality to have the leakage repaired. Through this project, principles of water purification were used to teach learners to determine the rate of flow (speed), calculate cost of water loss, and to communicate and network. The Physical Science concepts and principles they learned included weight and mass, mechanical energy, and separation of matter (water purification). The formal tests that the learners wrote also privileged the principles of water demand and supply scenarios covering the respective concepts and themes as depicted in the curriculum.

3.3.2.4 Participants' reflections

Another important tool that was used was the participants' reflections (Bringle & Hatcher, 2009:40; Molee *et a*l., 2010:240-243; Parker *et al*., 2009:588,591-593). This provided data that was more effective than cognitive. Learners were asked to give in writing their views about the study and the visit to the waste water treatment plant, as well as about their work study teams (Hickling-Hudson, 2006:3-4). In the same way team members also expressed their views through and during meetings, and the reflections characterised our coordinating team meetings and other participants' engagements. The learner participants also shared their views with the coordinating team members regarding what they liked or disliked (Agger, 1991:110-111, 119) and about their personal learning experiences during the period of the study, as well as on what could be done to help them to learn better. Written reflective submissions (Parker *et al*., 2009:588,591-593) that were received formed part of the data collected and analysed.

3.3.2.5 Recording devices

The audio recording was used to store data for purposes of transcribing and to ease its analysis. Video recordings were also made to enhance improvement of the actual intervention after viewing the initial practices. They were also used to afford those participants and parents the opportunity to observe and learn about the practices to be avoided and about which the community was to be educated. This was in line with the call by the services coordinator that there was a need to change the mind set of communities about and towards the environment. The recordings could also be used as learning aid and learning assessment enhancing tool at a later stage. The use of both the video and audio recording devices was done with the permission of the participants (DePalma, 2010:217). The recordings would not be used in any manner that would disadvantage the participants and their use would be sanctioned by the participants themselves. This was in addition to their free consent having been sought and granted prior to the recordings themselves. The participants were assured of the privacy and anonymity in respect of their rights and dignity, hence the transcription of recordings.

3.3.3 Data collection procedures

This section explains how the FAI principles were adapted and used in this study to collect data, starting by describing the FAI principles then outlining the significance of the comprehensive question in synergising the discourses, participants' views and perspectives. It goes on to show how the follow-up and clarity-seeking questions were used to guide the discussions towards the study aim and comprehensive question. It also relates the whole process to critical participatory action research that has been adapted to the study.

3.3.3.1 Free attitude interview principles

Meulenberg-Buskens' free attitude interview (FAI) technique was used to conduct the monthly meetings of the committee to monitor, evaluate and improve on the transformational learning through service learning implementation plan. In order to enhance meaningful participation of all coordinating team members in the data collection process, a mini-workshop session on the FAI was held, which enabled members to practice it as they took turns to facilitate coordinating team meetings. They further used the FAI technique as they engaged other participants, such as learner participants. The main focus of these engagements was to determine the conditions, under which the transformational learning could be successfully implemented, identify possible risks and produce evidence of its effectiveness.

The choice of the FAI as the procedure for data collection in this study was mainly because it was non-directive, and “it allows knowledge production to be humane and human without alienating and undermining the integrity of the research participants as full-fledged human beings” (Mahlomaholo & Netshandama, 2010:11). Being ‘humane and human’, the FAI is supportive of the social justice principles of human dignity and respect for human rights and freedoms to which people are constitutionally entitled (DBE, 2011b:4-5). The FAI’s character of not alienating and not undermining people’s integrity gives them hope for a better life and freedom to continue to express themselves and enjoy their freedoms (RSA, 1996a : s16). That it tends to make people feel recognised as human beings gives them peace of mind that they will be treated equitably. These principles are also espoused by critical emancipatory research and were fully embraced by the study as discussed in Chapters one and two.

The FAI’s theoretical origin, *viz*., critical theory, and its nature as explained above, inevitably made it relevant and imperative for this study. The FAI afforded participants an opportunity to go through the procedure being considerate of their own views and circumstances and those of others. This is corroborated by Kemmis (2008:127-128) and Swantz (2008:33-34) in their discussions of critical PAR and PAR respectively, which suggests coherence between the FAI and PAR because, for both, people’s own views of the character or nature of their problems is fundamental to research and the need to be understood fully. To this end the study endeavoured to ensure that the participants developed a sense of belonging and of ownership of the processes including decision making. The coordinating team members were themselves coordinators of major areas within the study, facilitating engagement sessions using the FAI and co-owning decisions in respect of the data collection processes.

The participants were in many ways embedded in the study and area of research, as they used their own transport to the venues and to the waste water treatment plant, as learner participants' supervisors together with teachers. They were actively engaged as trainees and trainers with learners, teachers and parents in the learners' study team, monitoring tool development and implementation. They made follow ups on study progress, including learners' study team engagements, and actively took part in, and earnestly but critically contributed their experiences and knowledge during the reflective and other team engagement sessions. This is very much akin to critical PAR as advocated by Kemmis (2008:125-126).

3.3.3.2 Comprehensive question focuses discussions

As indicated above, Meulenberg-Buskens' (1997:2) FAI technique was used to collect data, and involved asking one comprehensive question. In this case the question was the main question as reflected in the problem statement, namely, *How can service learning be used to transform the learning of Physical Science such that it is sustainable?* This question was found to be complex and too broad to be responded to in one session or in one meeting. The responses that were given were multiple and complex, and led to myriad clarity-seeking questions and follow-up questions before a summarised version could be obtained. At times the participants were defensive and protective of one another, and as such tended to shift the blame to someone else as though they were being accused. For instance, one viewpoint was that poor learner performance in Physical Science was as a result of:

> *systemic problems and that it was a nationwide problem, and that it emerged with the introduction of NSC; that there were no laboratory equipment; some concepts were too abstract to learners; that learning content was too remote to the learners; that teachers did not have time for experiments; that there was lack of enthusiasm for both teachers and learners of Physical Science and lack of commitment* (see Annexure T1).

This view could not however be negated, but was followed up for clarity in respect of how or what our role would be to transform the learning of Physical Science through service learning. In this regard the outputs of the Study Comprehensive Plan and the objectives of the study were used to simplify and to redirect the discussion. This was done in to facilitate the enhancement of common understanding of what the question asked for. The objectives of the study were derived from the aim which in turn gave rise to the study question. The FAI principles were adhered to even at the level of the objectives of the study that is, depending on the extent of the response, clarity-seeking and confirmatory questions were asked and remarks made. The discussions were subsequently summarised immediately after the clarity-seeking questions to ensure a common understanding of issues and thus confirmation thereof. In cases in which an aspect was found to have been misconstrued it was followed up during the next engagement sessions.

The study provided space for participants' interactions between scheduled study meetings to go over outstanding issues and to confirm shared views and discrepancies that might have existed. The frequencies of these engagements depended on the issues and the willingness of concerned members to do so. The shared views and discrepancies would if necessary also be re-introduced and discussed either directly or indirectly during formal scheduled meetings. This practice was found to be in keeping with the versatility of the formats of CER couching this study. The discussions during meetings were audio-recorded and subsequently transcribed verbatim for further analysis. The documents that were used more extensively, were the current Grade 10 physical science work schedule (curriculum) and respective departmental policies.

To illustrate the use of the FAI in this study, for each one of the five study objectives an open-ended question was asked within the meaning of the comprehensive question. Thus, this question was relatively not a high level question or as comprehensive as the study main question. These questions were couched from the responses, views and perspectives that were expressed by the participants (Steinberg & Kincheloe, 2010:145; Swantz, 2008: 33-34). They were fundamentally follow-up and clarity-seeking questions that were intended to converge the discussions and viewpoints towards the aim of the study. The process was supported through the skill that the coordinating team members had, and the conditions they seemed to have created for free participation in the discourses (Sanginga *et al*., 2010:699).

3.3.3.3 The follow-up questions guide discussion towards the comprehensive question

Clearly there was a need to ask follow up and clarity-seeking questions based on the responses and points of view summarised above. This was necessary in order to reconcile discourses with the main question namely to dispel misconceptions and mystifications inherent in the responses (Biesta, 2010:43); to address contradictions; and to balance of immanent power relations struggles that might be as a result of these diverse disparities (Liasidou, 2008:486-489; Van Dijk, 2008:87-92). Thus, in an attempt to achieve this follow up questions reconciling the discourse to the first objective would for instance be: ***To what extend were the learners' real life situations, backgrounds and needs used and incorporated in the teaching and learning of Physical Science?*** This enabled the coordinating team members to collect data in respect of the commonly used teaching and learning techniques in the Physical Science learning environments.

Pursuant to this purpose, the coordinating team members further identified the real life situation projects, needs, services and experiences that were used for purposes of serving and learning Physical Science principles. The investigation thus established the extent to which such services addressed the needs or problems of those affected; the extent to which it was aligned to the curriculum and the extent to which it was sustainable. The Physical Science principles, themes and concepts to be learned were identified from the curriculum related documents and were aligned with aspects of the services rendered accordingly.

Firstly, as discussed above, the coordinating team searched for the needs and problems through 'critical' participatory action. They sought to understand learning and learning facilitation from the points of view of those directly affected, *viz.,* learners, teachers and parents. These actions understandably compelled them to engage and be immersed in the Physical Science learning processes. Thus, the coordinating team facilitated the creation of collaborative learning opportunities. Secondly, the identified services were brought closer through the alignment of the identified services with the curriculum. This was influenced by and required the expertise of the Physical Science teachers, and the knowledge and understanding of education policies of the strategic partners and members of the coordinating team.

The gaps that were found between the objectives and the teaching and learning practices were further analysed in order to formulate the strategy for the use of service learning to transform the learning of Physical Science.

Thirdly, and finally, the team investigated the extent to which the identified services were sustainable. This was to ensure that such services could accommodate the parameters of sustainable empowering learning environments (Mahlomaholo, 2010:11-12). The collaborative learning facilitation partnership (Kenworthy U'Ren, 2007:818-819) that seemed to have been established by the teachers, the learners and parents was one of the parameters that was conceived as having potential to sustain the use of service learning to transform the learning of Physical Science (Mahlomaholo, 2010:12). Furthermore, the extent to which such collaborative learning practices were learner-centred, learning-oriented, problem-based, promoted active and self-directed learning, was crucial (Annexure CT 8). These would inevitably assist in establishing the extent to which the use of service learning to transform the learning of Physical Science in this manner would be sustainable.

Furthermore, based on the myriad views, perspectives and opinions raised during the discussion triggered by the aforementioned questions, another follow-up and clarity-seeking question might be asked: ***What elements/components/aspects are essential for the makeup/structure of teaching and learning Physical Science technique/approach that uses learners' real life situations, problems and needs?*** This question sought to establish the features from the physical environments of the learners from which learning of Physical Science could be facilitated. The team considered the major service learning components around which there appeared to be consensus in the RSA (Osman & Attwood, 2007:6). These and other components emphasised in other parts of the world, namely the SADC region, Nigeria and Australia. This exercise revealed similarities among the components that were identified by this study. The variance from one country to another, as in the literature, became the study's point of emphasis. Some components have been emphasised in order to respond to specific contextual realities associated with issues or events over time and region.

The team thus reflected on the literature's major service learning components around which there was consensus. These are repeated here for ease of reference and readership namely, the taken-for-granted discursive practices as well as power relations implied or embedded in the whole educational, political and economic systems discourses of active participation, thoughtfully-organised experiences, focus on community needs and school-community coordination, academic curriculum integration, structured time for reflection, opportunities for application of skills and knowledge, extended learning opportunities and development of a sense of caring for others (Asikhia, 2010: 229; Gboku & Modise, 2008:316, Merriam & Ntseane, 2008:185; Osman & Attwood, 2007:16; Otote & Omo-Ojugo, 2008:654).

During these reflective sessions the coordinating team confirmed the convergence of these components. These were then related to the area of this study by identifying and aligning them with the discursive practices and the components identified from the ensued discourses with the concerned participants. The discursive practices in this regard included those that the coordinating team and participants, parents and teachers were engaged in prior to, during and beyond the study period. These were, for example, the learners' study teams, service learning projects and community based learning centre.

The team paid special attention to the power relations embedded in those discourses and discursive practices (Osman & Attwood, 2007:6). For purposes of this study the team considered potentially prevalent power relations at the pedagogic and micro level between learners, and between learners and teacher; amongst learners, parents and teachers. Firstly, with regard to the micro level, the team investigated the power wielded by the teacher by virtue of the knowledge (Liasidou, 2008:486-489; Rocha-Schmid, 2010:355; Van Dijk, 2008:87-88) he or she had and the legislative role s/he played as a parent and implementer of curriculum and polices. Secondly, the team obtained data in respect of the potential power relations embedded in the relationship between the school (learning) and service provider (service) that emanated from local political upshots (Liasidou, 2008:486-489). The power in this regard was notably informed by tension brought about and informed by a myriad of legislative taken-for-granted discursive practices. These were also reflected in the legislated roles and responsibilities of parties and in turn involved imperative issues regarding hope, freedom and social justice responsibilities of the school and the community at large. In this regard, the team explored the impact of inherent economic imbalances that seemed to have existed between the school and the public service provider.

This exploration also considered the potential tensions that emanated from the possible contestations of ownership of the resultant programmes and/or campaigns. This the team did in acknowledgement and with the understanding of the constitutional obligation of municipalities in respect of provision of services together with members of the public (RSA 2004: s15 2b). The team considered the possibility of exploiting these imbalances for the good of the study, where both or all parties benefitted, and thus aligned the official service work schedules with the learning programmes in order to optimise the utilisation and access to resources. The coordinating team members needed to understand concepts such as teacher's power, levelling off of power, involvement of parents/learners, pedagogic encounters that took place in class and at homes, illegal and dangerous acts, citizens' responsibility, canvassing, local politics, and (dis)respectful actions that surfaced during the discourses.

These matters were pursued circumspectly: in a 'human' and 'humane' (Mahlomaholo & Netshandama, 2010:9) manner that did not jeopardise the position of the fellow participant's future employment, or the partnership or coordination between the school and the community and hence the service learning component (Osman & Attwood, 2007:6). In addition, the contextual implications of the concepts such as those referred to in the preceding sentences were explored. This exploration was also concerned with the extent to which they enhanced the interface between the lower and the upper development levels and specific components of service learning. Once again this was to ensure the attainment of unity amongst the different levels of development for each affected component. It was for these reasons that the matter needed to be understood well by the team. In Chapter 4, this data is analysed further to make sense of the situation and to interpret it accordingly.

The coordinating team had to raise a further follow-up question pursuant to '**How the conditions under which the use of service learning could be made conducive in order to enhance the transformation of learning of Physical Science**'. The literature review described the conditions found to be conducive for service learning, and the team re-interpreted these within the broader context of sustainable empowering learning environments. The conditions that were discussed included supporting legislative imperatives (Arenas et al., 2006: 23-24; Asikhia, 2010:229-230; Hatcher & Erasmus, 2008:50; Koosimile, 2004:484); enhancing school-community collaborations and coordination; and enhancing motivational levels (learner readiness and motivation to learn (Idowu, 2011:134; Koosimile 2004:489). They therefore laid the basis for the data collection in this regard. The team explored and contextualised issues and realities from which the learners were to be freed or emancipated; the systems and processes that were subsequently smoothened out and/or that were to be smoothened out; and resources and facilities to be provided and/or be compensated for, as well as the participatory action that ensured the democratic engagement of relevant stakeholders and participants.

The process outlined in the preceding paragraph was preceded by the discussion of the identified conditions with the purpose of enhancing mutual understanding thereof. This also involved their possible confirmation and/or rejection as potential conditions in this area of research. This in turn afforded the study an opportunity to identify and add those pertinent conditions to the list. It was also thought that it would enrich the contextualisation and areas of emancipation of learners and the parents from identified bondage, as explained in the preceding paragraph.

These conditions were then aligned to the various bio-ecological development levels to bring about synergy. This required that the impact or influence of each condition on the components be explored, which was deemed significant for the determination of possible intrinsic risks and threats to the service learning framework. This was found to be critical for the establishment of possible corrective measures should the risks and threats surface. For instance, the scarcity of resources was checked against each of the components to establish the component that would be most affected by it. These were then arranged in a manner that was reflective of the severity of the impact. The reason for this was to engage potential solutions in respect of those high impact effects where such were possible. This prioritisation was made in accordance with the criteria outlined above. The high priority impacts were attended in a timely manner for the enhancement and easing of other indirectly affected areas of the framework. This process was repeated for each condition and component.

It became imperative for the coordinating team to anticipate that the use of service learning to transform the learning of Physical Science would have threats and risks, thus it was critical to find out '**what other aspects were to be built in the use of service learning to transform the learning of Physical Science so as to protect it from failing to achieve what it was intended.**' In Chapter 2 we identified threats that often confront service learning and classified them under conceptual issues, financial issues, pedagogical issues, power differential issues and evaluation (Arenas et al., (2006); Koosimile, 2004; Akiri & Ugborugbo 2009; Nkoane, 2009; Mahlomaholo & Netshandama, 2011; Parker et al., 2009). The relevance of these threats and risks to this study was explored intensely and they were subsequently compared with those identified during the study engagement sessions and aligned accordingly. They were related to the components of the service learning strategy that were found to be imperative in each case, and were aligned with the conditions under which the framework would perform optimally.

The arguments advanced in respect of the above activities were firstly informed by the desire to reconcile all the constructs with all the five study objectives. This further consolidated these objectives into the response to study research question and subsequently the attainment of the study aim. Secondly, the establishment of relationships between the risks and the components facilitated and enhanced the problem identification and problem solving processes. These were considered to be unavoidable and a necessary requirement for the sustainable implementation of service learning. The study understood the relationships in the context of this study and that they were not so much about generalising same for predictions purposes. Thirdly, the coordinating team assessed the risks and threats that were inherent in the components of the strategy, and determined possible actions that would be taken to curb their effect. This process also considered other risks and threats that were regarded as external to the components. This process also culminated in the development of risk assessment plan that formed part of the comprehensive plan (see chapter 2 paragraph 2.8 and chapter 4 paragraph 4.5). The risk assessment plan enabled the coordinating team to anticipate and to act proactively and accordingly. As a result the service learning strategy was used successfully and efficiently to transform the learning of Physical Science. Thus, instead of taking four months, searching for the possible problem caused by a specific threat and specific condition on a specific component, it took only one week. The benefits of the latter exercise are crucial to the study.

The last aspect on which the coordinating team needed to raise follow-up questions was the availability and ‘analysis of evidence that attest to the applicability of the use of service learning to transform the learning of Physical Science. The question raised here was: **What evidence is there that this can also work in the area of this study**? There is sufficient evidence in the literature on service learning to have been successful (Hatcher & Erasmus, 2008:49-51; Kenworthy-U’Ren, 2007:819; Roschelle *et al*., 2000:843-846). The issues pertaining to evidence were viewed as threefold namely, evidence of support by policy and legislative framework; evidence from best practices; and evidence from the situation itself.

The coordinating team pursued the policy and legislative imperatives and considered the promotion of the provisions of the Manifesto on Values, Education and Democracy, namely, values and morality that give meaning to social relationships. These are respect for democracy, equality, human dignity and social justice, and the enrichment of the individual and the broader society (DoE, 2001:9-10). In the first instance, the coordinating team based its operations on a set of values of trust, care and respect. These were reflected in their Performance Charter. Furthermore, chapter 1 section 5 obliged the study to uphold the principles underpinning sustainable development as a whole, viz., hope, equity, social justice and freedom. It is imperative to note that they are also Constitutional values.

Pursuant to these, the coordinating team lived up to the guaranteed values of respect for human dignity, democracy and trust as in the signed consent letters. The participants were afforded an opportunity to exercise their constitutional democratic rights and freedom through the study. Their voices were considered and included in the recordings for later analysis and ultimate operationalisation where practicable, and the service learning projects and activities extended to the immediate community which was possibly also enriched thereby. The enrichment that learners and the community might have derived from the commensurate transformational and service learning is tantamount to the legislative and policy provisions in this regard. Through transformational learning, through service learning projects, the study attempted to equip learners with “knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society as citizens of a free country" (DBE, 2011b:4-5) (see paragraphs 3.3.2.2 and 3.3.2.3 on the learners' worksheets and service learning projects)

The introduction to chapter 1 advanced an argument that service learning in the RSA had been predominantly a matter for institutions of higher learning (*i.e.,* universities). This was evidenced further through the literature study and legislative framework. The community service as a policy framework in RSA for high schools was considered insufficient to address issues of transformation in the light of the purpose of current curriculum provisions (DBE, 2011b:4-5; DoE, 2003:10). The study identified and implemented relevant service learning projects that were supportive of policy and legislation as opposed to community service. The coordinating team considered this to have been in pursuance of the enhancement of the purpose to "provide access to higher education" (DBE, 2011b:5).

In the same vein, RSA policy provides for the facilitation of transition of learners from education institutions to the workplace. In contrast to this, the study argues that learners increasingly displayed greater inability to apply the knowledge they acquire from high school Physical Science learning environments in their real life situations. It further demonstrated that the educational reform that was geared towards the introduction of teaching approaches that foster closer working relations between schools and communities was preferred internationally. In the RSA, Botswana, Nigeria and Australian schools, it was necessary to transform learning environments in line with the socio-political and economic developments of the day (Arenas *et al*., 2006; Thomson *et al*., 2010; Mahlomaholo, 2010). The coordinating team therefore ensured that through its data collection processes participants also identified service learning projects that might improve their community's economic potential and status.

The best practices considered in this study were in the RSA, the Community-Higher Education-Service Partnerships (CHESP), the Australian Queensland University of Technology (QUT), as well as the To Hold Our Earth Firmly project. There were also the Basic Extension Skills Training (BEST) and the Out-of-school experiences in science classes/STS from Botswana and the Tanzanian's Jipemoyo 'Take Heart' project. The purpose of the CHESP was to avoid duplication of existing services in communities, as this would further fragment the existing third sector and its organisations while the QUT’s purpose emphasised group implementation of a community service project (Parker et al., 2009:587; Thomson et al., 2011). In Botswana’s STS, the purpose was to “facilitate critical thinking, understanding and ease of transfer of skills and knowledge to real life situations through what was culturally specific and flexible to cater for the change in the situation of the participants” (Gboku & Modise, 2008:316; Koosimile, 2004:485; Merriam & Ntseane, 2008:185). Similarly, the Nigerian schools were pressurised into making their “impact on society through the development of values that promote civic responsibility” and further indicated the centrality of the teacher’s knowledge in this regard to bring about educational reform (Akiri & Ugborubo 2009; Asikhia 2010; Otote & Omo-Ojugo, 2008:654).

The lessons that the coordinating team drew from these best practices revealed what could best be described as cornerstones to transformational learning of Physical Science through service learning, namely purpose; context; participants; roles and responsibilities of stakeholders; performance contract or agreement; clear outcomes; tangible service products and critical reflection of experiences. The coordinating team, resultantly, worked with the learner participants and parents (i.e., community members), notwithstanding their respective out-of-school work situations. As indicated above, the team signed the Performance Charter that also identified their agreed upon roles and responsibilities as participants to the study. The data collected through worksheets and service learning projects was related to the curriculum-prescribed outcome 3. The team held critical reflection sessions and learners gave their views about the service learning projects. For assessment purposes the coordinating team considered the inclusion of the service learning projects as formal assessment tasks subject to the approval by the school and by extension by the DoE.

The local context of the service learning projects in this project was water care and water management services. This was deemed to be critical in the current era when global warming effects and environmental sustainability needed urgent attention. At local level and specifically, in the area of the study, the community problems and needs in respect of the water demand and supply as well as water care were course for concern. The study coordinator, who had formerly worked for the municipality, brought his practical experience in respect of this subject and challenged the team and participants immensely. This served as a desirable dissonance for the coordinating team and learner participants that resultantly spurred them in one direction, which is, finding solutions to local water-related community problems through critical PAR (Agger, 1991:106-107; Kemmis, 2008:125-130).

The participants identified potential service learning projects through and from their visits to the water treatment plants/sites; their daily experiences regarding water and waste water provision (*i.e.,* management of demand and supply) services, as well as water care (*i.e*., water quality). The coordinating team also assigned the Physical Science teacher and HoD at the school, assisted by the environmental health practitioner, to identify curriculum-related items that could be aligned with the different aspects of the service. Support in this regard was sourced from other people who were not members of the coordinating team or the study. The municipality's project management unit manager, as well as the water purification plant operator, played a pivotal role in this regard.

The prospective service learning projects that were identified by learner participants included the following: water supply and demand management, leakages from detection to plugging; water care management, quality monitoring and processing of poor quality; community awareness campaigns, environmental health and water use management and a sludge fertilizers project for 'poverty' relief purposes. The coordinating team confirmed the need for the establishment of a community-based service learning centre for the sustainability of service learning projects. The study further identified cooperative learners' study teams as integral to the service learning, also in support of its multifaceted character.

The coordinating team worked out mechanisms for the determination and development of tangible products of each of the identified service learning projects. The criteria related to the different aspects or levels of learning, such as cognitive, affective and civic responsibility. The assessment standards on the other hand referred to the extent to which curriculum content was integrated with services. Moreover, the respective assessment standards and criteria were to be established to enhance their meaningful evaluation. For purposes of this study report, only one of the identified projects was considered and implemented in line with the preceding discussion.

3.3.3.4 Critical participatory action research

It is evident from the discussion above that 'critical' PAR was relevant and the affected stakeholders were engaged as equals in the processes of knowledge production. It was thus these participants' participation and action that contextualised this study (Swantz, 2008:33), and critical PAR expressed the theoretical framework provision sufficiently in this research study. Swantz (2008:33-34) explains this further in detail through her Tanzanian experiences, where PAR researchers went to the extent of renting houses from villagers, and living and working with them. Swantz (2008:34) further contends that they pursued the PAR's aim of making research an agent of transformation. Their understanding was that emancipation could be achieved if they gained "a deeper view of people's [*i.e*. the area of research] own concepts of development, what assets their own cultural ways could contribute and what conflicts they caused." It is this gained knowledge or deeper view of people's concepts of their development that should be beneficial for participants seeking emancipation, so that their voices can be heard and included in respective discourses. Similarly, in this study, the voices of learners, parents, teachers, service provider (for the public) were all heard and included (Stein & Mankowski, 2004:21; Steinberg & Kincheloe, 2010:143-145). The data collected was subjected to the critical discourse analysis (CDA) in Chapter 4.

3.3.4 Data Analysis

This section first briefly outlines the theoretical origin of CDA that is used to analyse data. It then explains the different levels on which data was analysed. These levels are the textual, discursive / cognitive and the social analysis levels.

3.3.4.1 Theoretical origin

CDA is viewed as a multidisciplinary and a shared perspective that encompasses a range of approaches. Thus, in this context, CDA is inextricably tied to critical emancipatory research (CER) that couches this study as a theoretical framework. In other words, CDA, like CER, has interest in and leans towards emancipatory praxis for social justice, democratisation and transformation of society (Biesta, 2010: 43; 45;

Liasidou, 2008: 486-487; Mahlomaholo, 2012:41-42; Merriam & Ntseane, 2010:187; Nkoane, 2011:113). It thus derives its theoretical origin from critical theory (Van Dijk, 2008:85) from which CER evolved. This means that CDA, accepts that ideology is a legitimate object of investigation (de Beaugrande, 2006:41-45; Liasidou, 2008: 487; Rocha-Schmid, 2010:354-355). This is further consolidated by the view that CDA forms part of social and political life on the basis of its aims, especially those relating to its social problem or issue orientation (Van Dijk, 1995:17-19, 2008:85-86; Sheyholislami, 2009:3-4). For instance, a range of 'approaches' that CDA encompasses are fundamentally the 'formats' of CER.

Furthermore, CDA declares its stance that leans towards social transformation (Liasidou, 2008:486; Steinberg & Kincheloe, 2010:141). It is not an apolitical (Van Dijk, 1995:19) or neutral (Rocha-Schmid, 2010:354) technique as it is used by mediators (Kellner 2000:3) who have declared their stance and interest in support of the transformation agenda (Biesta, 2010:43; Nkoane, 2011:112-113; Mahlomaholo, 2012:48-49; Merriam & Ntseane, 2008:187; Osman & Attwood, 2007:17-18). The mediators being referred to were the coordinating team members who pursued the facilitation of transformation of the learning of Physical Science through the use of service learning. In this study, CDA is opposed to value free scientific approaches as it is guided by the principles of freedom, equity, hope, social justice and peace (Mahlomaholo & Netshandama, 2012:43). It is operationalised through the values of mutual respect, trust and humility (Dominiquez, 2008:4; Rocha-Schmid, 2010:355; Steinberg & Kincheloe, 2010:142-143).

As with the critical emancipatory theory, to be "successful, CDA must be effective: its conclusions, recommendations and other practical interventions must work" (Van Dijk, 1995: 19). This is in line with the aim of this study. In this study, the Van Dijk's socio-cognitive model of CDA is used following a closer consideration of the many types of CDA which Van Dijk (2008:85) indicates to be within its aims:

> … of focusing primarily on social problems and political issues; being multidisciplinary and therefore empirically adequate; of its explanation of discourses in terms of properties of social interaction and especially social structures and its focus on ways discourse structure enact, confirm, legitimate, reproduce or challenge relations of power and dominance in society that is of

> asking questions about the way specific discourse structures are deployed in the reproduction of social dominance.

The choice of the socio-cognitive model of CDA was based on its capability of multiple level analyses of data from textual (micro) through cognitive to social (macro) levels (Van Dijk, 2008:87). It was thus conceived as having the capacity to analyse inherent inconsistencies and gaps between and among the different levels of learner development from the local classroom setups to community and regional macro levels engagements (Donald *et al*., 2010:15-16, 28). These levels form a unified whole in everyday interactions and experience. CDA has the capacity to bridge the gap that might exist between these levels and to arrive at a unified critical analysis of members-groups; action-process; context-social structure and personal and social cognition (Van Dijk, 2008:354-358). CDA was thus used to identify and analyse potential areas of weakness and disunity among these levels and for each of the five study objectives. This was done at the textual analysis level, the cognitive analysis level and finally at the social analysis level.

3.3.4.2 Textual analysis

The study identified concepts, words (*i.e*., spoken and written), operational phrases, and other forms of communicative signs of engagement that had specific meaning and bearing on the constructs and objectives (de Beaugrande, 2006: 31-42; Sheyholislami, 2009:3; Stein & Mankowski, 2004:28; Van Dijk, 2008:89-90). The micro-level of analysis or textual analysis focused on the participants' spoken word regarding their views about and experiences of learning, commonly used teaching techniques, learning support resources (human and physical), roles and responsibilities of relevant stakeholders, extended learning opportunities, stakeholders engagement sessions on feedback and reflections. The analysis was also sensitive to the non-verbal cues and expressions of members as they expressed their views. These clarified the spoken word and enriched the interpretations that were made by defining their respective contexts.

This analysis paid special attention, also in relation to the expressed views, to the participants' profiles. These enhanced the interpretation of meanings and to some extent were referred to in cases in which the source of data was questioned. For instance, the facilitation of analysis and/or interpretation of education curriculum policy and the environmental issues were likely to be by those who had access to and possibly worked with them more often. This kind of information was obtained from that given under the roles and responsibilities of participants. It was also possible to have obtained information that related to the possible impact of resources on learning and teaching from that provided.

The analysis was also sensitive to the possible over-reliance on and dominance of discourses by ‘participants’ who were in positions of power, such as the SMGD, HoD, and the SGB chairperson. Thus, the participants’ contributions, views and perspectives were considered equitably with respect and humility. This was because this analysis took a view that “discourse is not simply an isolated textual or dialogic structure. Rather it is a complex communicative event that also embodies a social context, featuring participants (and their properties) as well as production and reception processes” (Sheyholislami, 2009:3).

As such, an earnest attempt was made not to allow the data analysis to be drawn to a particular participant’s preference (Stein & Mankowski, 2004:28), and remained to be focused on the original stance for the transformation of learning of Physical Science through the use of service learning. This was conceived of as giving voice to the learners and parents for social justice and social transformation. The earnest attempt was, for instance, demonstrated in the reflective moments that the study had through and during the coordinating team meetings. Reflection was thus made an integral part of the study (Van Dijk, 2008:86).

3.3.4.3 Cognitive analysis

Cognitive analysis mediates between social and discourse, and represents peoples’ thoughts and communal practices; socially shared attitudes and ideologies (Sheyholislami, 2009:4). In this study, mental representations of the participants manifested in their defensive responses to the comprehensive question and were also evident from the team building exercise in which they indicated their personal traits, such as ‘defensiveness’; ‘impatience’ and ‘not being a team member’. These have been associated with the school practices defined by, for instance, 'lack of communication between parents and teachers'; 'our learners have a negative attitude towards learning of physical science'; and 'the head of department who was less concerned about his department'.

On the other hand, the discursive practices, such as learners' completion of worksheets in their study teams, visit to the waste water treatment plant, and coordinating team establishment, bridged the gap between the parents and teachers, and between the community and the school. This mediation (Kellner, 2000:9) or bridging of the gap opposed to the influence of the discursive practices mentioned immediately above, thus this also deconstructed and reconstructed (Agger, 1991:107-111; Hickling-Hudson, 2006:2-4) what had been the participants' socially shared attitudes and views about communication between parents and teachers (Sheyholislami, 2009:4), as well as the learners' negative attitude towards the learning of Physical Science. The other aspects of the communicative action (Van Dijk, 1995:21, 2008:92) of this study that represented reconstructed versions of the participants' ideological influences (de Beaugrande, 2006:43; Steinberg & Kincheloe, 2010:144) were: the parents' engagement in the learners' study teams, learners' extended learning times and opportunities, and learners' service learning projects (Liasidou, 2008: 488; Stein & Mankowski, 2004:29).

Through the process of cognitive analysis, the study identified cognitive activities (Steinberg & Kincheloe, 2010:145) and interpreted them in terms of their inherent power relations struggles. For instance, the power and ideological bias in the teacher-learner relationships leaned more to the teacher (Rocha-Schmid, 2010:353) on the basis of his/her knowledge of the subject content and experience. However, the quality of these relationships in relation to the extent to which such knowledge power was abused (Van Dijk, 1995:20) or appropriately used needed to be established. For instance, the choice and use of teaching strategies tended to be at the discretion of the teacher. This could exclude learners' backgrounds and styles of learning (Gboku & Modise, 2010:325) and as such legitimise (Van Dijk, 1995:18) teacher-centred or even examination-oriented teaching strategies.

In the same vein, the relationships between the SMGD and the teacher, between the HoD and the teacher, between the SGB chairperson and the SMGD, HoD and the

SMGD; teacher and the SGB chairperson; were imbued with many potential power relation struggles. These were “institutionally empowered social actors” with “discretionary power that was assigned to them by legislation” (Liasidou, 2008:491). The power they had that was based on their knowledge and expertise was another dimension of a power differential reality that confronted the coordinating team. The relationship between the coordinator of services from the municipality with the other members of the coordinating team and learners was not taken for granted. These were to be balanced without being suppressed or excluded, whilst ensuring that they were beneficial to the study and the learners especially.

The learner-learner relationships also had power relations struggles. These could be a result of their attitude about themselves in relation to their colleagues as well as other personal attributes. Factors such as those identified as contributing towards high failure rate offered the analysis a basis for this power relation struggle, namely gender; ethnicity; motivation, intellectual aptitude, personality of the learner, and self-confidence (Akiri & Ugborugbo, 2009:107-108,112; Asikhia, 2010:232-235). The parents and teachers who worked with the learners during their study team meetings had to ensure that the learner-learner power realities were balanced.

3.3.4.4 Social Analysis

The social analysis examines the overall societal structures, for example, social behaviour and arrangements (Liasidou, 2008:488; Sheyholislami, 2009:4). These tend to be an expression of attitudes and values that the community or society holds in high esteem, and to address the issue related to the connection between theory and practice, thus determining its relevance, meaningfulness and usefulness (Liasidou, 2006:488; Van Dijk, 2008:86). The study analysed these to establish their impact or influence on learning and teaching, and highlighted possible origins. The data in respect of the respective age and duration of some of these arrangements and types of behaviour was deemed to have been necessary. This point was made against the background of the history of the area of investigation and the general historical background of the RSA, as well as the historical backgrounds of the methods and techniques used herein.

Evidently, the cognitive activities were related to the establishment and arrangement of social structures, thus, social analysis interest and focus was conceived as connected to the learners' backgrounds and physical environments at school in relation to the community and the broader society. For instance, the coordinating team, comprising the representatives from the school, the municipality, the DoE, and the community representatives was a social structure that facilitated the school-community coordination (Rocha-Schmid, 2010:355; Van Dijk, 2008: 90). This further established a connection and working relationship between the two local schools as well as between the school and the municipality. As with the other engagements, the power relation struggles between, for instance, the school and the municipality needed to be addressed circumspectly. Thus, the study relied on it flexibility to sustain some of the relationships.

3.4 ESTABLISHING THE SCIENTIFIC NATURE OF THIS STUDY

The use of service learning to transform the learning of Physical Science was an attempt to address specific challenges experienced by a secondary school in which I was a Physical Science teacher (Roschelle *et al*., 2000:840-841). An example of such challenges was the use of teaching strategies that were inclined to divorce learning of Physical Science from the learners' backgrounds, thus abstracting learning. The teaching and learning strategies being referred to tended to render the learning of Physical Science meaningless and useless. The intension was therefore to contribute to the efforts of making this school a "venue of hope" (Steinberg & Kincheloe, 2010:142) and a site in which learners were taught and educated 'for empowerment rather than for subjugation'. In other words, the teaching of Physical Science strategies needed to respect the freedom (not to subjugate) and peace of the learners and the parents. Thus, It had no intension to develop a strategy that was to be a "universal blueprint" (Steinberg & Kincheloe, 2010:142), that claimed to be 'fit for use' in all situations. This, however, should not be construed as saying that it (*i.e*., service learning strategy to transform learning of Physical Science) cannot be adapted and adjusted to suite other situations, or to address their specific problems and needs.

The study also sought to pursue social justice-oriented (Roschelle *et al*., 2000:842-843; Steinberg & Kincheloe, 2010:143) teaching and learning approaches that would also contribute towards social transformation (DBE, 2011b:4) through the creation, facilitation and inculcation of emancipatory knowledge (Biesta, 2010:55-56; Liasidou, 2008:486-487; Niemi, 2002:769; Steinberg & Kincheloe, 2010:143). The emancipatory knowledge was to be facilitated through sustainable empowering learning environments (Mahlomaholo, 2010:11-12), because it sought to use active and critical learning (DBE, 2011b:4), problem-based, learner-cantered (Rocha-Schmid, 2010: 355), self-directed (Parker *et al*., 2009:592), and self-regulated (Niemi, 2002:764) learning and teaching strategies.

It was thus imperative to use the learners' backgrounds and public service contexts that were familiar and accessible to them to enhance their academic and cognitive development (Steinberg & Kincheloe, 2010:144-146). The cognitive development was to be realised and inculcated equitably and simultaneously (Liasidou, 2008:486) with the development of learners' social skills (Niemi, 2002:765). The significance of this was to make learning meaningful, useful and motivating (Mahlomaholo, 2010:12) for the learners. This was conceived as having the potential to practically prepare learners for real life work environments (DBE, 2011b:4), whilst at the same time developing them into informed and appropriately skilled social transformation agents (Roschelle et al., 2000:842).

The learners' physical environments from which the Physical Science learning context was derived, was marred by many social practices (Liasidou, 2008:487) that contradicted the democratic principles of social justice, peace, freedom, equity and hope. These practices were both at school, as perceived in the teaching practices of Physical Science, and in the community, as observed in the environment polluting practices. Evidently, the use of service learning to transform the learning of Physical Science had to be conducted in collaboration and in partnership with the other people from diverse backgrounds (Kenworthy-U'Ren, 2007:818-819). This enhanced the practical realisation and operationalisation of the democratic principles.

It is thus clear from the above explanation that the scientific character of this study can best be established on the basis of its underpinning democratic principles. This can be ascertained by establishing the extent to which the 'use of service learning to transform the learning of Physical Science' addressed issues of hope, equity, peace, freedom, and social justice in its endeavours. These should therefore be established in relation to each of the five study objectives.

3.5 CONCLUSION

This chapter has outlined the plan and structure of the study, indicating how each 'aspect 'of the structure was pivotal in data collection procedures and data storage, as well as processing. The aspects that were discussed were, design aspects, including the coordinating team, roles and tasks of the participants; the Study Comprehensive Plan; and the data and methodology aspects, including the profiles of the participants, instrumentation, data collection procedures and data analysis.

Under the coordinating team, emphasis is placed on teambuilding and the importance of cooperation when it comes to addressing the needs and problems of the people. This section showed that teambuilding processes need to be intentional and planned thoughtfully from the onset. It further highlighted the need for inbuilt mechanisms such as a Performance Charter to provide constant support towards its maturity, mechanisms that also informed leadership and management of the team processes, and those based on sound values and principles. The chapter further demonstrated how the team foundation could be solidified through ensuring that each participant had clear roles and tasks assigned to him/her. It emphasised in this regard the significance of delegation of responsibilities in accordance with areas of interest and competency, as far as practicable.

Data and methodology pointed to the significance of participatory action as a mode of collecting data through participants-friendly free attitude interviews. That afforded space for flexibly whilst critically engaging data with respect, humility and care, and giving participants hope for their Constitutional freedoms. The use of this technique was addressed adequately with the aid of open-ended questions for each of the objectives of the study. Finally, the chapter discussed how cognitive critical theory was used to analyse data from its textual and spoken voice, through cognition to social structural phases. This signified the critical issue of making sense from the taken-for-granted issues that are often resident and embedded in daily life experiences. The chapter reflected frequently on issues raised in Chapters 1 and 2 in an endeavour to demonstrate how the FAI, PAR and CDA were used.

Chapter 4 is saturated with original data and respective textual, discursive practice and social structures analysis. These are intended to make sense of the data collected and to address the study objectives and constructs.

CHAPTER 4

ANALYSING DATA, PRESENTING AND DISCUSSING FINDINGS ON THE STRATEGY TO USE SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE

4.1 INTRODUCTION

This study aims to formulate strategies for use in service learning to transform the learning of Physical Science such that it is sustainable. In this chapter the focus is on the analysis and interpretation of collected empirical data through the use of Van Dijk's socio-cognitive model of critical discourse analysis (de Beaugrande, 2006:29-52; Liasidou, 2008:487-490, 493-494; Sheyholisami, 2009:1-13). It analyses the texts to develop understanding of discursive practices and related social structure. The literature is thus confirmed or refuted by the data obtained from the participants' voices (Stein & Mankowski, 2004:21), as it is organised in accordance with the constructs that define each objective. The founding principles thus reside in the learning of Physical Science practices in relation to conceptual theories about learning. The other principles considered from the literature are in respect of such learning strategies as service learning and transformational learning.

Other factors include the learning styles as may be influenced by environmental and cultural realities (Donald *et al.,* 2010:19; Hammond *et.al*, 2001:2-19; Leu, 2008:17-26; Passarelli & Kolb, 2012:3-5; Shumba, 2010:337,347-348; Tudge et al., 2009:4-7). This analytic process is thus outlined by focusing on interpretation of the constructs which give clarity and meaning to them (Mahlomaholo & Netshandama, 2012:43-44; Steinberg & Kincheloe, 2010:148). In its conclusion, the chapter summarises the data analysis and interpretation, and highlights issues to be expected in the chapter on findings and recommendations.

CDA is viewed as useful in analysing such data because it relates to emancipatory knowledge the promotion of "progressive social change" (Liasidou, 2008:486). It is thus a tool and technique of analysis that is consistent with the tenets and principles of CER (Agger, 1999:118-123; Mahlomaholo, 2012:43-45; Steinberg & Kincheloe, 2010:141-143; Van Dijk, 2008:86). It enabled the study to consistently 'search deeper' for issues of emancipation; empowerment and transformation. This is pursued through the use of CDA's socio-cognitive model of analysis (Sheyholislami, 2009:2-4). This is to enable interpretation and making sense of the 'messy' data collected for each objective, in turn enhancing the processes of development and implementation of service learning strategies that transform the learning of Physical Science (Liasidou, 2008:487; Van Dijk, 2008:85-86).

The learning of Physical Science tends to be a complex process that involves many people, including learners, teachers and parents, as well as institutions such as schools, community development organisations and public institutions. The physical environment within which it takes place also influences it immensely (Bietsa, 2010:43, 53-56; Merriam & Ntseane, 2008:190-191; Niemi, 2002:765; Steinberg & Kincheloe, 2010:141). These issues diversify and complicate the learning of Physical Science process, imbuing it with power and differential cultural realities. These tend to be 'taken-for-granted', when for instance learning strategies are developed and implemented (Osman & Attwood, 2007:16; Van Dijk, 1995:19, 2008:87).

Critical analysis of data (as discourses) is conducted during the interpretative, analytic and educative phases of the CER to identify the constructs within each objective of the study; to analyse the conceptualisation of service learning projects; to organise data into respective constructs and levels; to establish data connections, that is, text, discursive practices and social structure; and to derive meaning and information from them. The data obtained is then reconciled with its respective discursive practices and social structural arrangements.

The following data was collected from the voices and actions of the participants, particularly to answer the main research question: *how can service learning be utilised to transform the learning of Physical Science such that it is sustainable?* The data in respect of the responses to the question was obtained from the coordinating team's meetings with parents and teachers; the research team's engagement sessions; Physical Science and natural sciences meetings of teachers and parents; and parents-teachers-learners meetings. Data was further drawn from the planned activities for the operationalisation of the priority areas which emerged from the SWOT analysis.

4.2 CHALLENGES IN THE LEARNING OF PHYSICAL SCIENCE JUSTIFYING THE FORMULATION OF THE STRATEGIES TO USE SERVICE LEARNING

The learning and facilitation of learning of Physical Science practices before we intervened at the school did not embrace the creation of emancipatory knowledge. Teaching tended to be abstract learning of Physical Science, to be teacher-centred and examinations-oriented, and lacked participatory learning opportunities, common vision, values, principles, mediation for transformation in line with the democratic legislative imperatives, and reflective moments. This was a problem because learning did not relate to the community or wider societal transformation, and encouraged a form of uncritical rote learning that was unsustainable (Biesta 2010:43; Mahlomaholo, 2012:48-50; Merriam & Ntseane, 2008:185; Piper & Piper, 2009:99; Nkoane, 2009:22).

This view is pursued by analysing the extent of Physical Science non-emancipatory structures and learning practices in relation to the CER theorisation. The data in respect of these broad parameters is thus processed and interpreted using Van Dijk's cognitive model of critical discourse analysis (de Beaugrande, 2006:31-32,38; Sheyholisami, 2009:4; Steinberg & Kincheloe, 2010:148-149; Van Dijk, 2008:85-99). The key issues that demonstrated and justified the need for the use of service learning to transform the learning of Physical Science are thus narrowed down to: the operationalisation of legislative and public mandates; lack of transformation-oriented Physical Science learning context; lack of collaborative efforts for transformation; lack of shared values and goals; the teacher-centred Physical Science teaching practice; abstract learning facilitation approaches; examinations-oriented teaching strategies; shifting away from learner-centred Physical Science teaching; lack of participatory teaching opportunities; lack of mediation for transformation; lack of support for learning to transform learning of Physical Science; and lack of reflection on transformation of learning Physical Science.

4.2.1 Prevalence of uncritical learning and teaching strategies which violate the educational legislative and public mandates

The learning and teaching practices of Physical Science at the school were fundamentally uncritical and mainly oriented to rote learning. Prior to the intervention of this study at the school, the Physical Science teaching practices were observed to be examination-oriented (Salleh, 2004:8) and abstract (Koosimile, 2004:485). Much focus was on the teachers' evidence (Servage, 2008:65) of the amount of prescribed Physical Science work the learners covered, thus, they could be said to have been in direct contravention of the policy imperative of

> equipping learners…with the *knowledge, skills and values* necessary for self-fulfilment, and *meaningful participation* in society as citizens of a free country'. That is the skills and knowledge that would enable them to '*use science* effectively and *critically* showing *responsibility* towards the *environment* and the health of others; and *demonstrate an understanding* of the world as a set of related systems by recognizing that *problem solving contexts* do not exist in isolation (emphasis mine) (DBE, 2011a:4; DBE, 2011b:4-5)

They were thus inconsistent with the Physical Science curriculum policy provisions, which encourage critical thinking and active learning (Mahlomaholo, 2010:10; Niemi, 2002:763-764) by the learners. This problem is illustrated through the data from the actual Physical Science classroom. For example, Bohlokwa shared her experience with the planning meeting facilitated by the coordinating team, which happened during a Physical Science workshop that she attended. Bohlokwa was apparently concerned about the examination-oriented approach that teachers were encouraged to follow in order to get the results that the department allegedly sought from them as teachers. She said:

> *o ile a etsa ntho e nngwe ke be ke tsheha ke bona hore ngwana a ka etsa ntho ena a ba e nepa a sa utlwisisi altogether seo a ntseng a se etsa. Eile ya re ha ke tsheha a be a re.* (There is nothing we can do, Department wants the results, so we must produce results… he did something that made me laugh because I realised that a learner could do it and get it right without understanding what he/she is doing altogether. When I laughed he said: "there is nothing we can do. The Department wants the results so we must produce results.")

The workshop facilitator 'did something', in other words he had presented a Physical Science aspect or topic to show teachers who were in attendance how to teach it. He did this in a way that appeared 'questionable' and 'peculiar' to Bohlokwa. That could have been a way of encouraging rote learning, such as showing how to get easy marks or remembering the facts (Salleh, 2004:10; Servage, 2008:65). This provoked Bohlokwa to laugh, and this act of ‘laughing’ or ‘grinning’ invoked a response from the facilitator, probably because it was interpreted as contesting the mode of presentation. This is evident in the workshop facilitator’s spontaneous response to the grinning, without even asking why Bohlokwa laughed. The facilitator had also been aware of a serious challenge regarding the method he used, hence his apparent transfer of the weakness of his teaching strategy to the DoE, by saying that he was doing what the Department wanted, namely to cover the syllabus irrespective of whether the students understood the subject content.

The transference of the teaching strategy as reflected in the phrase ‘there is nothing we can do’ reflected an inability to take responsibility. It could also be interpreted as indicative of the impact of power on learning and teaching practices. In this instance it could mean that abuse of power or excessive power can lead to distortions and misinterpretations of policy imperatives (Laisidou, 2008:486; Sheyholislami, 2009:3; Van Dijk, 2008:88). In this case the department which has the power to determine policy and monitor its implementation through such workshops could be viewed as also contributing to deviant practices.

The FSDoE is projected in the light of a ‘dictator’ who restricts his ‘subjects’ and ‘subordinates’. In the same vein, it could be that the facilitator ‘uses the power of the Department’ as its representative to subjugate the voices of teachers about the appropriate teaching methods (Stein & Mankowski, 2004:21; Swantz, 2008:33-34). It is therefore critical that structures such as the Education District Support Teams, made up of teacher representatives and government officials (DBE, 2011b:3-5), and that give expression to and create space for freedom of expression by local teachers and equity for social transformation, are resuscitated. Such structures would have tempered the power of the FSDoE participants therein are required to debate and defend their arguments freely, without appeal to authority. What counts most during such conversations is the power of the argument, not the status of the participant.

4.2.2 Lack of mediation for service learning that transforms the learning of Physical Science

There were limited collaborative efforts at the micro level of the school, that is within the school, amongst the teachers of Physical Science, Natural Sciences and related subjects. There was lack of coordination of the learning activities of Physical Science, because of the absence of a coordinating team or its dysfunctionality. This lack was prevalent within the department of Physical Science and Natural Sciences and between the school and the community. This was a problem as it tended to legitimise power relations that encouraged dominance of some teachers over the other teachers and over parents, to the exclusion of learners' and their learning interests (Arenas *et al*., 2006; 26-28; DePalma, 2009:215-220; Jordan, 2003:188; Salleh, 2004:4-5; Sanginga *et al.,* 2010:695-699). There was no agreed upon mode of interaction among teachers, and every teacher took his/her own direction, which sometimes contradicted and violated what the other teachers were doing. There was no synchronisation of actions or activities.

The data from Rethuseng's sentiments suggest and confirm the non-existence, the ineffectiveness and dysfunctionality of the internal coordinating team within the department of Physical and Natural Sciences at the school. Rethuseng expressed these sentiments during a departmental meeting that sought reasons that may have contributed towards the poor work performance in Physical Science of the school. Rethuseng said:

> *ha ho wa ba le plening e hantle, <u>re</u> dule fatshe <u>re</u> bolele o tlo etsa tsena ke etse tsena* (there was no proper planning so that we sit down and discuss what we were going to do).

Rethuseng's view of proper planning (*plening e hantle*) involves the participation of all teachers, especially of Physical Science and related subjects, as illustrated by the use of plural pronoun 'we' (re); to be about face-to-face engagements between and amongst teachers who 'sit down'; and to be about working at something in a concerted and focused manner as in 'we discuss or say what we are going to do'. The latter part, what 'we are going to do' is 'futuristic' and gives the impression of time when to do something (de Beaugrande, 2006:40-41). Evidently this collaborative planning practice that Rethuseng referred to did not happen. This was despite the prevalence of opportunity for such in view of legislated structures in the form of a school-based support team, education district-based support structure (DBE, 2011a: 3-5), and the school governing body (SGB). This problem that had been prevalent over a relatively long period was corroborated by Mosupatsela. This was another teacher who worked with Rethuseng in the past. He said:

> *Laek ha ke ne ke ntse ke sebetsa le Rethuseng; o ne a ntjwetsa mehla ena hore 'wena o ituletse fisiks'. O etsa fisiks ho feta baeloji. Jwale ha re tlo botsa re a sokola. Sei ke ruta ka tlelaseng jwale re aguwe ha re tlo seta jwale ke se ke entse ntho e ngata ya saense* (Like when I was still working with Rethuseng; she told me every day that 'you virtually do Physics only. You do Physics more than you do Biology. Now when the time for testing learners arrived we struggled'. Say I taught in class then we 'argued' when we were to set tests. Now I have done a lot of Physical Science).

The word '*do*' in '*you do physics*' means teaching, that is, Rethuseng meant that Mosupatsela spend much more of his teaching time on physics than on chemistry or life sciences. Rethuseng considered this as a problem, particularly when learners taught by them were to be assessed. These were the learners who were in the same grade and were to write the same test or examination. This shows the challenge brought about by lack of coordination between the two teachers' work. It also exposed the teachers' unwillingness or inability to use the 'power of difference' (see paragraph 4.2.1.2 above) in learning and learning facilitation of Physical Science (Steinberg & Kincheloe, 2010:145). This was evident in the diversity that was brought about by the engagement of the more than one teacher in the teaching of Physical Science in the same grade. It became apparent that Rethuseng's teaching capabilities were stronger in Life Sciences than in Physics, while Mosupatsela was stronger in Physics than Chemistry and Life Sciences.

Furthermore it was also apparent that '*working within*' this context only meant being responsible for teaching learners from the same grade. The teachers (*i.e*., Mosupatsela and Rethuseng) did not collaborate, but rather worked individually. They covered different themes, concepts and scientific principles during the same period as they focused on different branches of Physical Science. It is also clear that they could not have supported each other on areas of their potential weaknesses in

Physical Science learning facilitation and content. This is apparent in the statement that at the time of 'assessment of learners' performance' they were not in agreement on what to assess, and the phrase 'we argued' in this context tends to have its meaning 'shifted' from an amicable conversation and discussion. It has connotations of contestation and disagreement between the two teachers.

That the two teachers 'argued' confirms the exclusion of the other participants from the matter, namely, the HoD, other teachers in the department of Mathematics and Natural Sciences and parents. This represented typical individual teacher-centred planning, learning facilitation, and learners' performance assessment, with learners' interests were not being taken into account. This is evidently a problem because learning facilitation and learning of Physical Science are compromised. This is so because potentially valuable inputs of other persons are also excluded from the Physical Science discourses.

Mmusapelo confided that she did not accede to the request by his colleague not to teach Physics at the expense of Chemistry and Life Sciences. Mmusapelo was apparently advised in this regard quite frequently that is '*every day*'. It also appears that the argument arose only at the time of assessing of learners' work that was the end of the term or end of the school year. This practice confirms the continuation of poor planning of Physical Science work Rethuseng referred to above, and the prevalence of power differential realities that suffused the teacher-teacher engagements, leaving no space for balancing them. This resulted in the unobtrusive imposition of power by Mosupatsela (teacher) over Rethuseng (another teacher) (Liasidou, 2008:489; Maholmaholo & Netshandama, 2011; Steinberg & Kincheloe, 2010:141).

Evidently, the absence of a structure to mitigate and mediate these problems amongst teachers, between teachers and learners and all other stakeholders makes the situation worse. It denied teachers an opportunity (Nkoane, 2011:119) to conduct their situational analysis in respect of Physical Science content knowledge and pedagogy; to develop their annual and lesson plans together; to share experiences and to support each other; to reflect and give each other feedback; and to assess and discuss learners' performance (Idowu, 2011:134; Salleh, 2004:5-8). The first extract above (section 4.2) corroborates the issues raised by Lebohang in respect of the problems emanating from lack of commonly agreed upon principles expressed in the second.

The data further suggests that where two or more teachers are responsible for the teaching of Physical Science in the same or different grades, they should meet and plan their work together. Their diverse knowledge, experiences, interests, and competencies constitute a challenge for learning if it is not synergised. In the context of the discourse above, the following specific challenges were experienced: variations in the Physical Science themes, concepts and scientific principles; unsustainable utilisation of the limited laboratory resources; inability to support each other on areas of weaknesses that is in teaching methods and Physical Science content; inability to garner support and tap from parents and the community (*i.e*. from the learners community cultural wealth) and teacher-centred learning facilitation (Mahlomaholo, 2011; Yosso, 2005:69-81; Nkoane, 2011:114).

4.2.3 Lack of situational and contextual analysis for transformation of learning

The learning of Physical Science was divorced from the learners' backgrounds or community cultural wealth (Koosimile, 2004:483-496; Mahlomaholo, 2010:11-12; Merriam & Ntseane, 2008:185; Otote & Omo-Ojugo, 2008:654), as a result of lack of respect for the 'identification of a context, which should be directly relevant to learners' concrete reality' (Rocha-Schmid, 2010:345). No situational analysis of contexts had been conducted, as clear from the statement by Rethuseng (see 4.2.2) about lack of planning. This was a problem in the learning of Physical Science because it deprived teachers and learners the opportunity to audit inherent teaching and learning capabilities, competencies and skills. An analytic process could have helped identify the teachers' strengths, weaknesses, opportunities, and threats in respect of the different themes, concepts and scientific principles. It would have similarly identified issues pertaining to methods and strategies that teachers had or did not have. This process could have matched the weaknesses to relevant strengths and opportunities to the extent that they could be operationalised internally, making the school 'self-supporting'. The areas that could not be addressed internally could then be referred to the school management and SGB for external support. The view is based on the principle of ‘power of difference’ espoused by Steinberg and Kincheloe (2008:145).

The ‘power of difference’ for this study is understood as referring to the diversity as ‘submerged’ in the different strengths, weaknesses, opportunities and threats that teachers, learners and parents have. These are conceived as characterising the schools that are associated with them. However, in this case, this opportunity could not be optimally utilised. The analytic process constituted pertinent communicative action, reflected through the processes of consultation, negotiation and ultimately of the engagement of participants as a team. Through this action, they reached agreements about learning of problems related to Physical Science and suggested solutions, notwithstanding their individual subjectivity (Kemmis, 2008:127-130). They created spaces through the study team engagements to explore myriad possibilities that would influence and foster possible collaborative efforts for transformation (Wicks & Reason, 2009:247-250).

The learners’ backgrounds were divorced from their learning of Physical Science, which made their learning not transformational or sustainable (Mahlomaholo, 2010:11-10). This lack of integration and coordination with the learners cultural wealth and other contextual issues resided in the lack of contextual and situational analysis. The teaching and therefore learning of Physical Science subverted transformational, participatory and democratic modes of learning and learning facilitation (Steinberg & Kincheloe, 2010:143,145). They lacked common goal and vision in that respect.

4.2.4 Lack of vision and shared values

There were no agreed upon principles or shared goal and values that guided Physical Science’ pedagogical dynamics, so learning could not be enhanced efficiently. Subsequently, the academic knowledge content, the learning facilitation (pedagogy) and therefore the learning were not synergised (Howard, 1998: 25-27; Idowu, 2011:136; Steinberg & Kincheloe, 2010:141-142; Van Dijk, 1995:17-18). The statements by Lebohang, a member of the school management team, attest to this observation. This was during the study planning session and the participants were engaged in the analysis of the situation or context within which the study was to take place. He said:

> *Wel anfotjhuneitlili ke ne ke ntse ke na le hed of Physical Science and natural sciences subjects ya neng a ntse a se khonsente ka lefapha la hae, It was de moust anfotjhuneit phat of de stori* (Well, unfortunately I still had a Physical Science and Natural Sciences head of department who was unconcerned about his department. It was the most unfortunate part of the story).

The phrase "*ke ne ke ntse ke na le…*" literally translates as 'I was still having a...', that which was 'owned' or 'possessed' being a person, a colleague. It then means 'I still had a head of Physical Science ...', which could also be indicative of an element of time factor or duration of working with him. In this sense it denotes a shorter period of work in relation to the speaker's. It transpired that they worked for about three years in this relationship. The second issue relates to the phrase "*ya neng a ntse a se khonsente ka lefapha la hae*", which literally translates as 'who was still not concerned about his department'. This phrase qualified the attitude of the head of Physical Science towards his department, reflecting a carefree attitude indicative of lack of interest in the pedagogical dynamics of affecting Physical Science. In the context of the conversation, the HoD had practiced predominantly a laissez faire type of leadership. This Lebohang experienced, as the most unfortunate part of the learning dynamics of Physical Science.

This may explain Lebohang's further observation of the practices in the Physical Science: "*ha re tla re e stope, e tlare ha o feta titjhere e mong o ntse a omanya e mong…ho re ha o so etse ntho e itseng*" ('when we said it must stop… when you pass one teacher would be arguing with another, that you have not done a certain thing'). The 'it' here referred to the teaching situation in which two teachers taught Physical Science to the same class; one responsible for the Physics and the other for Chemistry. It had to be stopped because the two were not collaborating and their teaching practices were uncoordinated, thus creating tension. One teacher and not the HoD had to confront his colleague about his failure to teach certain parts of the syllabus, a problem because certain topics were overlooked.

This created a culture of lack of communication and reflection (feedback), evident in the manner in which Lebohang identified the problem between the two teachers. That was not through a meeting or a formal engagement with the department, and there were no ‘unity-enhancing-spaces created’ for the teachers and SMT members to share or express their teaching frustrations and problems (Nkoane, 2011:119). This is evident from the phrases “*e tlare ha o feta’ and ‘titjhere a be a ntse a omanya e mong”* (‘as you pass; and one teacher would be yelling at the other teacher’). This means that Lebohang had discovered the affected teachers’ interpersonal relationship problem as he was passing, when one teacher was heard shouting or raising his voice (yelling, “*omanya”*), fighting about the work not having been done (de Beaugrande, 2006:40; Liasidou, 2008: 487, 494).

This showed lack of respect or humility (Mahlomaholo & Netshandama, 2012:37,38; Rocha-Schmid, 2010:355; Steinberg & Kincheloe, 2008:142-143; Swantz, 2008:34) between teachers, as indicated by the concerned colleague, and was evident in the communication being imbued with high emotions, predominantly one-way. This problem arose because there was no leadership and deviated from set of principles that defined the transformation of learning that was supposed to have informed the operations in the department (Rocha-Schmid, 2010:346), namely social justice, hope, freedom, equity and peace (Mahlomaholo & Netshandama, 2012:43).

The teachers’ actions of not executing their respective responsibilities, such as avoiding some sections of the syllabus and not teaching content at the expected level can be socially unjust. They impact negatively on other social justice oriented practices at the school and in the community and have a ripple effect on learning. They became part of a vicious circle of poor teaching and learning and violated the learners’ right to learn. This in turn could lead to other unpleasant experiences that aggravate a relationship of disrespect for other learners (Hickling-Hudson, 2006:4; Liasidou, 2008;486-488; Steinberg & Kincheloe, 2010:143-145; Swantz, 2008:35).

The immediate contribution of actions and not teaching to poor learner performance in Physical Science was evident in the statement by Lebohang in which he responded to a question seeking to establish the trends of learner performances. This was a clarity-seeking question following a statement by one of the participants, Thlokomediso, who alerted the meeting that a fall in results in Physical Science had taken place since the introduction of the national curriculum statement (NCS). This was corroborated by Popano, who added that it was a national trend. She used the

Sesotho expression “kobo anela” (‘all over’) to illustrate the point. As further confirmation of that downward trend, Lebobang said:

> *Ebile prosese, e nkile bo tri yese. Bat e ne e matha bo di eithisi ya theoha di seventhis fo tri, foh yes*. (It was a process, it took three years. But it was running at the eighties [percentages], it declined into the seventies for three, four years) (see Annexure T1)

This refer to the pass rate percentages in Physical Science, which had declined from percentages in the 80s to ones in the 70s. The lowest percentage attained in Physical Science was a zero (0%). Lebohang further pointed out that strategies such as team teaching, by which two teachers shared the teaching of Physical Science, had not worked and so had to be abandoned.

Evidently, the downward trend of learners’ performance in Physical Science persisted, despite attempts to address it. That this trend could have dented the attitudes and confidence of prospective learners was suggested by remarks made by one teacher, Masello, during another parents-teachers-learners meeting. The teachers were giving feedback on the learners’ performances to the parents in the presence of their children. Masello said:

> *… bana ba rona ba na le athitjhuti. Ke hore batla ba ntse ba nyoloha jwalo le di class ba se ntse ba na le kelello ya hore science le maths ke thuto tse thata. O tla bona hore o o shebile mare jwale ha a mono. A se a ipoleletse hore haele ena yona ke ya e tlosa hara di learning areas tsena tse supileng* (… our children have an attitude towards Science and Maths that says these subjects are difficult to comprehend. You will notice a learner starring at you [the teacher] yet she would not be there with you. The learner attends class having already decided to drop Physical Science from the other subjects).

A positive aspect in this discourse is that Masello had admitted to a problem, and to her allusion to a familial relationship with the learners, as in the phrase “bana ba rona” (our children). The ‘attitude’ (*athitjhuti*) that Masello referred to had been an intrinsic trait within the learners’ psychological and/or emotional make-up. This was a critical issue that needed to be addressed, as it was influential on learning capabilities, driving learners to view Physical Science negatively, as a ‘difficult subject' (Salleh, 2004:4). It was also as though the 'attitude' influenced learners not to pay attention in class but to 'stare' at the teachers as he was teaching. This had an impact on learners' performance in Physical Science, causing them to lose hope that they could pass and achieve what they aspired to. The loss of hope by the learners as a result of poor, bad and lack of teaching inevitably affected their mutual relations, likely devoid of peace, beyond the school bounds.

The study sought to annul these negative teaching practices and capitalised on the potentially positive aspects embedded in these discourses, that is to create space (Nkoane, 2011:119; Wicks & Reason, 2009:244) where all participants (learner, teachers and parents) could share their views freely without being intimidated, and which could restore learners' hope through equitable consideration and accommodation of the diverse knowledge, experiences and backgrounds of the participants. The opportunity for the creation of this space was identified through subjecting the conflict situations experienced in the study to a SWOT analysis.

For instance, there had been potential positive aspects in two conversations referred to in this chapter. First, although they did not teach the same topics, Rethuseng and Mosupatsela had an arrangement regarding how they assessed learners; and second, the two teachers argued about teaching and not teaching of certain topics that Lebohang referred to in his conversation (above). These had concealed the desire of at least three teachers, Mosupatsela, Rethuseng and another unnamed teacher, to work together for learning and teaching purposes. This act also showed that teachers were not entirely ignorant of each others' work and responsibilities for learners. This needed a 'mediator' (Kellner 2000:3; Rocha-Scmid, 2010:345) who could critically analyse and interpret that discourse with a view to reconciling it with the principles of social justice and peace.

The act of not teaching was socially unjust on the part of the learners and the community. The two teachers needed to work together and peace to exist between them. Evidently, such an act of mediation would have ultimately created a vision for the department that would have fuelled support for learning through shared values (Steinberg & Kincheloe, 2010:141). This resistance manifested itself in the act of 'scolding' (*omanya*).

4.2.5 Lack of strategic partners for transformation of the learning of Physical Science

There were also limited collaborative efforts at the macro level of the school, on which exist the relationship and engagements between it, the community and society. As a socialising agent (Akiri & Ugborugbo, 2009:107; Asikhia, 2010:231; Tudge *et al.,* 2009:17-27), the school should embrace and inculcate in learners such values as respect and humility, enabling the learners to develop social conduct commensurate with their striving for peace, equity and freedom of association, with the ultimate goal of working for social justice in and for their respective communities. Thus, this created a problem of denying the school the opportunity to “encourage moral and democratic work” (Steinberg & Kincheloe, 2010:142). For instance, parents, teachers and learners discussed the issue of learning of Physical Science that was not usefully related to learners’ backgrounds. As Mosupatsela stated:

> *Batswadi ha ba bui le matitjhere. Ke rutile science e sa le ke fihla mona, ha ke hopole motswadi leha a le mong a tla a tlo botsa ha ke so bone motswadi le ya mong a tlo mpotsa hore na ngwana hobaneng a feila* (Parents do not communicate with teachers. I taught Physical Science at this school since my arrival here. I only left it some two years ago. I do not remember any parent coming to ask me why his or her child failed).

Analysis and processing of this conversation reveals that parents and teachers “did not communicate (*ha ba bui*)”, and their non-communication had continued for a long time, at least for the duration of her employment at the school. This is clear in her not remembering any parents asking why a learner had not performed well in Physical Science. The duration of the parent-teacher non-engagement was found to be over 10 years, entrenching it amongst teachers of Physical Science and severely affecting learners. It marginalised them and deprived them of an opportunity to access learning Physical Science that could have helped them address their needs and problems (Mahlomaholo, 2010:11-12).

It is evident from the preceding paragraphs that the arrangements in the school did not offer sufficient support for this coordination to happen. The leader, who was HoD prior to this intervention, was ‘unconcerned’ and teachers were not well coordinated. As these practices took place against a background of declining performances in

Physical Science, both the parents and the teachers should have been equally concerned. Had the department of Physical Science afforded Mosupatsela space or opportunity for self-reflection and feedback in this regard, and allowed him to further engage other teachers and parents to reflect on this the situation, there could arguably have been a different result (Nkoane, 2011:119).

Mosupatsela believed that the teachers and parents needed to be closer to each other for mutual support of learning, and that communication between the two groups was imperative for the benefit of the learner-community engagements and coordination of efforts. The lack of it denoted a significant gap between parents and community on one hand, and the teacher and school on the other. This gap, as far as Physical Science support was concerned, was a legacy of the social arrangement of apartheid, which kept parents away from school (Liasidou, 2008:488). It also ran counter to the democratic principles and pertinent legislative imperatives.

The deliberations of the study coordinating team thus established the importance of the establishment of a community-based service learning centre, to create space for the engagement of people from diverse backgrounds (Nkoane, 2011:112) in order to support and enhance the learning of Physical Science through service learning. In the *Jipemoyo* 'Take Heart' project the research team, together with the Maasai people, worked together to support each other in their respective missions (Swantz, 2008:34), unlike in Malaysia where physics experts and teachers worked in silos, as a result of which there was no physics learning related to real life problems (Salleh, 2004:10).

A learning centre would contribute towards addressing the transformation issue of institutions of higher learning of working with their respective communities (Arenas *et al*., 2006: 23-24; Hatcher & Erasmus, 2008:50), and would simultaneously provide support to teachers and learners in the Physical Science subjects and community.

4.2.6 Alignment of strategic partners' programmes

It was imperative for the study to synergise the participants' efforts and to converge their diverse experiences and backgrounds through a common vision, but in order to achieve this, the coordinating team considered aligning the participants' interests, aspirations, work-related activities and points of view with the study. The alignment process followed from the contextual and situational analysis as well as from the reflection sessions of the coordinating team. It was a product of the engagements thereof, from interpretive through analytic and educative (Mahlomaholo & Netshandama, 2012:35-48, Steinberg & Kincheloe, 2008:148-149) interpretations and development. It was conducted through a process that involved the study UFS approved proposal which formed the basis for the study action plan. The action plan was used to develop what became known as the Study Comprehensive Plan.

The study comprehensive plan comprised three main sections, each of which was aligned with the five study objectives and respective constructs. First, the **Performance Charter** or **Performance Agreement** was developed to serve as a guide for the leadership of the coordinating team and the study as a whole. It sets out the long term view of the study through the vision and mission, and directs delivery modes and strategies through the values; providing guidance on communication and study structure while broadly outlining the roles, responsibilities and envisaged conduct of partners. In this way it bestowed a strategic character upon the overall Study Comprehensive Plan.

Second, the study's operational plan was used as the development and implementation plan to transform the learning of Physical Science'. The study team embarked on a SWOT over three meetings, with participants invited from various sections/sectors to attend the inaugural planning meeting, namely Physical Science and Mathematics teachers; (senior) SMT members (*i.e.*, principals); school HoDs; colleagues and researchers from the UFS's sustainable empowering learning environments; local municipality environmental health representatives; a community member; school management and governance; as well as education specialists. This was to facilitate collection of wide range of relevant data and to enhance comprehension of the extent and nature of the problem in the area of research.

Using the FAI technique, broad and vague thought-provoking and participatory action triggering questions were asked. Participants were all asked to express their views and share their experiences on any matter that was raised. They were also made aware they were free to seek clarity where necessary and to ask exploratory or probing questions on any issue raised. This was done in order to pursue the achievement of the purpose of gathering data in respect of the state of teaching and learning in the Physical Science learning environments. The vague and broad questions were asked by the research study coordinator through a story which also constituted personal experience:

> *Ke bona bana ba rona ba sa sebetse hantle science, feila reiti ya saense e bonahala e ntse e phahama. Ke eng eo le bonang eka ke bothata; ho ka etsuwa eng (ho bo rarolla). Olso re shebe yo experience meibi ha o ntse o tsamaya dibakeng tse fapaneng, ke eng eo re ka ithutang yona?* (I noticed that our children do not perform well in Physical Science, the failure rate in science appears to be increasing. What is it that you see (consider) as possible problem (cause); what can be done (to address it). Also we should consider our experiences maybe as you travelled from one place to another what is it that we can learn therefrom).

An observation that the study coordinator's question makes is that of the gradual decline in learners' achievements or performance in Physical Science. It then asks participants to identify possible causes of this and to suggest means through which it be addressed. The second part sought to establish the progress of those who passed matriculation, in both their performance at tertiary level, their roles in their respective communities and possible challenges they faced. Finally, participants were asked to share their experiences of the matter in the broader community, on regional and continental levels, and say what could be leant from them.

The responses to this question, as well as the team's observations, were subsequently categorised into strengths, weaknesses, opportunities and threats. The team agreed it should consider the political, economic, social and technological (PEST) nature and aspects, as relevant and in line with our critical emancipatory theoretical framework and the nature of the study. The SWOT/PEST categorisation culminated in the study developing a grid that matched opportunities and strengths with weaknesses and threats that were more likely to be addressed thereby. The weaknesses and threats were taken to a section of risk assessment plan, discussed below. This exercise characterised the interpretive and analytical stages of CER.

As indicated above, these and other questions could not have been addressed in full in one session, hence the number of meetings and the plan that evolved. Some information still had to be obtained from learner participants and parents pursuant to proposed solutions. This is in addition to the process of listening to the voice recordings and further engagements amongst participants to confirm the messages or data received. A number of issues pertaining to the study objectives that were captured in the plan as outputs came out clearly and were developed into activities that gave expression to relevant outputs. The activities were simplified into their respective lower level sub-activities and appear in the plan as key tasks. The team then identified resources (e.g., funding, responsible persons and time frames) needed for the execution of each key task. Potential funding sources were also considered (see Annexure CT 2). Without this operational plan the team might have lost focus of its mandate and timeframe.

Third, the **Risk Assessment Plan** constituted the last section of the Study Comprehensive Plan, developed in observance of the University Ethics Committee considerations. The main purpose was to make sure that the study coordinating team was sufficiently prepared. The safety of learners and participants during fieldwork trips, the practical investigation sessions in the laboratory or classroom and their execution of the service learning projects were paramount. It was thus imperative for the team to have a session on this aspect and identify potential risks for each of the aspects mentioned. The study team thus described the risks they identified, allocated responsible persons to attend to each risk, estimated the impacts and frequencies of possible occurrence of each identified risk, determined appropriate mitigating circumstances, and prioritised them accordingly.

For the prioritisation purposes, the team used the criteria propounded by Maxwell (2002:30-34) and Covey (2002:37:39), dividing priorities into four: A: high priority risks, which according to the team's understanding became those with high occurrence likelihood and risk impact; B: those with low occurrence likelihood and high risk impact; C: those with high occurrence likelihood and low risk impact; and D: those risks with low occurrence likelihood and low risk impact. The team discussed and agreed on the interpretation of the criteria and followed the suggested strategy in respect of the attendance of such priorities. For instance, whereas one might have been tempted to attend to the priority D risk last, the criteria suggest that it should be worked into a daily routine on set deadlines. The priority C risks were those busy repetitious pieces of work that were carried out in half-hour segments every week.

For priority B risks, quick and efficient ways were to be found without much personal involvement; while the priority A comprised those risks that were tackled first. The details in this respect are also annexed for more information.

4.2.7 Lack of reflective moments

There were no instances of learners and parents providing feedback or airing their views about their experiences of learning and teaching strategies or how they could be improved (Molee *et al.,* 2010:240-241). This was also the case for the use of service learning to transform the learning of Physical Science. The assessments were mainly confined to the academic development of learners and remembrance of facts as opposed to understanding of them (Salleh, 2004:10). The issues that pertained to learners' personal growth and civic engagements were given scant or no attention (Molee *et al.,* 2010:241-244). The parents did not communicate with teachers about the learners' performances nor did such learning focus primarily on learners' social problems and needs (Kiely, 2005:17-18; Liasidou 2008:487). This practice is influenced by the prevalence of power imbalance realities between parents and teachers, amongst learners and between teachers and parents.

The practice of not having time for reflection deprived the teachers of an opportunity to voice their frustrations and challenges in respect of the teaching of Physical Science. It also denied them and the learners opportunities to learn from and support one another. It tended to discourage problem-based learning (Whitfield, 1999:106-107). This study, on the other hand, created space and set aside time for reflections (Kottkamp, 1990:127, 132, 136). One such reflective moment involved teachers of Physical Science and Natural Sciences. During that session, for instance, Rethuseng said:

> *nna ke ne ke re ho bua nnete ha ke clear hantle ka fisiks,..so nka se kene dip ho yona laek ke kena phateng ya laef saense, ya baeloji. Ke titjhere ya baeloji le jiografi, ho batla yona ntho ya hore re kopane re bone hore phate ele re e etsa jwang*. (I was saying to tell the truth I am not clear with Physics… so I will not be able to go deeper in it like I do in life Sciences and Biology. I am a

Biology and Geography teacher. We need to meet and see how that Physics part can be addressed.)

Rethuseng had opened up and indicated the problem in respect to her area of specialisation, Geography and Life Sciences, and confided that as a result she could not teach Physics well. The phrase '*nka se kene dip*' (I cannot go deeper) refers to Physics She could not teach Physics as well as she could Life Sciences or Biology, where teaching 'well' in this study means doing so in a way that connect learning to learners' real life situations, and that can help them address their needs and problems (Arenas *et al*., 2006:27; de Beaugrande, 2006:37-40; Rocha-Schmid, 2010:344, 354-355**;** Tatto, 2008:236). It is a form of teaching that is considerate of and powerful on the technical or subject content, and professional methods of teaching, taking into consideration the learners' learning needs and problems. Rethuseng's and other teachers' problems could not be identified during the interactions, such as the one between Rethuseng and Mosupatsela, becasue of a lack of collaboration and willingness to support each other. Conversely, the reason could have been lack of trust between the teachers. However, Rethuseng had hope that her frustrations could be addressed, hence her request that '*re kopane*' (let us come together / meet), and '*re bone*' (let us see), which in this context means 'let us help each other', that is let us do something to address the problem of teaching Physics. The act of doing something to address this problem gave the study hope that the learners' voices would be heard and considered (Rocha-Schmid, 2010:355; Stein & Mankowski, 2004:21; 23; Tatto, 2006:237-238).

Notwithstanding the apparent animosity, as interpreted from scolding, displayed during their uncoordinated interactions, teachers showed some willingness to work together to change their situation. It was clear that as a result of the lack of leadership, as in the case of the HoD who did not care for his department, there was no one to mediate for this inherently desired transformation. The mediator who was sought was the one who would declare his/her stance (Rocha-Schmid, 2010:355) on the side of the oppressed and the downtrodden, in this case the learners of Physical Science. This study supports the transformation agenda and the mediator would hold a view that would result in an empowering action (Salleh, 2004:8), emanating from but extending beyond the issue at that point to include the learners' contextual realities and society (Koosimile, 2004:490; Mahlomaholo & Netshandama, 2012**;** Steinberg & Kincheloe, 2008:145).

4.2.8 Lack of collaborative learning opportunities

The Physical Science teaching did not encourage participatory learning, and the engagement of parents and other teachers in the enhancement of learning of it was minimal. The problem that resulted was an inability to facilitate the achievement of learning of Physical Science, and data confirmed lack of participatory teaching practice amongst teachers (scolding). There was no feedback, concern or right attitude (impassionate) about the department of Physical Science, with no meetings held, no joint planning sessions, and imbalanced teaching. Learners in the same grade were taught different topics and different extent and depth, with poor communication because the 'arguments' were only at the time when learners' performance was to be assessed, and parents and teachers had not communicated with each other about matters related to Physical Science for a relatively long time.

What was supposed to have been an opportunity for team teaching had to be abandoned because teachers could not cooperate, suggesting a lack of participatory action. There were also signs of lack of cooperation between learners as a result of their respective variant perceptions, conduct and behaviour. For instance, Khethu did not want to work with learners from the neighbouring school because they were in her view ill-disciplined; Thandiwe did not like those who did not want to expose their weaknesses, and Khotla was irritated by the ones who did not keep time (Annexure 1-7). This was in addition to the learners not being organised to work in teams or groups to facilitate and enhance collaborative learning. My observation was that learning of Physical Science was fundamentally confined to the classroom. These factors are indicative of and confirm the lack of a participatory action oriented learning process in Physical Science.

There was also no structure in place to support and mediate (Kellner, 2000) for the transformation of learning Physical Science through the use of service learning strategies. This study intervened in this respect and established a coordinating team that comprised participants with diverse experiences and knowledge from the community and the school. This was a structure similar to that of the *Jipemoyo* ‘Take Heart’ project (Swantz, 2008:35), as the coordinating team then facilitated processes that addressed the prevalent weaknesses and threats. These were the lack of joint planning or shared vision, transformation-oriented Physical Science learning context, collaborative efforts for transformation and participatory teaching opportunities. Most learners came from indigent families, as was the case in Botswana’s ‘out of school experiences project’ (Koosimile, 2004:485); Tanzania’s *Jipemoyo* ‘Take Heart’ project (Swantz, 2008:33-34) and the Australian’s ‘Hold Our Earth Firmly’ project (Hickling-Hudson, 2006:4). Their indigence was found to have been connected to or complicated by other social challenges, such as lower levels of education of the parents. One parent said to a parents-teachers meeting that,

> *thuto tsena tsa morao di a ntlhola* (the subjects of today are difficult for me).

This was when the meeting was discussing issues of support of learning at home by the parents (see Annexure TP3). The other parent remarked that:

> *bana ba nka monyetla ka hore batswadi ha ba ya ruteha* (learners take advantage of parents because they are uneducated or illiterate) (see Annexure TP1).

The parents who were employed, on the other hand, could not attend meetings or support the learning of their children, because they did not have time as a result of the nature of their work (see Annexure TP3). Thus, the support offered during this study was in the form of bringing together the coordinating team, which levelled the power imbalances (Hatcher & Erasmus, 2008:50-51; Koosimile, 2004:485; Swantz, 2008:34) between the teachers and parents, as evident in statements made by Mosupatsela. He said that learners behaved like children who lacked parental supervision and discipline from their homes. Manthabiseng, on the other hand, indicated that learners took advantage of their parents because they ‘lacked formal education’.

This legitimise acceptance of the power dominance of the teachers at the expense of their learners and parents (Liasidou, 2008:489), in turn defeating the purpose of transformation and possible comprehension of modes and styles of learning embedded in the learners’ backgrounds or community cultural wealth (Donald, Lazarus & Lolwane, 2010:19; Mahlomaholo, 2011; Tudge *et al*; 2009:4-7). This was because the relationships that were imbued with power differential realities tended to be hostile to collaborative work and association, as was the case between Rethuseng and Mosupatsela (Dominiquez, 2008:4; Mertens, 2010:238; Servage, 2008:65-73; Steinberg & Kincheloe, 2010: 142-143). Other critical issues that were raised concerned an apparent lack of supervision that learners left children more powerful than parents.

The coordinating team in this study mediated to quell the differences that prevailed, hence the team found means and mechanisms for realising the ideals of collaborative learning. The study, through the collaborative efforts and mutual agreements of the participants, consequently established learners study teams, which ensured that the learning of Physical Science was learner-centred, empowering and sustainable. The learners' study teams explored and used learning strategies, such as problem-based and self-directed learning (Annexures CT8 & 9).

4.2.9 Learning not facilitated through sustainable empowering learning environment(s)

This section discusses teaching practices that were taken for granted as transforming the learning of Physical Science, and whether these teaching practices may not necessarily lead to transformation unless facilitated through sustainable empowering learning environments. The said taken-for-granted teaching of Physical Science practices included the examinations-oriented Physical Science knowledge-abstracting and teacher-centred strategies.

4.2.9.1 Examinations-oriented teaching strategies

The achievement of agreed upon outcomes and outputs as indication of performance appears to be natural (Sulleh, 2004:10). The teacher's performance tends to be pitched on learners' performance in the examinations (Akiri & Ugborugbo, 2009: 108; Asikhia, 2010:234; Koosimile, 2004: 484). In other words the teacher whose learners attain a pass mark in the examinations is considered as a good teacher depending on the number of learners who do so. The good teachers will have more learners than the bad or poor teacher. This is determined on the basis of the average pass percentages that learners attain in tests and or examinations (DBE, 2011a:4-5). The quality aspect of the results tends to be on the basis of the number of learners who attain high levels (Mahlomaholo, 2012:46-47). It is also important to note that examination questions are also moderated or assessed for quality (*i.e*. academic and non-academic) purposes.

These performance percentages are also critical to parents and the public, policymakers and administrators (Koosimile, 2004:484; Perold *et al.,* n.d.:53-55; Servage, 2008:65). The determination of learners' pass rates as teachers' performance indicators often disregard contextual realities which encompass but may not be limited to learners' cognitive capabilities in Physical Science and related subjects; input and role of other partners in the learning of Physical Science; and lack of basic Physical Science resources.

The result of this discursive practice influences the teachers' choice of teaching strategies, thus they focus their teaching on those topics declared examinable, which leads to them disregarding the other topics. The other practice is related to drilling of learners based on previous examination question papers, as teachers are encouraged to depend on the scenarios which represent contexts of the examiners. These will naturally be different from one place to another, depending on the socio-economic and cultural backgrounds of the learners and teachers. This practice in itself has a character and possibility of excluding other cultures and socio-economic factors from the teaching and learning discourses (Hackling-Hudson, 2008; Yosso, 2005:70). At the classroom level the examination-oriented teaching strategies lead to the exclusion of slow or weaker learners from the teaching and learning processes, and to setting of lower standard tests and examinations pursuant to the attainment of higher pass rates. These two observed practices compromise the learners' understanding of Physical Science principles and concepts (Arenas *et al.,* 2006:28; Asikhia, 2010:234; Hickling-Hudson, 2006:2, Tatto, 2006:238).

These practices manifested themselves in and on technical aspects of assessment of the learners' work, and focused on Physical Science examinable material to the exclusion of prescribed non-examinable material. This creates gaps in learners' creation and acquisition of potentially emancipatory knowledge, and excludes the inculcation of social skills in learners (Niemi, 2002:764-765). This is as result of teachers not developing questions based on the same scientific principles but ones customised to the learners' contexts. The service learning projects and assignments that were undertaken in this study illustrate this point clearly. The examination-oriented teaching strategy also involves focusing on how marks are allocated with a view to showing learners how to gain 'easy marks', thus encouraging learners to memorise and 'regurgitate facts', such as definitions of concepts and scientific principles and laws.

This is clear from Bohlokwa's experience with the teaching of Mathematics and Physical Science, expressed during the study's inaugural meeting during analysis of the situations and contexts of this study:

> *Di risalts di bohlokwa haholo. Mme ke bone di entse hore re senye nako ya rona e ngata, ho bona hore na bana bana re ba kgontsha jwang ho pasa. Ke hore bana bana ke ba thusa jwang ho pasa fisikhal saense? Mme poroseseng eno re khomporomaesa andastending ya fisikhal saense haholo* (The results are very important. I see they made us waste much of our time to find out how we can enable these children to pass. That is, how do I help these children to pass Physical Science? And in that process we compromise the understanding of Physical Science very much.

The 'results' here refer to the learner attainment of outcomes during the examination or assessment processes, which Bohlokwa conceives as having led to wasting much of the teachers' and learners' time as they were supposed to focus on enabling learners to pass their examinations as opposed to understanding the subject. Bohlokwa believed that some teaching strategies could compromise understanding of Physical Science, even if learners could attain expected percentages. This view was consistent with those expressed in the literature (Asikhia, 2010:234; Idowu, 2011:134; Niemi, 2002:763-764, 770; Tatto, 2006:238), which also argues that lack of attainment of good results by learners can be the result of the quality and content of the teacher-learner engagements.

This puts teachers under pressure to ensure that such results are improved (Koosimile, 2004:484; Perold *et al.,* n.d.: 53-55; Servage, 2008:65), however, the improvement should also reflect in the learners' communities and societies. This requires thorough critical engagements on continuous basis with policymakers and curriculum material. The success of these engagements depends on the understanding and use of CER principles (Hickling-Hudson, 2006:2) in service learning, in order to transform the learning of Physical Science. CER principles for instance impact upon the DBST members (DBE: 2011a), comprising school-based, community-based and office-based participants to balance issues of power embedded in their engagements, to develop and nurture relationship of trust, and to show respect and humility (Dominiquez, 2008:4; Mahlomaholo & Netshandama, 2011; Steinberg & Kincheloe, 2010: 142-143; Swantz, 2008:31-32) amongst team members and to critically reflect (Bringle & Hatcher, 2009: 42-44; Molee *et al.,* 2010:241-242) and mediate (Mahlomaholo & Netshandama, 2012:37) between the teachers and policy imperatives in search of the solution as beneficiaries thereto. In other words, the team would not be an uninterested party but a partner that leans towards the side of the subjugated voices in solidarity with a social justice oriented learning community (Liasidou, 2008:486-487; Steinberg & Kincheloe, 2010:143; Van Dijk, 2008: 88-89).

4.2.9.2 Teaching approaches that abstract learning of Physical Science

The approaches used for teaching Physical Science were predominantly removed from the learners' experiences and were thus abstract (Akiri & Ugborugbo, 2009:112; Arenas, Bosworth & Kwandayi, 2006:23, Koosimile 2004:490). They did not align Physical Science curricular themes and priorities with learners' contextual realities, or with well thought out or relevant learning activities. The data in respect of this abstraction of scientific knowledge development is demonstrated through a Physical Science lesson presented by Nkutlweng to a class of Grade 11 learners during September 2012 over a period of 35 minutes:

> Right what do we do now? What we do now is this I draw these three forces…I draw the first on scale, I draw the reference point, then I draw my second one there…If I draw it that way…ok. What should it be? Now I can draw that which it should be (he draws). It should be a nice closed figure. Now I measure that… you see what we have done here? It should have been a closed figure. Why

> should it have been a closed figure? Because it was in equilibrium… right. Now if I look at this drawing, what I will do with this drawing, I will take these two forces and I will complete a parallelogram of forces.

The ‘we’ in the opening question includes both the teacher and the learners so the task at hand was to be done by the learners as well. However, the question posed at the beginning of the lesson was not intended to establish the learners’ understanding of the concepts or scientific principles related to the subject matter under consideration, namely the equilibrium, equilibrium of forces, force diagrams, or applications to the learners real-life situations. Notwithstanding that the lesson was presented a demonstration it was still not introduced through examples from learners’ experiences or concepts of equilibrium. The learners would probably describe it as ‘balanced’, ‘equal’, ‘equivalent’, and a logical question following each response would have possibly been to ask them to give examples of what they meant. The follow up to the different conceptualisations likely have been the practical demonstration, like the forces board, to illustrate the differences between or amongst the concepts’ balance or equality to address misconceptions of learners.

The follwoing contextualises the frustration of Moletsane, a learner in the Physical Science class during one of the reflective sessions arranged by the coordinating team:

> *Ho na le thopiki tseo e leng hore ha o bone hore di amana kae le bophelo boo re bo phelang* (There are topics that one does not conceive their connection to the life we live).

The topic of ‘equilibrium of forces’ had been like one referred to by Moletsane (see paragraph 4.2.2.2). Nkutlweng did not show the application of ‘equilibrium of forces’ in the learners’ real life situations. Conversely, the lesson was neither related to a real-life application in which a need or a problem is addressed (Biesta, 2010:43; Kellner, 2000:6; Mahlomaholo, 2012:48-50; Nkoane 2009:22; 2011:112) through the use of the equilibrium of forces, nor drawn or designed from it. Thus, the usefulness and meaningfulness (Mahlomaholo, 2010:16-18) of the concepts had been made too abstract. The issue that teaching methods can abstract learning was also expressed by one of the participants during the study’s situational analysis engagement regarding the teaching practices in the Physical Science based on the participants’ experiences as teachers. Moeletsi, a retired teacher of Physical Science, added his views without negating (Kemmis, 2008:130; Wicks & Reason, 2009:244-249) the sentiments expressed by a fellow participant regarding science concepts that were perceived as being too abstract:

> *Samthaems ke mokgwa oo le rutang ka oona, o divosd haholo le riel laef* (Sometimes it is the teaching methods that you use when teaching, it is divorced very much from real life) (see Annexure T1).

Moeletsi's contention had been that the teaching methods that were currently used in teaching of Physical Science had been 'ridiculously' removed from real life. The use of the adverb 'ridiculously' is understood to be embedded in the phrase '*divosd haholo*',implying that the teaching strategies were too remote from the learners' experiences. This conception is based on the purpose of Physical Science in relation to the physical environment (DBE, 2011b:5; Mahlomaholo, 2012:48). The lesson presented by Nkutlweng also shows the extent to which there was a shift away from learner-centred Physical Science teaching approaches.

4.2.9.3 The teacher-centred teaching practice

The teaching of Physical Science, were predominantly teacher-centred, with the learners' interests and needs excluded from the subject's discourses (Koosimile, 2004:484; Niemi, 2002:764; Perold *et al.,* n.d.: 53-55; Servage, 2008:65, 72-73). Bohlokwa shared her experience of management of learners' 'delinquent' behaviour during a lesson presentation:

> *Ha o ntse o tswela pele o ruta o tla bona le bona ba se ba ipuela tsa bona. O kgutle o kgalemele. Ka nako e nngwe o utlwe hore bana bana ba ntena. Ke ruta ba mametseng. Ke tswela pele le ba mametseng* (Whilst you continue teaching you will notice that they are also talking about their own business. You reprimand them. Sometimes you have a feeling of being annoyed by these children. Then you decide to continue with those who are listening. I continue with those who are listening).

In the phrase '*ha o ntse o tswela pele o ruta…*' The word 'o' is a pronoun 'I' or 'one' and refers to the one who is speaking. Then '*o ntse*' denotes an act of being in progress or in the process of a certain act. Next, '*o tswela pele*' means 'continuing with' and '*o ruta*' means teaching. The entire phrase in this context means 'as I am (or as one is) busy teaching…' It appears that the teacher is the one who does the teaching while learners are to listen. This means that the teacher continues teaching learners who are listening and leaves behind those who are not, without letting them leave the class, which disrupted the teaching and learning process and excluded other learners from their own learning.

Bohlokwa had not analysed the situation critically or self-reflected on it (*Hammond et al.*, 2001:2; Rocha-Schmid, 2010:345-346; Tatto, 2006:239), as she could have also asked or established whether the cause of the other learners not listening was the approach she used to teach or even the misconceptions those learners might have had about the concept/principles under consideration. The misalignments between what is conceived as being known, and what is practically being experienced at a specific time often invokes action on the part of the one experiencing it (Kiely, 2005:19; Merriam & Ntseane, 2008:195). This action in turn creates an opportunity for critical learning for both the teacher and the learners. The lack of critical self-reflection and reflection created space for the exclusion of learners from their own learning because potential and possible barriers were experienced by the learners. This was evidenced by their talking to one other not being diagnosed, as a result they of which they could not be addressed. The learning barriers which learners indicated having experienced in the learning of Physical Science, later during the reflective sessions of the use of service learning to transform it, included:

> misunderstanding of questions; not being sure about myself; don't attend classes; did not ask questions where I don't understand; I had no time on this subject; I didn't understand the teacher at all; less practice and too many things in a short time; I was not reading; I usually read when writing the next day; I was over confident that I didn't even edit my work and my mistakes; financial problems, stress because of parents' poor health condition, and own medical problems (see Annexure LR1-7)

These challenges were not identified by the teachers in the teacher-centred learning encounters that were evidently non-participatory. The dominance of the teacher power (Koosimile, 2004: 490; Niemi, 2002:764; Servage, 2008:72-73) had not afforded the least powerful learners an opportunity to express their opinions or views, and were de-motivating (Idowu, 2011:134; Koosimile, 2004: 489) because learners would start their own conversation, unrelated to the lesson at hand, as the instruction or teaching progressed. That act of the learners had been a sign of either loss of interest in the lesson or of a need to engage with the subject matter. Thus, the *laissez faire* strategy or attitude that Bohlokwa or the teachers resorted to complicated the problem and further disorientated the learning and learning facilitation.

4.2.10 The shift away from learner-centred facilitation

The teaching practices in the school shifted markedly from being learner-centred (Kenworthy-U'Ren, 2007:818; Niemi, 2002:763-765; Merriam & Ntseane, 2008:196), characterised by one or a combination of being examination-oriented; abstract and teacher-oriented. Evidently, the learners' voices had been restricted to answering questions not clearly related to their real life situations. The lesson on the 'equilibrium of forces' discussed and presented above attests to this in a number of ways:

First, the **classroom organisation** for purposes of a demonstration lesson presentation, were poor. The main aspect of the subject matter to be learned or with which learners were to interact was physically remote from them. The force board was at least four meters and at most five meters away from them, and the diagram the teacher drew was on a relatively smaller A4 page. The effect of that was that learners could not see what was happening from the given distances. At times the teacher obscured the board from the learners, thus they could not see how the apparatus, namely the protractor and the setsquare, were being used. Nor did the lesson appear to have been organised according to intended objectives or outcomes for the lesson, as these were not clearly spelt out to learners at the beginning of the lesson so that they could be used at the end to assess the extent of their achievement. The presentation was not presented in a systematic way befitting the generally accepted way, that is 'from the known to the unknown' or from the 'simple to the complex' (Idowu, 2011:134), where the known refers to learners' prior knowledge and the unknown to the new knowledge they acquire. Its not being done created problems for the learners.

The **second** issue was excluding learners from their learning encounter by disregarding or **neglecting** their **prior-knowledge.** This could also be extended to include the teachers' disregard for the learners' prior understanding or misunderstanding of Physical Science concepts from their experiences. This was evident from the response the teacher gave, namely drawing the vectors on the piece of paper pasted on the forces board. Furthermore, Nkutlweng asked learners questions to which he gave the answers without giving learners an opportunity to give their responses. This deprived him of an opportunity to learn from or use learners' understanding or experiences of 'force', 'equilibrium' and related concepts, in order to enhance learning and enrich the facilitation thereof (see Annexure TLP1) (Hammond *et al.,* 2001: 2-8; Kiely, 2005:5-6; Passarelli & Kolb, 2012:2; Merriam & Ntseane, 2008:183-184; Niemi, 2002: 764; 770; Richards & Novak, 2012:2-3; Salleh, 2004:3).

The **third** aspect which could be drawn from the 'equilibrium of forces' lesson presentation by Nkutlweng was the **exclusion of learners** from the learning encounter. Nkutlweng was actively engaged in the lesson through drawing of the forces diagrams (parallelogram and triangle of forces) and giving answers to the questions he asked while the learners passively watched him. The overuse of the pronoun 'I', referring to him (Nkutlweng or the teacher) attested to this. Listening to the voice record it was evident that he spent about 20 minutes of the total 35 minutes doing the activity. Learners 'participated' only when they gave their chorus responses to questions such as "*everybody clear how we are going to do this? Everybody happy?*" This practice clearly was inclined towards 'exclusion' of learners, as was the case of Bohlokwa above.

In the **fourth** instance, the **teacher** Nkutlweng **wielded much power** through display of his knowledge and habit, as reflected in his teaching (Van Dijk, 2008:89) of the 'equilibrium of forces'. Throughout the lesson he was the only active participant, leaving the learners to be passive. The use of the pronoun 'I' in the text above attests to this. In some instances during the lesson he did not even ask questions to establish if the learners had been following. For instance, in the statements: '*you can explain what is there; it was due to the friction; it should have been a closed figure;*' the learners are told what to do, explain and expect. The opportunity for them to conduct further research from textbooks or other learning support materials was aborted by the teacher's provision of answers, a result of the knowledge he had. However, he had been unable to use his knowledge power to achieve effective and efficient use of the resources that were available. For instance there were enough resources available in that instance for learners to perform the experiment. The teacher did not use his professional discretion to persuade or motivate learners to work in teams of five per team on the exercise. In the process, he could have walked around to monitor each team's progress and provide 'technical support' accordingly (Tatto, 2006:237-238).

The **fifth** aspect from the 'equilibrium of forces' lesson presentation was the discrepancies in respect of **lack of time and** the tendency to be more traditional (Howard, 1998:23) and **shift away from learner-centred teaching strategies**. There were six complete sets of forces board apparatus, each with relevant and necessary accessories, such as pulleys, strings, mass pieces, mathematical instruments, mirrors and A4 paper/pages. These were not used as part of the demonstration lesson. Each set could have been used by five learners to learn requisite skills from each other, for instance the use of the mathematical set of instruments to draw parallel lines and to measure the sizes of the angles to determine directions of affected vectors. They could have also learned social and critical skills, such as collaboration, mutual support and critical thinking imbued with values of mutual respect and care (Salleh, 2004:5, 8). These learners missed out because of the teacher-centeredness of the approach. Other areas that suffered as a result were lack of connections made with the real-life situations of the learners, as well as assessment.

Thus, the teachers and learners had been acculturated to feel comfortable in relations that lacked interdependence. This created a problem of subjugation of the voices of teachers and learners that sought to seize the opportunity to control their own lives and situations in solidarity with a justice-oriented community (Liasidou, 2008:489; Steinberg & Kincheloe, 2010:149; Stein & Mankowski, 2004:22-23). The democratisation of learning of Physical Science was taken-for-granted. In this context, the evidence has shown that teachers did not work together or with parents, and there were no learner study teams. They accepted culture for teaching and learning practices characterised by selfish and self-centred individual interests, thus the learners were fundamentally excluded from the learning process. This act could arguably be conceived as socially unjust.

The teachers like Mosupatsela, who ‘yelled’ at his colleague for not teaching, as well as Moeletsi and Moletsane, the learners who questioned the relevance of some of the topics, were perceived as having sought to gain power to control their learning and teaching in solidarity with a justice-oriented learning community (Biesta, 2010:55-56; Hickling-Hudson, 2006:6-7; Kellner, 2000:5). The justice-orientation of this practice is informed by the learners’ constitutional right to education, which had been violated as a result of the ‘subjugation’ of their voices. The lack hereof was a reason learning of Physical Science was abstracted and not meaningfully related to learners’ backgrounds (Hickling-Hudson, 2006:4-5; Mahlomaholo, 2012:46-47; Mahlomaholo & Netshandama, 2012:37; Perold *et al.*, n.d.:53; Steinberg & Kincheloe, 2010:140; Thomson *et al*., 2010:214-237).

It is evident from the above that the shift away from learner-centred Physical Science was a result of such factors as the prevalent gaps in the leadership, as evidenced by lack of shared vision, values and principles. It was also a result of limitations in respect of management of learning practice, as attested to by the operationalisation of legislative mandates and lack of collaborative efforts, ineffective and inefficient use of time and learning related resources (Rocha-Schmid, 2010: 345; Salleh, 2004:10; Tatto, 2006:237-238); inability to identify and balance power differential issues amongst the teachers and between teachers and parents, and between teachers and learners (Hickling-Hudson, 2006:2). This was a problem because they rendered learning abstract and de-motivating (Idowu, 2011:141).This blurred our hope that Physical Science learning would one day contribute to the socio-economic development of community and society.

4.3 COMPONENTS OF THE STRATEGY TO USE SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE FOR SUSTAINABILITY

The components of the solution to the problems and challenges identified above in respect of transforming the learning of Physical Science through the use of service learning were integration (*i.e.,* service and academic curriculum); community-school coordination; focus on community needs; active participation; structured time for reflection (Hatcher & Bringle, 1999:115; Parker *et al.*, 2009:585-588); development of caring for others; opportunities for application of skills and knowledge; extended learning opportunities; thoughtfully organised experiences (Koosimile, 2004:483-484; 489; Osman & Attwood, 2007:16); role of the teacher (Otote & Omo-Ojugo, 2008:655; Whitfield, 1999:108); accessibility to educational material and infrastructure; cognitive stimulation (Asikhia, 2010:234); as well as prior experience and personal insights (Gilley, 2005).

4.3.1 The coordinating team for mediation of transformation of learning through service learning strategies

The mediators (Kellner 2000:3, 7-8) in the context of this study are people who have interest in and vision of the transformation of learning Physical Science. Their mission should embrace giving the learners hope that they can understand the subject and still do well in their examinations. Thus they are to collaborate with respect, humility and trust (Rocha-Schmid, 2010:355; Steinberg & Kincheloe, 2008:142-143; Swantz, 2008:35) in the processes from identification of services and related curriculum content, analysis, development and implementation of strategies to transform learning. They should be embedded in the learning of situations.

In this study, the process of mediation was conducted by the study coordinator with a representative team of parents, teachers and learners. The representatives of learners were elected democratically by the learners themselves and like other participants had clear roles to play. The other members were identified through a process that involved consultation and negotiations that sought to persuade others to be engaged voluntarily in the transformation process (Sanginga *et al*., 2010:696-697, 698-699; Swantz, 2008:34). Having established a team the next action was for the participants to be engaged in the contextual analytic process of integration between service and learning.

4.3.2 Participants' engagement in the process of integration of service and learning of Physical Science

The coordinating team in this study conducted a situational analysis identifying the context and the curriculum imperatives that could be operationalised simultaneously (Biesta, 2010:43; Merriam & Ntseane, 2008:185; Piper & Piper, 2009:99). The analysis involved the matching of identified strengths, weaknesses, opportunities and threats embedded in the context (Passarelli & Kolb, 2012:2-8; Salleh, 2004:8), with the priorities and themes from the relevant curriculum statement (DBE, 2011b). The issues that were also approached collaboratively included agreements and decisions on what strategies and activities were to be engaged in, delegation and sharing of responsibilities, identification of resources needed for each activity, decisions on the due dates on which the activities were to be completed and agreements on dates of meetings. The main reason for this was that some of the activities could best be addressed by teachers whilst others could be addressed by parents or even by a team of parents, teachers and learners.

The transformation of the learning of Physical Science through the use of service learning was fundamentally influenced by the study coordinating team members' views. The views of Moeletsi (retired Maths and Science teacher) and Moletsane (a learner) regarding the teachers' perception of Physical Science concepts as '*too abstract'* attest to this assertion. Moeletsi said:

> *Samthaems ke mokwa oo le rutang ka oona, o divosd haholo le riel laef…ke hore ha a tloha ka claseng a fumane ntho eo a ithutileng yona e teng mane hae…hore a kgone ho bona molemo wa ntho ena a ithutang yona* (I think it is the teaching methods that you use, it is divorced very much from real life that is from the classroom the learner must find that which he/she learned at school is there at home, so that he/she should realise the importance of that which he/she learned) (see Annexure T1).

Moeletsi was of the view that learning facilitation strategies that the teachers use may contribute to the learners' inability to understand the concepts. The approaches that tend to divorce Physical Science from learners' backgrounds were considered as contributing to that abstraction of knowledge, also been found by Mahlomaholo (2010:119). Learners find no value or importance in Physical Science, a view was confirmed by a learner participant, Moletsane during one meeting (above).

In this study, integration between service and learning occurred through the use of service learning projects and assignments. One assignment, for instance, used the toilet cistern to integrate issues of service and of learning, and to explain the concepts of mass, weight, pressure, force, kinetic energy and gravitational potential energy, and to elucidate the principle of conservation of mechanical energy to Grade 10 classes. It was in accordance with the schedule of dates in the curricular prescriptions to which the study was aligned (see Annexure AS1).

Apart from the scientific principles and concepts learned, the learners were also challenged to think critically, to use their understanding of these concepts and principles to explain how they would assist their parents or neighbours in the choice of a cistern that was efficient, economical and effective. They were to indicate how they addressed the problem of a leaking cistern when the water was continually released into the toilet, and this they did after discussing how they identified the specific leakage. This helped to introduce a new concept of sound, that is its frequency and amplitude; and to integrate it accordingly. The points that were illustrated without defocusing any one lesson were to ensure that learners were aware of the rate at which water was lost in order to trigger their corresponding actions. It was in the resultant learners' corresponding actions that the social responsibility and care resided.

The facilitation of engagements of the participants with diverse backgrounds such as the one referred to in above, required that they (participants) be 'identified with the marginalised groups' (Steinberg & Kincheloe, 2010:141). The group that appeared to be marginalised in this study turned out to be the learners of Physical Science and some of the teachers whose voices about change were not heard (Stein & Mankowski, 2004:21-23). The voices such as those of Moletsane (a learner), Moeletsi (a parent and an ordinary member of the community) and Mmusapelo (the teacher) are worth mentioning in this regard. These ‘subjugated voices’ needed to be identified as they were at no point in the same place or at the same time talking about the issues of transformation of learning of Physical Science. The participants’ coordination on the basis of their shared goal of transforming the learning of Physical Science resulted in them being fully embedded therein, that is in the learning of problem situations. The success of the facilitation of participants’ engagement processes had been based on a set of values to which they subscribed, namely humility, respect and trust (De Palma, 2010:216; Hickling-Hudson, 2006:2-3; Kemmis, 2008:127; Mahlomaholo & Netshandama, 2012:; Maton *et al.,* 2006:16-17; Mertens, 2010; Reason & Wicks, 2009; Sanginga *et al*., 2010:705-706; Steinberg & Kincheloe, 2010:142).

4.3.3 Community-school coordination

A further contribution that spurred the study in the direction of service-oriented transformational strategies was that made by a parent, Manthabiseng, and also considered as a potential solution to the challenge of lack of connection between the school and the community:

> *Mme ha a pheha o etsa di mejamente tsa letswai leo a le tshelang o etsa mejamente wa phofo eo a e tshelang. Abuti ha a ka atisa hore a be haufi le ntho tse kang tseo o tla kgona ho utlwisisa. So bo abuti le bo ausi atamelang haholo ka tlung hore o tsebe ho enjoya ntho eo o e etsang…ke nahana ke moo dikarabo le mothiveishene o leng teng* (When a mother prepares (cooks) porridge she measures the amount of salt she uses as well as that of maize meal. Boys and girls should make it their habit to come closer to such activities at home they will be able to understand. I think the answers and motivation can be derived therefrom).

The statements by Manthabiseng provide typical examples of learners’ experiences, problems and needs at home. The issue is that some of the activities that Manthabiseng cited are fundamentally the daily chores for most learners in the area of this study. Thus, most learners had access to activities such as preparation of food and cooking in their respective homes. As a result, Manthabiseng’s views are considered as provoking the thoughts and creativity of partners, especially of teachers in respect of the integration of such experiences in the learning of Physical Science. The challenge was thus conceived as being to identify the learning topics, concepts and themes from the cooking processes that could be connected to the academic curriculum. This principle could be extended to the other experiences, problems and needs of learners, so enhancing consideration of learners' respective community wealth.

The study accepted the challenge posed by the parents, Manthabiseng and Moeletsi. The study coordinator and Physical Science teacher, assisted by the coordinator for curriculum and HoD of Natural Sciences subsequently developed assignments for learners in the contexts suggested by Manthabiseng and the study coordinator**.** These were returned to the study coordinating team and other teachers to solicit more input and support where required. The two assignments were based on the coordination of the school and the community, the first being coordination at school-home level and the second at school-municipal service level.

The coordination between the learners' **homes and the school** was realised through the learners' assignments that are based on the learners' chores at home. This was critical because most of our learners were from homes facing challenges that required them to address. These included struggles from acquisition of groceries (raw food), to preparing (cooking) meals and other housekeeping responsibilities (see Annexure LR1-7). This often creates a situation in which learning and familial objectives contest for time. The solution that Manthabiseng suggested was that of finding a way of harmonising and synergising these objectives, thus enhancing coordination between the home (community) and the school.

This coordination can be achieved by way of finding connections between the learners' chores and the curricular content. In the context given by Manthabiseng above, the learners' assignment sought to connect the process of food preparation (cooking) at home with curriculum theme, concepts and principles. The theme on chemical reactions is what took place in the 'pot' and the factors that affect the rate at which it took place (when the food is ready for consumption). The factors being referred to here are temperature and heat; state of division of prepared raw food; the size of the pot compared to the amount of food to be cooked; and chemicals, such as sugar, vinegar, or bicarbonate of soda, that act as catalysts (DBE, 2011b:123).

The assignment challenged learners to demonstrate how they would use knowledge to address their familial potential challenges of energy saving and other economic issues. They were also to submit evidence (from the parents) which they would then use to advise them, for instance on how to save energy (electricity) during this process; the potential dangers that might be caused by substances used as catalysts; and why they thought that way. The performance of learners in that assignment also contributed to their formal assessment mark, and this was found to have improved (see Annexure RP2).

The assignment that was based on **municipal services**, on the other hand, targeted themes such as mechanics, with concepts of mass, weight, pressure, gravity, force, velocity/speed and mechanical energy. It employed the system of used water transportation to the treatment plant/site. The exercises or assignments included scientific principles involved in waste from a toilet cistern passing through the sewer system to the treatment plant. It also targeted a curriculum theme on matter and material with concepts of compounds and solutions, and methods of separation from hand sorting, mechanical methods and sedimentation to chemicals. This finally targeted electricity and its use in the plant, considering the connections and amounts of electricity used with a purpose of enhancing responsible social activism in partners.

Aspects of social responsibility were also covered through a water leak detection project, in which learners engaged with other community members to work on and use their communication and negotiation capabilities to address a real life social problem of pollution of land and water (see paragraphs and Annexure RP1) This integrated community activities with the technical and scientific knowledge claims in the curriculum. Also, the learner service learning project integrated Physical Science concepts with mathematics and accounting, as well as with communication and civic responsibility capabilities. A further investigation into the activities at the purification plant, when considered on a step-by-step basis, revealed elements of life sciences, namely aerobic and anaerobic respiration, and chemistry’s chemical separation of matter.

It is evident from the above assignments that the learners' and the parents' voices were no longer subjugated, but rather empowered to address their own problem and needs. They focused on learning whilst preparing food in safe and economical manner; of learning whilst saving water and money and at the same time proactively diverting potential conflict and tension with the municipal water services provider. These were in line with the principles espoused by CER, of 'drawing strength from the multiple perspectives' of teachers, lecturers, scholars, parents and learners (Stein & Mankowski, 2004:32; Steinberg & Kincheloe, 2010:149); and addressing multiple objectives simultaneously (Mahlomaholo & Netshandama, 2011; Steinberg & Kincheloe, 2010:148). The balancing of the power differential realties through the use of a study coordinating team, representing a new form of connectedness with others, and the embracing of principles of respect and humility (Steinberg & Kincheloe, 2010:142;143) had been used successfully.

The community-school coordination and academic integration discourses are imbued with power differential realities. These are inherent in the diverse backgrounds and experiences of the participants. Their success lies fundamentally in the ability to synergise them towards a common goal without subjugating anyone of them. Thus, CER's principle of considering each participants' contribution, with respect and humility and awarding equal status become imperative. (Mahlomaholo & Netshandama, 2012; Steinberg & Kincheloe, 2010:142-143). Furthermore, the meanings in the voices of the participants need to be comprehended in order that they may be operationalised to achieve their intended goal. This is because their

> 'utterance and situation are bound up inextricably with each other' and that 'each verbal statement by them (human beings) has the aim and function of expressing some thought or feeling actual at that moment and in thatsituation…either to serve purposes of common action' (de Beaugrande, 2006:31)

This statement confirms the view that verbal statements are the expressions of thoughts that people have. Thus, it is critical to have a clearer understanding of the participants' voices. Through the use of critical discourse analysis of these voices the study had the "clear potential in addressing change possibilities both at the micro and the macro levels" (Liasidou, 2008:486). The micro level in this study was represented by the engagements within the school, whilst the macro level was represented by those between the school and the community or even the DoE.

4.3.4 Focus on community needs

The needs and problems in the learners’ assignments were fundamentally derived from the learners’ physical environment. They were in the form of services such as addressing the problems experienced with the cisterns at home, and consider both the curriculum learning efforts and service as equally critical to learning (Niemi, 2002:765; Richards & Novak, 2010:46,50). This strategy clearly integrated the technological aspects, such as the cistern structure, and mathematical skills, such as computational skills, with Physical Science, for example calculations based on basic definitions of weight, gravitational potential energy and others. At the same time it (the toilet cistern strategy for TSL) required learners to use the knowledge they had acquired to address related potential needs at their homes, such as choosing an efficient, effective and cost-effective cistern, and problems such as leakages and malfunctioning of the cistern in their home. There is sufficient literature on concerns about the relating the capacity of academic learning to learners’ real-life needs (Hatcher & Erasmus, 2008:49, 53-56; Kinsley, 2006:53-59; Koosimile, 2004:484; 490; Otote & Omo-Ojugo, 2008:654).

The study viewed community needs as learners’ needs and thus established a close connection between school and community. The study coordinating team members and the learner participants identified the needs and problems experienced by them as community members (Gboku & Modise, 2008: 322; Hatcher & Erasmus, 2008:56; Hickling-Hudson, 2006:8-9; Idowu, 2011:137). With the study coordinating team, this happened during the inaugural study planning session and during subsequent meetings. The participants had opportunities to bring out their voice through the reflection sessions (Kiely, 2005:5-7; Passerelli & Kolb, 2012:2-5), for example, after the visit to waste water treatment plant and with the submission of service learning project (see Annexure T1).

4.3.5 Active participation: study teams

The participants had agreed upon active participation as modes of realising their expressed views, as evident from the suggestions about strategies to be employed in order to transform the learning of Physical Science through service learning (Gboku & Modise, 2008:322). They proposed the use of strategies that:

> would relate learning of Physical Science to real live situations that learners were familiar with; would engage learners in experimental or practical work; relate learning to what learners do at home; were activity-based where most of the time the learner performed activities (see Annexure T2); encouraged collaboration with the community; that teach 'civic' responsibility (see Annexure DM1); that are geared towards changing the mindset of the learners from negative to positive (see Annexure T1).

The above was obtained from the participants' communicative actions (Kemmis, 2008:127-128; Reason & Wicks, 2009: 245), but neither 'negated' nor 'fully argued and complete' (Kemmis, 2008:129). They were considered as of 'equal value' for which due regard should be given with respect and humility (Mahlomaholo & Netshandama, 2012:42-44; Maton *et al*., 2006:16-17; Steinberg & Kincheloe, 2010:142-143). The study thus sought mechanisms through which these voices could be turned into 'practical' action. As a result the learners' study teams were created to "serve purposes of common action" of transforming learning of Physical Science (de Beaugrande, 2006:31).

Each **study team,** consisting of not more than five learners, with one elected by others as their team coordinator, had a parent who supported the team and motivated them to learn. The teams, including the parent member and the teacher, agreed on time and venue where they would meet to complete their agreed-upon assignments. They would decide to do an activity based on the principle of conservation of mechanical energy, starting with what they had observed in real life water-related projects, for instance as depicted in their respective worksheets. They would then pick up challenges based on other scenarios from sources such as their formal assessment tasks. After having agreed on the activities each learner made his/her individual attempt and wrote down an answer, which served as preparation for the teamwork on the same activities, and an opening to the discussions during the team session.

During the team session, the team coordinator facilitated the discussion and began by confirming attendance. Each member then showed his or her work and the team discussed and compared their respective responses. This was to identify the gaps which would be reflected by differences in the answers and responses to the question under consideration. The team then discussed the inputs with a view to identifying knowledge gaps by reflecting on the reasoning that informed the individual response. Where there were serious challenges, either the parent or the teacher was called in for support. Finally, the team decided on a response, based on their collaborative effort. They then brought a team effort to the teacher for further consideration and assessment purposes. Learners were afforded an opportunity to discuss with the teacher to correct or further address knowledge gaps (see Annexures CT 8 and CT 9). It is again noteworthy that there were no focused study teams prior to this study, though the effectiveness of the participatory and collaborative learning strategies has been recorded in literature (Gboku & Modise, 2008:322; Hertz-Lazarowitz *et al.,* 2010:270-271; Maton *et al.,* 2006:11; Niemi, 2002:769-770; Salleh, 2004:4-5). The study balanced the diverse power relations inherent in the teams by allowing them to be guided by principles of trust and respect (Kenworthy-U'Ren, 2007: 817, Steinberg & Kincheloe, 2010:142)

The learners were asked to reflect on their experiences of this mode of learning, the introduction and use of which they had also contributed. The feedback obtained suggested that the learners' study teams should be continued, and the exercise attracted learners from the neighbouring school who were also given an opportunity to participate. The data provided by learner participants is reflected in Khethang's words:

> ... we made a group of five students where we revised. I really liked that method of studying and discussing and it was very helpful because we share our opinions together… sharing some views was very good idea.

Lefuwe echoed this view:

> … this teams method is still fine as it helps each and every member of a team to be helped by other team members where they can.

This aspect enhances the cooperative character of transformational service learning of Physical Science as espoused in this study, and learners also learn mutual care and respect. As Khethang indicates, they were free to express their opinions through communication with each other, which was the case when they were with the teacher alone. Also, the discussions that ensues enhance learners' logical reasoning and critical thinking capabilities, as they were able to substantiate or explain to others why and how they had arrived at their respective answers (Hatcher & Erasmus, 2008:51; Idowu, 2011:137; Kenworthy-U'Ren, 2007:814-817; Salleh, 2004:5).

The learners were engaged in the use of service learning to transform the learning of Physical Science through assignments and projects, which were fundamentally cooperative (Niemi, 2002:765), as they partnered with learners from other grades and were supported by parents (Hatcher & Erasmus, 2008:51; Kenworthy-U'Ren, 2007:817). The project, for instance, was about investigating the processes and systems used or followed from waste disposal to its final stage of treatment at the treatment site. The purpose was to afford the learners an opportunity to discover scientific principles that are applied in their immediate real-life situations to address a real need and a problem. It was also to afford them an opportunity to apply their minds to potential social and technical challenges experienced by the 'systems and processes' and how they could contribute in addressing them.

The instructions of the abovementioned transformational service learning project are given here as data (the whole document is attached as an annexure):

- There is one site where waste water is treated in the municipality in order to attend to *inter alia* the environmental health needs of the community.
- Find out about the *scientific principles* used in the transportation of waste water from water users (community).

The principles in this regard are related to the theme of mechanics in the work schedule for Physical Science. The concepts involved here are, for example, weight, mechanical energy (potential energy of water in the cistern transformed to kinetic energy as it flows down or gravitates); pressure (force or weight of the water in the cistern per surface area of the hole through which the water pass as the toilet is flushed); the slope of the pipe system that serves as a route to the treatment plant. The concept of slope and motion in two dimensions also finds expression, and the later concepts also relate to mathematical skills of trigonometry, as slope or gradient is related to the ratio of tangent (see annexure AS 1). Secondly, the research required the learners to;

- Find out about the *scientific principles* used in the treatment of waste water at the treatment plant/site (*n.b.,* this may require you to pay the site a visit to collect data and to interview relevant workers)

This part of the project targeted a Physical Science curriculum theme on matter and materials. The related concepts were, *inter alia*, mechanical methods of separation of matter based on the physical properties of matter, such as particle sizes and density. It also sought to focus on chemical composition of some substances that were in the learners' physical environments, such as carbon dioxide, ammonia, urea, nitrates and sulphates. Finally, it also targeted chemical reactions as a means for purification, as seen for instance in the final stages, when respiration takes place. The latter part integrated Physical Science (chemistry) with life sciences (see Annexure AS1), and served as a basis for discourse between the teachers responsible for these subjects.

Thirdly, the project challenged learners to engage their thoughts and attitudes towards their physical environments. It sought to solicit the learners' and parents' social responsibility by relating the Physical Science concepts and principles to the social challenges. Thus learners were to:

- Describe challenges or problems you identified or learned about in the waste water treatment system and processes. Also identify the possible solutions to the identified problems.

The site visit was followed up with a reflection session for learners, who were guided through a process to establish how they experienced the visit and as far as possible relate aspects thereof to their work. Amongst the challenges they identified were those related to the abuse of the sewerage system by members of the community. This they related to the type of items they found at the screens or pre-treatment stage, which included clothes, utensils and other non-biodegradable materials. These items they listed in worksheets that they completed during the visit, on site. They also identified themselves with such socially unjust practices, to which they appeared regretful. This is evident from Dirontsho's statement that young people were mainly the ones who committed the act of illegal dumping, thus polluting the water and throwing unwanted objects into the sewerage system. They subsequently suggested projects that could be pursued to remedy or help alleviate the situation.

- Indicate how you have played or you can play a role in addressing those challenges.

Amongst the projects that learners and parents suggested was the leak detection and plugging assignment, mainly pursuant to the fulfilment of the quest to play a role in addressing or contributing towards addressing the identified challenges. It was thus prioritised over the other assignments.

Some of the activities that learners performed were given as part of their daily assignments. The Physical Science subject policy categorises work into *formal* and *informal* (DBE, 2011a:5; DBE, 2011b:143-150), with assignments being activities that learners can execute at home or in class. An activity, such as the one discussed below, was given as an assignment for learners to perform following their visit to the waste water treatment plant.

- Inspect the school or home waste water and water network to identify water leaks and measure the exact quantity of water loss experienced, evidence is required for this. You must also express the loss in monetary terms for a period of one month. Advise the responsible owner of the pipe or tap where the leak was detected based on the data you shall have gathered on how much he or she is losing in both monitory and water quantity terms. Also explain how you helped address the challenges you experienced in this regard.

This assignment was to be completed in a shorter period than a project, the duration taking into consideration that learners were to make arrangements with community members who had a water leakage in his or her water system. It required that learners should walk around and search for water leakages in order to be able to perform the task. The evidence that was sought was to be a video recording of the leakage taken with a cell phone, where possible, or a confirmatory note by the affected parent or member of the community. The confirmatory note was to contain a message to the affected person, alerting him/her about the amount of money likely to be fruitlessly spent on water bills, the amount of water wasted over a particular period, and a commitment that he/she would repair the leakage. In the event of no cooperation the learner was to approach the municipality and ask that the leak be plugged or repaired. Issues emerging relate to learners' civic responsibility and communication over and above mathematical calculations and costing (a bit of accounting) based on the flow rate (Physical Science).

The learners' actions of addressing their-real life needs and problems, as in the projects and the assignments mentioned above, are emancipatory. They are also transformational because the community members are engaged in addressing their problem (Biesta, 2010:55; Hammond *et al*., 2001:11-14; Van Dijk, 2008:86). The community members' direct problems or needs would be to plug the leak, save water and money, and to spare their emotions from imminent confrontations. Also, in this way, the community members gain "power to control their own lives in solidarity with a justice-oriented community" (Liasidou, 2008:486-487; Steinberg & Kincheloe, 2010:143; Van Dijk, 2008:88-89). The latter often happens when the affected community members are, for instance, legally forced by the municipality to pay large water-related bills. Some of the costs could be avoided by following the proposals arising from learners' assignment. This also affects the learners as members and the community, whose attitudes towards their environment and resources need to be shaped up in a timely way.

Another benefit that learners derived from the above assignment related to their learning of Physical Science. Some leaks were identified through sounds that the water made as drips from the system. The sound waves are an aspect of the theme on waves, and so concepts of pitch and loudness could be explained in relation to wave properties. These could then be used to determine the amount of water lost, thus helping with the turnaround time for the repairs, based on the quantity estimated to be lost and the potential damages that could be associated with them.

The other critical Physical Science learning concepts from the assignment relate to the concept of rate and rate of change of physical quantities, such as mass, volume and time. The learners' measurement of the amount of water lost per unit of time is used to explain the concept of speed and flow rate (see Annexure AS 1). This concept is dealt with under mechanics. The water lost (that leaked) is collected in a container and its amount determined both as mass and as volume. The two concepts can then be clarified and the values in respect of each be used to determine the rate of flow in mass per unit time or volume per unit time.

The other concept relates to the density of water and the parameters that determine it. For instance, learners engaged in an activity of dividing the mass and the volume of the water that was lost per unit of time. They compared the values obtained and even shared the readings for purposes of further learning activities. These included representing the mass to volume ratio graphically, then continuing with analysis of results up to a point at which would draw their own conclusions. The instruments for measuring mass and volume may be borrowed from the learners' respective homes or communities, thus helping them realise that science is connected to the physical environment.

The effect of water loss on the pressure in the water supply system can be explained with reference to supply to other users. The concept of pressure is further explained and its usefulness to the water supply. These activities involved periodic reflection with the teacher, particularly during classes. The reflection sessions were open to other teachers. The HoD and teachers available at the time also formed part of the sessions, and their views were considered as data in this study.

4.3.6 Structured time for reflection

The reflection sessions were held after the execution of a significant action or phase of the study. It thus took place during the course of the study. For instance, after the visit to the treatment plant the teacher and learners had some time together to reflect. Using the principles of FAI technique (Mahlomaholo, 2010:20), I facilitated learners' discussions of their Physical Science learning experiences from the treatment plant. The learners brainstormed and discussed their observations of the process at the different stages, from pre-treatment, to primary, through the secondary up to the tertiary. Their observations were then guided to relate to water quality with special emphasis on its physical properties at the different stages. Khethuoe and Ruthe identified non-biodegradable materials and items that were not supposed to have been disposed of in the sewerage system. These included clothing, plastics, bottles and metal, such as tins. The learners also noted the relevant method of separation, namely manual or mechanical.

They were to relate the methods of separation of materials (matter) from water to the properties of the affected materials, and the properties were to be identified as chemical or physical. This was to address learners' comprehension of the curriculum content and its meaningful integration with real life situations. The concepts targeted were the microscopic and macroscopic view of matter as they related to Physical Science. The physical properties identified at the pre-treatment stage were size (mass and volume) of material relative to grid dimensions, as well as density (ratio of mass to the volume). At the primary stage the latter property and corresponding method of sedimentation had been predominant, while the mechanical method was at the pre-treatment stage.

During the secondary and tertiary/maturation stages of purification there was a predominance of chemical methods and sedimentation. These methods of separation of matter were explained to learners by the municipal plant operator(s) on site and during the site visit preparatory engagements. The chemical methods that were explained included aerobic and anaerobic respiration of bacteria. The clear water that became the end product of the purification process was chlorinated in order to control the micro-organisms, such as bacteria and viruses. The chemical methods of separation connected well with the concepts of synthesis and decomposition reactions that are dealt with in chemistry. This knowledge was then taken further during respective Chemistry lessons (see annexure TWS 1).

The different stages of purification constitute parts of the entire process of waste water treatment, directly related to the learning content as contained in the Physical Science curriculum. These individual parts were thus used to connect curriculum learning content to the real life social needs for a hygienically healthy and safe environment. That she site visit had usefully reconciled the curriculum content learning with the learners' background was clear from the statements of learners, Khethuwe, Khotla, Thandiwe, Modiehi, who visited the plant. They indicated having 'really liked' learning from the waste water treatment processes. For instance, Khotla appreciated the "*work that we have done when we visited waste water treatment plant*." By 'we' he was referring to himself, other learners as well as the teachers and parents involved in the activities. The detail of the work was covered in the worksheets completed before, during and after the visit to the plant (see Annexure CT 5). They covered the curriculum themes, concepts and scientific principles, from mechanics and electricity to matter and materials.

Khethuwe corroborated what Khotla had said:

> The visit was very prominent to me because I was able to know even to see how water was clean back to be clear water to be drink.

Modiehi added that she had learned about the 'particles' found in the used water and went on to refer to the use of calcium carbonate and chlorine as some of the chemicals used in the process. The particles that Modiehi referred to were the ions and other dissolved substances, including nitrates, sulphates, phosphates and carbonate ions. This is according to the information that the learners gave in their worksheets, but could also be related to the theme on fertilizers. The learners subsequently connected fertilizers to the sludge that was left untreated at the plant. One learner even proposed that the sludge should be treated to make fertilizers which could then be used to address economic needs of the community. This was one of the potential projects that the study found to be worthy of further consideration through a community-based service learning centre.

The above discourses clearly show that through the reflection sessions the study was able to take the learning of Physical Science beyond the classroom. It also went beyond connecting the learning thereof to the backgrounds and need of the learners and their community as it identified implementable projects that engaged other participants from the community. These projects, also referred to as the use of service learning to transform the learning of Physical Science, had the potential to sustain it. For instance, the cistern assignment and the leak detection and plugging project were aligned with municipal social services programmes. This fundamentally depended on the levelling of power relations amongst persons in positions of power, from both the local municipality and the school. The success in that regard created learning opportunities that strengthened pursuit of social justice-oriented practices. These practices explored and used participants' diverse skills, knowledge and experiences (for example, technical water services, teaching, environmental health, legal services), equitably to give hope to the learners regarding the capacity to do well in Physical Science.

The current legislation provided for such democratic and participatory approaches towards learning and support (DBE, 2011b:5). This aspect was addressed under a section on the process of assessment of learners' performance, that is to "assist teachers, parents and other stakeholders in making decisions about the learning process and the progress of the learners" (DBE, 2011b:143). This legislative imperative entrenches the principle of freedom of association amongst parents, teachers and learners throughout the learning and teaching processes. Such associations would in turn afford space to inculcate co-operation and peace amongst the participants. As a result, the use of service learning to transform the learning of Physical Science derived strength from these principles. They were the cores of the coordinating team, learners' study teams and the guiding principles for their reflective moments.

Another reflection had been of the social practices that learners were also engaged in that posed a threat to the sustained functionality of the treatment process. These were fundamentally a threat to the sustainable implementation of the solution to the community problem that was inherent in untreated and waste water. Thus, the social practices that posed such a threat were the 'abuse and misuse' of public resources, whether water, funds or such facilities as the sewerage infrastructure. This 'misuse and abuse' were because members of the community disposed of non-biodegradable materials (e.g., plastics, motor oil, metal substances, cutlery), and carcasses into the sewer system. These items were identified by learners at the treatment plant and recorded in their worksheets (see Annexure TWS).

Subsequently, the learners also identified possible activities in which they could engage in order to contribute towards addressing or curbing socially 'unjust' practices. These activities included awareness campaigns through posters and placards to discourage such practices, and door-to-door campaigns (see Annexure TWS). The learners' affective aspects of development had been challenged, and they felt they had a role to play in their respective communities. It was thus imperative for the teacher, supported by the other teachers engaged in the transformational service learning of Physical Science, and parents, to design appropriate curriculum-related activities, assignments or projects. They should identify critical curriculum content, concepts and scientific principles that learners could learn as they conducted their awareness campaigns. Once more, this was also a potential project that needed involvement and alignment with the relevant municipal section, in this case the Environmental Health division. This aspect captured their curiosity as they enthusiastically executed their respective social responsibility through the service learning project.

Another reflection was in writing, when learners were asked to share their overall experiences of the study, that is from their collaborative multi-grade study team engagements on site visit to transformational service learning project execution. One purpose was to assess the acceptability and usefulness of service learning to transform the learning of Physical Science through study team engagements. In this regard Lefuwe, remarked that:

> I have learned that a person is a person through interaction with other people. I have learned that a real team does not consist only of best friends, but strangers can make a team and at the time become friends. Also working with learners from different grades and class had made me be able to succeed…

It was evident from remarks such as this that learners wanted to work with each other. The issue of multi-grade teams encouraged learners further, and most of those who shared their experiences had appreciated and been enthused by working in multi-grade teams. They were of the view that this contributed towards their improved learning and performance in Physical Science, as explained above.

It is imperative to note that these reflective sessions took place as part of and during the iterative and integrated steps of CER according to which this study is couched. This was helpful, especially given the limited time available and because it allowed for unrestricted freedom of expression of views and arguments that enhanced other aspects of learning of Physical Science. They were, as a result, also conducted through the use of the FAI principles. The textual data had various issues and connotations of power, class, dominance, interests and hegemony (Van Dijk, 2008: 87), which thus required the use of CER's interpretive-analytic-educative mode to make sense of. As a result, the participants' views, as data, were audio-recorded, transcribed and analysed using CDA (Laisidou, 2008:486-489; Mahlomaholo, 2010:20; Stein & Mankowski, 2004:21; Steinberg & Kincheloe, 2010:148-149; Van Dijk, 1995:20-24).

Throughout these processes the participants' views were treated with respect and humility (Steinberg & Kincheloe, 2010:142). The most logical arguments were however those taken up in the report under a specific topic or sub-topic. This had the purpose of ensuring the unity of the diverse views and of the study coordinating team and participants. Their views were accepted and noted without necessarily spending much time on overt or trivial differences. In other words, views were brainstormed but not allowed to be immediately or directly negated. When a debate ensued it was done so as not to instil feelings of disrespect or fear in others. The counter-arguments were thus made without mentioning that the previous contribution had been wrong or unacceptable.

For instance, the issue of Rethuseng that '*ho bua nnete ha ke clear ka fisiks*' (to be honest I am not very clear with teaching of Physics) was not responded to directly or arrogantly, but handled with humility and respect. The team provided her support to the extent of having a mentor with whom they discussed, prepared, presented and reflected on three Physical Science lessons, namely the lesson plan on the arrangement of elements in the periodic table, electrolysis, and displacement reactions to the Grade 8 classes. The following conversation was held during the reflection session in which teachers sought feedback and inputs from learners and parents on how they experienced teaching of Physical Science (Annexure T2):

> *Bohlokwa (Facilitator): Na mekgwa eo le e bonang re e sebedisa na le bona e ka e na le bokowa kapa bofokodi hokae mme re ka e ntlafatsa jwang* (the methods of teaching that you see us using when we teach, in what manner are they good or bad and how can we improve)
>
> Makgothatso (parent): *Nna ke ne ke kgothaletsa weekly test*… (I encourage that there learners should be given tests on weekly basis)
>
> *Matlholo: Ke ne ke re group di hlodisane ka hore group e sebetsang hantle ka test tseno tsa beke le beke, ba fuwe ntho e itseng*…(I suggest that teams

should compete a team that performs well in those weekly tests should win something)

Bohlokwa (facilitator): *E ya utlwahala mme* … (it is understandable madam)

Without going deeper into the analysis of this conversation, it is apparent that the teacher Bohlokwa, who was a facilitator of the discourses, asked a question which was not well understood. The responses were not on how teaching was experienced by the learners but while it is not clear if the responses from Makgothatso and Matlholo were addressing how to improve the teaching strategies, Bohlokwa did not interject or say they had not responded to the question. The issues that were raised had been accepted, because Bohlokwa said it was ‘understandable.’ The study considered these issues during subsequent parents, teachers, learners meetings and followed up with teachers to establish the possibility of them being implementable. In that way, parents Matlholo and Makgothatso were not humiliated and so continued to participate in the study.

4.3.7 Opportunities for application of skills and knowledge

The learners determined the actual water losses and extrapolated over a month the cost without interest or tax, which when added would increase the cost significantly. There is an opportunity to determine other cost drivers that accompany the loss, depending on the effects of flow rate and the quality of water loss as well as the environmental impacts. This suggests that learners’ knowledge of content of Physical Science in class finds expression in the service learning project. To unearth possible cost drivers requires more than just computation skills, also invoking critical thinking and analytic skills. This shows the significance of integration of academic knowledge and its application to real-life situations, suggesting that the development of critical thinking and analytic skills is achievable through a service learning project.

For instance, learners inspected and investigated the cause of a problem such as leakage, to determine the urgency with which it requires attention as well as the type of attention it requires. The learners would then either plug the leak, that is solve the problems themselves, or solicit support or advice in respect of solving it. In the case of a malfunctioning cistern, he/she had to analyse how that cistern worked, by identifying its components and their functions. This could be done by comparing the broken cistern with a similar functioning cistern. The cistern project has been discussed in relation to how it enhances comprehension of concepts of mass, pressure, and mechanical energy. These principles can then be used in class when solving Physical Science problems. One understands the problem, researches it; attempts to find a solution by oneself (taking a calculated risk), then finally seeks support either to confirm or obtain a better explanation.

An example was the learner who proposed the chemical treatment of sludge to change it into fertilizers that could be of economic benefit to unemployed families. Currently, the municipality is merely discarding it. The coordinating team sought through the convener to engage the University in the possible realisation of such a project. The issue of water leakages is a serious community challenge as it involves both waste and scarcity of water resources, and issues of poverty. That it is an issue of social injustice is significant.

4.3.8 Extended learning opportunities

Extended learning opportunities were created for learners to engage with each other through activities, for instance in the time taken to complete their worksheets in their respective teams. Thandiwe, one of the Grade 10 learners who participated in the study teams, also visited the water treatment plant and Here gave an account of her experiences:

> What I really liked is learning how wasted water work like and how to save water, tell people or neighbours about how to save water; but what I disliked is people who throw unnecessary thing / non-biodegradable in water. Again what I liked from the study team is we worked together we exposed others how to answer questions and showed others things that they nearly forgot about.

The learning aspects depicted by Thandiwe worked at the cognitive and affective levels (Molee *et al.,* 2010:242-243), covered by the phrases ‘how wasted water work’ and ‘how to save water’. The learners addressed the details when they worked on their worksheets. For Thandiwe, working in the study team aroused her interest to learn, as can be deduced from the phrase ‘I liked from the study team’ and we ‘worked together’. The word ‘exposed’ in the phrase ‘we exposed others how to’ does not have negative connotations, but is understood to be referring to learning content as opposed to other learners. Thus, she was saying that they helped one another with regard to ‘how to answer questions’. Finally, Thandiwe suggested that through team work they were able to remind one another of the concepts and scientific principles they had forgotten.

Thandiwe was excited about telling people or ‘neighbours’ about using water sparingly. Evidently, the time that the learner takes to complete the worksheet, to visit the site, and to tell ‘neighbours’ is more than the time taken in ordinary and normal classroom teaching. It however affords the learner more time to engage with the content to be learned and also to be of help to others, not only to fellow learners. Thandiwe also performed social responsible tasks and connected the school with the community to address other people. The impact of this by all learners in a class of 70 would be considerable.

Another Grade 10 learner, Mohoto, corroborated Thandiwe’s views:

> I saw that when we work in the study teams we can pass our class. When we worked with others from different classes and grades to respond to the questions we do well and I have learned more about waste water treatment plant.

Mohoto clarifies the issue of other learners as having been from another grade, namely 11. They were the ones Thandiwe referred to when she said ‘showed others things that they nearly forgot about.’ The Grade 11 learners who also participated had something to say. For instance, Khotla indicated that:

> When we are mixed with other learners from other classes like Grade 10, we do better job rather than when we are the learners of the same class… what I dislike is that they don’t keep time… from now I know that there is something I can get from them even if they are in Grade 10 and I am in Grade 11.

Critical in this instance was Khotla’s excitement, that from then he knew that there was ‘something’ he could ‘get’ from others ‘even if they’ were ‘in Grade 10’ and he was ‘in Grade 11’. This taught Khotla, also a learning point for the study, that ‘learning knows no grade’ (my view). In other words, we can learn from those we tend to look down upon. This is reflective of the disadvantage that power differential issues can have if not identified and balanced accordingly. The phrase ‘even if’ in this context suggests that Khotla was labouring under the illusion that there was nothing to learn from a Grade 10 learner when one is in Grade 11. It is as though his understanding of being in Grade 11 meant he had more knowledge than those in the lower grade. Such a dismissive attitude reflects feelings of domination amongst learners and is unhelpful. This is clear from the views expressed by all the learners who participated in the study and who had some reflection on the exercises. The study, however, created a helpful practice through the use of the study teams. It also influenced social structures such as families and homes, which were visited by the learners who performed their service learning project to transform the learning of Physical Science.

Khethu confirmed the importance of using service learning to transform the learning of Physical Science:

> I really like that method of studying and discussing and it was very helpful because we share our opinions together because to discuss alone was too complicated to understand, but sharing some views on the questions was very good idea. What I hate about that discussions was the students from other school…they came to make the going up and down, making noises and making conflicts but that does not bother us a lot.

As with other learners who participated, Khethu did not complain about the relatively lengthy time that was spent on the use of service learning to transform the learning of Physical Science. This had been overshadowed by the excitement of learning while serving others. She did however have a problem with ‘students from the other school’ (Atleha S. School), who in her view ‘came to make noise’, and to cause ‘conflicts’. She continued to show that the ‘noise’ and ‘conflicts’ did not bother them unduly, which was understood and interpreted in light of the positive aspects of study teams that Khethu acknowledged and welcomed, namely, ‘I really like that method…’. As a result, the coordinating team focused on minimising and removing the barriers to the method of studying as teams, that is, ‘making noise’ and ‘causing conflicts’ without denying any learner, including those from another school (Atleha School), the right to learn. Thus, the principles of peace and freedom to learn were upheld. As a result, a study team comprising learners from ‘the other school’ (Atleha) joined and participated in this initiative.

The learners learned from each other through discussions amongst themselves and between them and their teacher or parents. The worksheets covered themes on electricity, mechanics and matter and material, and many concepts and related scientific principles. These could not be done in one day or one session. The learning was not limited to Physical Science content as experienced in class but extended to their respective communities and homes, and it addressed both their cognitive and affective aspects of development. For instance, a leak requires that the learner should negotiate and ask for permission to measure the rate of flow from the owner of the property. The message and feedback that must be given to the person whose tap was leaking include evidence of the learner’s findings, in respect of flow rate or speed, and amount as mass or volume. In this manner the learner is afforded an opportunity to talk about what he or she learned in class more usefully.

Evidently the learners were encouraged to be creative in their attempts to solve problems, as they devised means to analyse those they encountered, worked out strategies to address them and implemented their solutions. Thus, learning of Physical Science ushered the learners into real-situation meaningfully, for an extended time for purposes of learning. This also afforded them an opportunity to learn from others. Having understood the process of water purification and having identified the resources helped the learners understand how the costs of water were determined. The chemicals used to purify waste water that are pertinent to the curriculum, such as calcium carbonate, calcium oxide and chlorine, the energy transformations involved, as from electricity to motion of aerators and other machines, necessarily formed part of the feedback to the owner of the leakage. This enhances the learning of concepts of Physical Science and extends learning opportunities.

4.3.9 Thoughtfully organised experiences

The participants were from diverse work environments, such as teaching, environmental health, schools management and development, law (human rights) and municipal water services (technical). They also played leadership roles in the respective communities, in churches, local political structures and community-based development organisations. Their gender also added to the diversity. The learners were also from diverse socio-economic backgrounds, that is, some were relatively well-resourced, other under-resourced and some from indigent families with different traditions and customs. It was therefore necessary to recognise and accept everybody, despite imbalances in their backgrounds. Their participation and voices assumed and enjoyed equal and equitable consideration, ensuring that they worked together in a team and between teams. The learners had the freedom to establish their own teams and so associate with each other.

In order to promote peace and minimise the potentially negative impacts and effects of the embedded power relations issues embedded in their diversity (Van Dijk, 1995:20-24), and in order to synergise and harness the energy and potential resident in their diverse experiences and knowledge (Steinberg & Kincheloe, 2010:145), the study established a coordinating team (Kemmis, 2008:133; Swantz, 2008:34; Wicks & Reason, 2009:249-250), which performed functions of a mediator for transformation (Kellner, 2000:9) of learning of Physical Science using service learning. Through this process of mediation the vision, values and objectives of the study, and by extension the coordinating team, were fostered. The team developed and matured with the progression of study as team members engaged in the study from its initial stages.

The coordinating team members' engagements (Mertens, 2010:238) involved identifying the Physical Science learning problems and needs and identifying potential solutions to the learning of related problems. These engagements were also geared towards opening the communicative space through the creation of inter-subjective space for participatory action. The use of services learning involved preparation and planning by the study coordinator and enhanced team-building exercises and process.

Based on the coordinating team members' commitment and acceptance of the study, their agreements were recorded as part of the strategy development process, thus a mutually agreed upon Performance Charter that evolved from it was signed by the coordinating team members. The signing symbolised the participants' keen interest as mediators for transformation, notably the use of service learning to transform the learning of Physical Science for sustainability. It also served as guide for the implementation plan of the study. Clearly, the experiences of the coordinating team had to be thoughtfully organised and the data from the voices of the participants attest to the thought behind this. During the eighth coordinating team meeting, which also served as reflective session and last meeting of the 2011 school year, a member of the coordinating team, Ntsoteng, expressed her excitement:

> I so wish that learners see the positive side of what you are doing… I must admit that there are number of things that I can mention about the study. The concept behind the study, the manner in which meetings were conducted, the relation between team members, the trip to the waste treatment plant and the study groups for the learners …meetings were conducted in a professional manner… I strongly believe that this story will change our lives for the better.

The use of the pronoun 'I' in this excerpt was understood as indicative of an expression of her personal experiences and views about the study. She was evidently excited or impressed by the level of commitment of the team members, especially the learners (Maton *et al.,* 2006:18). It is also interesting to note that in her remark about what appears to be the future, she used the pronoun 'our', which suggests that she included herself as a potential beneficiary with the learners. Ntsoteng's statement 'I strongly believe that this story will change our lives for the better' was a message of hope for social justice and transformation, embedded in the phrase 'I strongly believe'. Transformation was evident in the phrase 'change for the better' and the pronoun 'our', which refers to her and others in the society at large. Social justice (Roschelle, Turpin & Elias, 2000:840) related to the different states of change implied in the phrase 'change our lives for the better.'

It was intriguing to learn from Makgabane, the coordinator of the parental engagements and community liaison, during the first 2012 learners-parents-teachers meeting, that when she was giving feedback and reflecting on her experiences since getting involved in the study she

> … learned so much from 'supervision' of learners' study teams. I also apply these 'principles' at my work place to monitor work performance and progress (translated from original Sesotho text).

Bohlokwa, the coordinator for curriculum, also self-reflected and expressed his excitement in how the study helped him to have a “critical outlook of issues in the department”. At a personal level and as a manager the study helped him, he said, to “identify and understand the magnitude of the problems in the department of mathematics and Physical Science”. This feedback he also gave during the reflective session. Interestingly, the most senior and experienced member of the team, (coordinator for community based service learning centre) Moeletsi, expressed his amusement by the courage shown by Ntsoteng in the team, who was not even in the teaching profession. Moeletsi confided to the team that he did not expect Ntsoteng to be in the team or the study so long. He expressed his appreciation on behalf of the coordinating team and encouraged her to continue.

Our lived up to its qualities of being caring, reverential (respecting each other), dynamic (strategically flexible), responsive (respecting time), diligent (hard working), and having the will to succeed (afraid of failure). Also, the coordinating team was aware of its worst attributes, such as impatience, not being a team member, moodiness, and being defensive. The knowledge about these traits helped the team members to understand each other, provide mutual support and be more focused. This was enhanced by their specific responsibilities which they oversaw and executed. These were unearthed during the team-building exercise after their voluntary consent to participate in the study was obtained.

The coordinating team subsequently employed strategies and approaches similar to those used for establishing a coordinating team. This was in order to take advantage of field work activities and real-life experiences that offered the learners the opportunity to organise their experiences through a cycle of preparations and planning; execution; reflections and self-reflection that gave effect to assessment (monitoring and evaluation) of performance. Thus, the participants were engaged in the preparations for the waste water site visits, which involved planning of activities to be undertaken prior to the visit. These included consultations and negotiations with the municipality to give permission for site visits, consultations with operators and waste water facility managers regarding their possible support and engagement; presentations to learners in respect of safety issues on site and health-related issues; organising pre-site visit presentations on the waste water treatment processes and attending to issues of pre-site visit inspections (see Annexure AS1). All these issues influenced the specific plan that detailed the activities that were to take place before, during and after the site visit.

The plan prepared learners for learning Physical Science prior, during and after the site visit. For instance, the information worksheet challenged learners to think of the reasons why the waste water treatment facility was located where it was, in a lower location or position relative to the households and users of water. The answer to the question was based on the direction of flow of water as a result of weight and gravity. It was also based on the chemical and physical properties of water, which learners were to know and use to respond to the question. This and other questions did not need to be answered after having visited the plant but required learners to think critically and analytically, even prior to the visit, and thus served as their congitnive preparation. The logistical issues that had to be arranged and prepared included; note book and pen, worksheet, dress code and transport.

The plan in the worksheets on mechanics, matter and materials related to the activities during the site visit. The questions raised were aimed at enhancing their application of Physical Science to the process of used water treatment as they observed and engaged with it in a real-life situation. They were fundamentally about the curricular content (cognitive) and social aspects (affective). The worksheets were issued before the site visit as part of the participants' preparation and plan, so the activities were clarified for all participants, affording learners an opportunity to prepare carefully and thoughtfully for the site visit.

The actual site visit during which learners completed their worksheets represented a critical stage for the **execution** of the use of service learning to transform learning of Physical Science. This afforded learners the opportunity to interact and engage with the operators who explained the processes and the systems involved in water purification. In the process, learners were able to respond to some of the questions asked in the worksheet. It is evident that the execution did not necessarily start during the site visit, as some questions required learners to think prior to the visit. Also, the execution stage did not end with the actual site visit because learners had to work on some of the activities even after it. They worked in their study teams where they also supported each other, thus extending the time and the opportunity to learn related Physical Science concepts and principles.

The **reflection** and self-reflection sessions that followed the site visit provided a further opportunity to learn. This session sought to reconcile the learning of Physical Science by the learners with their experiences of the waste water treatment processes. It is also critical to note that it happened during the preparation and planning stages, when the plans were critically discussed. This was in order to ensure that the plan addressed issues that they it was meant to address. It also helped adjust the plan where necessary, making it a flexible 'dynamic' document that evolved with the evolution of pertinent events and activities.

The learners who visited the site gave **feedback** in respect of their experiences (self-reflection) of the water treatment process. They were given assignments, a project and test to assess their comprehension of the scientific principles and concepts they had learned (see Annexure CT 6). The tests asked about the applications of scientific principles in other contexts that may have been conceived as remote and out of reach.

The above engagements reflected power differential realities. The planning of curriculum related material was mainly conducted by the teachers. The HoD played the role of oversight monitor and evaluator of the work, whilst the other team members played pivotal roles in the social aspects. They addressed the question of connections between learning of Physical Science and the real-life backgrounds of the learners. However, using CER principles and the recognition of the power of difference, the study coordinating team members remained united (de Beaugrande, 2006: 31-32, 42; Steinberg & Kincheloe, 2010:145), thus their diverse backgrounds and experiences were coordinated relatively well towards achieving their common goal and aim. The learners grasped Physical Science concepts and principles and also ultimately addressed their respective social problem (water loss) (Hickling-Hudson, 2006:2-4; Van Dijk, 2009:86).

Diverse experiences and backgrounds can thus be organised such that they work towards a common goal. They were synergised through a commonly shared vision of using service learning to transform the learning of Physical Science. The achievement of this vision was operationalised through its objectives, namely the need to transformation the learning of Physical Science through the use of service learning, the components, conditions and potential threats and risks thereof. The operationalisation of the objectives was in turn anchored in the principles of social justice; equity (gender and diverse backgrounds); peace (curbing of potentially disruptive conflict between learners); and freedom (of expression and association); with the goal of giving hope to learners that they can do well in Physical Science. It is also apparent that diversity is not necessarily an indication of 'animosity' but that it is actually necessary for the 'fortification' of unity of purpose. What is required are common goals, values and principles to organise diversity; thorough plans by the affected participants; joint execution of plans with continual and inbuilt reflective moments; and evaluation and re-planning or adjustments of plans for re-execution of the plan.

4.4 CONDITIONS CONDUCIVE FOR TRANSFORMATIONAL SERVICE LEARNING OF PHYSICAL SCIENCE

The data provided here outlines the conditions conducive to the implementation of service learning in order to transform the learning of Physical Science. These conditions also contribute towards the sustainable implementation of the use of service learning to transform the learning of Physical Science, emanating from inconsistencies embedded that also receive attention. This is against the background of literature service learning (Gboku & Modise, 2008:317; Kenworthy-U'Ren; 2007:812; Koosimile, 2004:484-485; Perold *et al.*, n.d.: 54; 58; Osman & Attwood, 2007:16-18; Thomson *et al*., 2010:218-223).

4.4.1 Supporting democratic policy imperatives

The prevalence of policies that support transformation and democratic processes creates suitable conditions for the implementation of use of service learning to transform the learning of Physical Science of Physical Science. The TSLS seeks to create emancipatory knowledge which reflects in the broader societal transformation (Biesta, 2010: 43, 45; Steinberg & Kincheloe, 2010:143). Thus, TSLS seeks to ensure that learners acquire and apply Physical Science knowledge and skills in ways relevant to their lives. It uses knowledge in the local context, as in the waste water treatment processes and encourages its application in global, unfamiliar contexts (DBE, 2011b:4-5). These issues may not be realised through teaching approaches that are classroom-bound and that encourage rote learning. Rather, they require the engagement and participation of other partners and participants. As a result, the study coordinating team enquired from other participants about the possible strategies to be used. A reflection session facilitated by Bohlokwa enquired:

> *Na mekgwa eo re e sebedisang le bona e ka e na le bokowa hokae? Mme re ka e ntlafatsa jwang? Maikutlo a lona (bana) re ya a amohela a ka ba matle kapa a ka ba mabe ha feela ho se na tlhapa.* (In your view in what manner are the methods that we use for teaching flawed / weak? And how can we improve them? Your positive and negative views are welcome as long as they are not vulgar language).

It is evident that Bohlokwa was aware of the possible prevalence of weaknesses in teachers' teaching methods. He asks about their weaknesses as observed by the learners and parents, as in the interrogative '*bokowa hokae?*' (in what manner / how are they weak?). The participants' views and contributions towards improving these strategies were also solicited, as above.

Bohlokwa's request that views be expressed in a respectful manner operationalised the principle of CER (Steinberg & Kincheloe, 2010:143,148). The contributions were also indicative of convergence of thoughts, notwithstanding the diverse experiences and knowledge of the participants which were considered of equal value. The establishment of learners' study teams as well as the study coordinating team offered opportunity for social arrangements (Sheyholislami; 2009:4) that supported transformational learning of Physical Science through the use of service learning. It also encouraged 'scholarship of engagement' amongst the participants (Mahlomaholo, 2010:9-11).

The availability of supporting legislative imperatives eased the application and acceptability of the use of service learning to transform the learning of Physical Science, based on the provisions of the legislative imperatives. For instance, there is synergy between the values espoused in the Manifesto on Values, Education and Democracy and CER which grounds this study (DoE, 2001:9-10). Thus, the supporting legislative frameworks laid conducive contextual grounds for the implementation of TSLS of Physical Science.

4.4.2 Democratisation of teaching and learning of Physical Science – optimal utilisation of resources

The willingness of teachers and other participants to operationalise the legislative imperatives favours the use of service learning to transform the learning of Physical Science. It makes the learning relatively easy to implement, where and when there is need and willingness to shift away from teacher-centred teaching practices. It is easy to implement when teachers open up and share their challenges, shortcomings and experiences, with a view to solicit support from each other. This was the case, as Seroba proposed and subsequently accepted the study meeting of parents, teachers and learners of physical science). This optimises the utilisation of human resources that are available. Seroba said:

> *Re sebetse kaofela. E se be ntho ya hore ke ruta ke le mong. Sena e kaba bothata* (Let us all work. It should not be that I teach alone. This can be a problem).

Seroba uses a pronoun 'we' (*re*) that denotes inclusion of more than one person. In this context it includes the attendees of the meeting. His view was that all participants should work, as amplified that in the next phrase in which he uses the pronoun '*ke*' which literally means 'I'. However, in this context it is used to refer to a teacher like a pronoun 'one'. This is the case because there were other teachers who were also teaching at the school with him and in the same meeting. Seroba proposed the use of participatory action-oriented or democratic strategies in the learning and learning facilitation of Physical Science processes.

The democratic strategies thus replaced the teacher-centred Physical Science learning and learning facilitation processes. As indicated Chapters 1 and 2, these were imbued with knowledge power differential realities, realities not of benefit to learning and learning facilitation of Physical Science. The teachers were 'masters' of Physical Science knowledge, with recipients being the learners. The evidence provided above, of teachers who do not plan and teach together, attests to this.

The democratisation of learning and learning facilitation of Physical Science further afforded the participants an opportunity to contribute and express their views freely

(RSA, 1996a:s16; Gboku & Modise, 2008:317). The coordinating team composition was sensitive to gender equity and diverse work experiences and backgrounds. Participation was based on democratic right to pull out of the study at any time they found it no longer in accordance with agreed upon purpose and principles (Kemmis, 2008:125-130; Mertens, 2010:238). Thus, the participants contributed their resources, time and ideas towards the conceptualisation and implementation of the 'use of service learning to transform the learning of Physical Science'.

4.4.3 Enhancing learners' motivational levels

The use of service learning to transform the learning of Physical Science thrives in learning environments that develop and have the capacity to motivate learners (Idowu, 2011:136-137; Mahlomaholo, 2011). The learners' critical roles in the learning environments are to learn, a principle that underpins the legislative imperatives that relate to pedagogical praxis (DBE, 2011b:4-5; Idowu, 2011:135-138). The data obtained pursuant to the enhancement of the low motivational levels through transformational service learning of Physical Science is illustrated using Moletsane's concerns.

Moletsane had been demotivated by lack of connections between curriculum content and his real-life situations. He referred to the topics or learning content that 'sometimes' did not address real life issues. He said one does "*not see their relation with real life; where it works in life*" (*o sa boneng di amana kae le bophelo; e sebetsa kae bophelong*). It was apparent that Moletsane was more interested in learning Physical Science concepts that made sense or that were meaningfully related to his real life situations. Conversely, his case could have been that some of the real-life situations were remote and unknown to him, and he could thus not visualise the useful connections through explanation only. Learners' who were like Moletsane would thus not participate in the learning process, not by their choice alone but as a result of the apparent shortcomings in the learning facilitation strategies. Identifying this is the teachers' role and is another mechanism through which undesirable future power differential realities develop. These tend to be embedded in the potential lack of sufficient scientific knowledge that in turn enhances participation in mainstream developmental activities. Lack thereof as a result of lack of interest and motivation to learn Physical Science legitimises continuation of future marginalisation of learners from such mainstream developmental activities (Salleh, 2004:8). This is because learners are prospective participants in the mainstream developmental activities.

Similarly, Thandiwe cautioned that for study teams to be effective they should comprise learners who are '*positive*' and '*serious*' about learning of Physical Science (see Annexure AS 1-7). The word 'positive' is understood here to refer to 'positive attitude towards learning of Physical Science'. In the same vein, by being '*serious*' Thandiwe is understood to be referring to learners who would be focused to their learning endeavour during team engagements. It appeared to her that team members should be '*open*' to the team and not conceal their learning related problems. Conversely, they were not to be self-centred. Thandiwe's concerns about her team members' negative attitudes were of conduct she described as '*bearing grudges, hatred and selfishness'* (see Annexure AS 1-7). She subsequently requested that the teacher guide them on how to handle such learning barriers.

Another learner, Khotla, added an issue of not keeping '*time*' as another challenge to study teams (see Annexures ST 1-7) that constituted an important component of the TSLS of Physical Science. Khotla felt this was 'de-motivating' on his part as he was on time for study team meetings. There was 'lack of enthusiasm' on the part of some learners, who were either consistently late or did not honour their sessions.

In response to the above challenges the use of service learning to transform the learning of Physical Science required quick parental and teacher support and intervention. This was relatively easy to accomplish as each team had parent and teacher support arrangements. They solicited further support when necessary, based on the seriousness of the learners' conduct. The interventions were to be considerate of learners' myriad potential challenges from their developmental stage to their family backgrounds.

It was important that the learners' apparent lack of enthusiasm and its potential causes were not taken for granted. These afforded TSLS an opportunity to rapidly address inherent learning-disorientating practices. The attempts made to accommodate or include all learners in the learning of Physical Science thus created space in or through TSLS. Where applicable, the learners' differences were used to inculcate social skills in respect of tolerance for each other and 'basic' problem-solving principles (DePalma, 2010:215-216; Kemmis, 2008:125-130; Steinberg & Kincheloe, 2010:148-149). The principles of persuasion during the establishment of the coordinating team could thus be extended to other structures, in such a way that learning of Physical Science would not be distracted.

This necessarily implies that learners are and should be considered as the primary role players in the learning process (DBE, 2011b:4-5), and the learning encounter should be considerate of the learners' situations (Hickling-Hudson, 2006:6-7; Osman & Attwood, 2007:17-18; Yosso, 2005:77-81). Transformational service learning of Physical Science motivates learners to learn Physical Science, an inherent characteristic of TSLS based on its multifaceted nature. This derived from engagement of participants from diverse backgrounds; working in teams; learning from a plethora of real-life situations using diverse learning strategies from brainstorming to computational and communication and negotiation skills; and addressing multiple objectives (for example, academic and service objectives.

4.4.4 Enhancing school-community coordination and optimal utilisation of resources

The need to enhance cooperation and coordination between schools and communities is an enabling condition for the development and implementation of 'the use of service learning to transform the learning of Physical Science'. The areas that create opportunities for such coordination should be of mutual benefit to learning and community service. The public institutions, including schools, have a significant role to play towards the transformation of society (Biesta, 2010: 43; 45; Mahlomaholo, 2012:46-47; Martin, 2008: 699; Merriam & Ntseane, 2010:187; Nkoane, 2011:113; Osman & Attwood, 2007:18; Sanginga *et al*., 2010:696, 702-707; Swantz, 2008:33). In this section the study demonstrates the extent to which the experiences, knowledge and skills in public institutions can be harnessed towards transformational learning. The study based the coordination between the school and public institutions or community on their common interest and problem or need. The problem was the need to take care of the environment (water) (RSA ,1996a, s 24; s 152 (1) (d)) (also see Annexure CT 6). The municipality, on the other hand, had a constitutional obligation to "ensure the provision of services to communities in a sustainable manner” (RSA, 1996a: s 152 (1) (b)). In the same vein, the schools were amongst the public institutions obliged to take care of the environment (DBE, 2011b:5).

Notwithstanding the above legal obligation the environmental issues were taken for granted, as can be deduced from the social injustice perpetuating practices such as disposal of solid waste in the sewerage system. This practice had been given scant attention by public schools and so indirectly encouraged it. The same service, that is water management services, offered myriad potential curriculum learning opportunities that were not used. This was an opportunity for the enhancement of coordination between the school and the community through municipal services and incorporated the services and expertise of the municipal officials (resources) to engage in learning facilitation. The Environmental Health practitioner, project management unit manager and plant operators were instrumental in this regard.

The study encouraged collaborative learning of Physical Science among learners from different local schools (see Annexure DM 1), to address issues of learners’ challenges. The work covered by teachers in the previous grade in order to help the ‘new grade’ teachers to plan better for their newly admitted learners; and teachers’ support on pedagogy and subject content in the light of recent curriculum changes also in relation to the original teacher training (see Annexure DM 1). The collaboration was thus to include both the secondary and primary schools, crucial because there were learners who were admitted at Grades 8, 9, 10 and 11 from the local neighbouring primary and secondary schools. The DBE was also in full support of this endeavour (2011b:5), and there were already schools clusters in other parts of the district that could offer structural support for the enhancement of the collaboration. This tended to evoke the need for the establishment of a society-wide collaboration effort that would also engage relevant schools (disciplines) from the institutions of higher learning (Salleh, 2004:5; Swantz, 2008:33).

The data provided pointed to the potential problems that were considered as possible reasons hy the collaboration failed initially. One teacher, Kutlo, shared his experiences:

> *Ke kgothaletsa hore re kopane feela et de seim thaem ke a tshaba… mae feye is ba bang o ba bontsha bothata ba bona. O ka tloha wa fumana hore e baka bothata bo keneletseng* (I encourage that we should meet but at the time I am

afraid that we meet…My fear is others' (teachers') problems will be exposed. That might lead to serious problems).

The phrase "*re kopane*" (we should meet), was responding to the need to work together with teachers from other schools as explained earlier. It thus meant 'collaboration'. Kutlo was however 'sceptical' about establishing this working together arrangement in that he encourages its establishment whilst at the same time he was 'afraid'. He fundamentally sought to bring the attention of the initiator to the two main issues. At first his scepticism was based on teachers' problems going to be exposed. These were pedagogical problems in the forms of Physical Science content knowledge and the teaching thereof, and that such exposure might lead to more serious problems between and amongst teachers. This is evident from his second concern, as he also learned from some affected teachers in another area:

> *… ba re the mein problem ke hore…wa bona syllabus e ya tjhentjhwa…ntho tsena tseo batho bana ba tlang ka tsona boholo matitjhere… ha ba di tsebe* (… they say the main problem is… most of the changes that are brought into the syllabus teachers do not know).

The main concern of the affected teachers was that curriculum changes introduced most of the factors that the teachers were not familiar with. There was misalignment between what teachers were trained in and the new content that they now had to teach (Jansen, 1998:321-331. The teachers' comprehension and mastery of the new content was taken for granted, that is, they understood the new curriculum content easily. This corroborated the concern raised by Tlhokomediso, that we needed to check with the teacher preparation programme and the extent to which it addressed new curriculum matters (see Annexure T1). This the study conceived as a request to consider including the institutions of higher learning in the teacher development and support discourses (Salleh, 2004:10).

The study considered Kutlo's fears or concerns as the main reason collaboration was necessary. This is clear from the convener's (Phehello's) statement:

> *… ha re hlolwe re lekile. Feela re e etsa ka maikutlo a matle…maybe the approach was wrong kapa the manner in which re neng re batla etsahale ka oona o ne o fosahetse* (… let us fail having tried. But we should do it with good

intensions…maybe the approach was wrong initially or the manner we wanted it to happen).

The phrase ‘let us fail having tried’ was an action-oriented encouragement to the participants to improve the learning of Physical Science, with encouragement that the envisaged action was to be informed by ‘good attitude’ (*maikutlo a matle*). This invoked respect, humility and accommodation of diversity by the teachers (Steinber, Mahlomaholo & Netshandama, 2011) and required a critical consideration of the approach to introduction (Swantz, 2008:34; Kemmis, 2008: 125-130). To this end, a multipronged approach was used to solicit interest amongst the participants, to consult and negotiate with their counterparts. For instance, secondary schools were written a letter in the name of the study asking to introduce the study to the teachers (Annexure L1). There were one-on-one consultations (Wicks & Reason, 2009:250) with the School Management and Governance officials responsible for these schools, requesting their involvement to facilitate holding of meetings. Finally, parents, learners and teachers held meetings.

Notwithstanding the challenges experienced at the initial stages, the goal of blurring the affected schools’ boundaries to enable learners to access learning of Physical Science were on course. The subsequent winter and spring classes were jointly planned by teachers and attended by learners from both schools. It was however still critical that other partners were involved. The study envisaged respectfully and humbly persuading them, while the collaborative efforts were continued with. The coordination between school and community is thus a critical component as it opened up the schools for support from retired and experienced teachers. These would help address the young teachers’ academic and didactic needs and opportunities, as indicated above. Applying Physical Science knowledge in real-life situation augmented the shortages of resources in the laboratory.

The discourses above depict manifestations of the effects of inherent abuse of power (lingering) in pedagogical praxis (Mahlomaholo). That Kutlo was afraid to meet other teachers to address common pedagogical challenges is reflective of this reality. ‘Fear’ is instilled by the one in a position of power in those in less powerful positions. It can also be as a result of the prevalence of attitudes that are imbued with discrepancies in attributes such as self-esteem; confidence; knowledge and experience (Akiri & Ugborugbo, 2009:107-108,112; Asikhia, 2010:232-235). The effect of Kutlo's 'fear' was perceived as an unintentional continuation of the exclusion of the interests of the learners from learning of Physical Science. This is by way of inadequacies in the content knowledge and/or teaching strategies. The teachers' expertise in content is imperative. As Salleh (2004:8) argues, "students could develop skills that correspond with those the experts though not at the level of the experts."

4.5 ANALYSIS OF THE THREATS AND RISKS FOR THE USE OF SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE

This section provides data in respect of addressing the threats and risks of using service learning to transform the learning of Physical Science. The data relates to and integrates these risks to the components and conditions for the successful implementation of strategy. It thus considers the risks as they were experienced during the implementation of some of the aspects of the study and relates them to those recorded in the literature, namely conceptual veracity, financial issues, pedagogical issues, power differential issues and evaluation issues (Arenas *et al*., (2006:33-36; Koosimile, 2004:488,490; Akiri & Ugborugbo 2009:108; Nkoane, 2009:22; Mahlomaholo & Netshandama, 2011; Parker *et al*., 2009:592).

4.5.1 Conceptual veracity

It is imperative for users of service learning to transform the learning of Physical Science to theoretical understanding of issues of transformation, emancipation, participatory action, service as well as learning (Hickling-Hudson, 2006:2; Nkoane, 2009:23; Tatto, 2006:237-238). This will help them to be open and accommodate the diverse experiences and expectations about learning of learners, parents and other participants, from their previous learning (Gboku & Modise, 2008:325). It is also critical that their vision (drive), values and principles lean towards the emancipation of the individuals with a view to effect and influence change in the learning of Physical Science and ultimately the community and society (Idowu, 2011:140-141; Koosimile, 2004:490; Rocha-Schmid, 2010:355; Salleh, 2004:10). This is to help guide the transformation of learning of Physical Science through service learning so that it does not degenerate into volunteering, community service, or civic service (Arenas *et al*., 2006:33; Terry & Bohnenberger, 2004:17-18) or even into co-optive service learning (Osman & Attwood, 2007:19).

The coordinating team adopted the aim of the study as its vision and the objectives were transformed into outputs and outcomes, with constructs captured in functional and operative terms to give effect to activities, each of which was assigned or delegated a responsible person to manage or oversee, then operationalised through respective tasks which were allocated timeframes (see Annexure CT 3). This was described as an operational or implementation plan, drawn from a framework of the study and UFS-approved proposal (Annexure AS1).

The coordinating team aligned the action plan (annexure AS1) with the operational plan (Annexure CT 3) through a connection between the activities and the Physical Science curricular themes. The activities of the operational plan were informed and based on the methods for data collection of the action plan. The choice of the context followed an engaged process of situational analysis (SWOT) that was mainly influenced by the prevalence of the social need and problem regarding water scarcity and quality. The call that attests to this was made by one of the participants, Ntsoteng**,** who appealed to the study team to do something to "change the negative mindset" of the residents regarding the practice of "illegal dumping" of solid waste from the households/homes, and to "rather reduce waste" (see Annexure T1), that was being disposed at the dumping site, through recycling processes and methods. This was during the coordinating team meeting that sought to identify the context for the use of service learning to transform the learning of Physical Science.

The action plan (Annexure AS1) and the operational plan (Annexure CT3) were aligned in the following way: consider a **theme** and priority on **chemical change**s (Annexure AS1) that deals with '*microscopic interpretation of macroscopic changes*' and '*separation of particles in decomposition and synthesis reactions*' (DBE, 2011b:35): the methods proposed in the action plan and subsequently accepted, modified, improved and operationalised through the operational plan were *worksheets, test, reflection, free attitude interview, and focus group*. The coordinating team developed activities for the operational plan in this respect, such as *develop* *worksheets; establish learners' study teams; arrange and facilitate reflection sessions, induct participants on the FAI techniques and use its principles to facilitate coordinating team meetings*. These activities were developed and informed by the context within which service learning was used to transform the learning of Physical Science. The coordinating team pursued an emancipatory and transformative approach that linked learning to society needs and problems (Biesta, 2010:43; 45-51; Hammond *et al.,* 2001:7-9; Merriam & Ntseane, 2008:194-196).

The coordinating team's identified context of water care and management services, as provided by the local municipality, was the basis for service learning multiple activities that were conducted 'simultaneously' and 'concurrently', namely, data collection, service provision and learning encounters (Hatcher & Erasmus**,** 2008:51-53; Kenworthy-U'Ren; 2007:812; Richards & Novak, 2010:46). In this way the learners', parents' and teachers' respective contextual realities, needs and problems were reconciled and synergised with the shared goal, vision and objectives. The reason this was considered as critical was the multiple objectives might potentially upset achievement of academic learning outcomes or service outcomes (Gboku & Modise, 2008:315-316; Merriam & Ntseane, 2008:195; Osman & Attwood, 2007:16). Again, it is critical to be aware that concepts such as participation, learning and service are imbued with political connotations (Gboku & Modise, 2008:317; Hammond, Austin, Orcutt & Rosso, 2001:2-15; Perold *et al.*, 2006:53-54, Osman & Attwood, 2007:18). As a result it was imperative to guard against being swayed from transformation of learning of Physical Science course through the use of service learning by any of these institutions. This made the engagement of all potential and relevant participants imperative and inevitable.

Service learning is often confused with community service. In our case there was policy provision, to the extent that for secondary schools it could be practiced. Notwithstanding that provision, "no single model is indicated in the curriculum framework for grade 10 to 12", that is for community service (Perold *et al.*, n.d.:62). This lack of framework invited the use of service learning to transform the learning of Physical Science, to contribute towards the development of such a framework and influence it towards transformation. This is because community service is often understood to be service that is not consciously connected to Physical Science academic curriculum. Where and when such conscious connections are made it turns out to be service learning in the institutions of higher learning. Even service learning may not necessarily be transformational but rather used to address short-term objectives and thus be unsustainable.

The comprehensive plan to use service learning to transform the learning of Physical Science for sustainability evolved from the action plan which served as a strategy that helped curb possibilities of reducing the study to volunteering and community service. The processes through which the comprehensive plan evolved, formed part of the iterative interpretive, analytic and educative discourses of the coordinating team (Steinberg & Kincheloe, 2010:148). The issues pertaining to site visits, preparation of worksheets and study teams were the outcomes of these discourses. Their development and implementation were based on common understanding of the goal and conceptual characterisation of the use of service learning to transform the learning of Physical Science. These discourses also involved clarification or a form of training of the study coordinating team members on CDA, FAI and CER (see Annexure CT 3).

The need for training on FAI was identified during the meeting by the study coordinating team members. The information on CER and CDA formed part of the discourses from the first planning meeting as part of discussions of the study proposal (see Annexure T1). The CER principles permeated our deliberations, pivotal in addressing the inherent conceptual challenges. The team members were as a result more aware that ‘the use of service learning to transform the learning of Physical Science’ was not volunteering, community service or civic service. As such the general view was not to allow it to degenerate into community service and volunteerism to the exclusion of academic learning. The latter appeared to the study team as having the potential elements of using services (or serving) for subjugation rather than transformation.

4.5.2 Financial issues

The literature searched records time, lunch and transport as the main cost drivers for service learning (Gilley, 2005; Thomson *et al.,* 2010:228-229). These factors prevailed in this study. The time taken by members of the team at the study away from their respective private business had a potential for retarding progress. We held not less than eight study coordinating team meetings, excluding the one-on-one engagements with and amongst participants, the parents meetings and parents-teachers-learners meetings. The estimated duration of the participants' engagements was over a thousand participant-hours in a period of 18 months (see Annexure sum 1). In this regard there was heavy reliance on building of the relationship of trust amongst team members, thus engagements were guided by values of humility, care and respect for each other and each other's viewpoints (Kemmis, 2008:125-126; Steiner & Kincheloe, 2008) and eased the process of monitoring progress.

Transport was required for taking learners to the treatment plan, about seven kilometres from the outskirts of town. The Study Coordinating Team arranged the trip in consultation with parents, learners and the teachers. The transport arrangement was made for about 70 learners and would have been wholly incurred by the study coordinator. However, the participants did not accept the proposition, arguing that they were equally benefitting from the study and thus felt obliged to address the need for transport. Some of the teachers used their cars and gave lifts to learners, whilst others contributed money. They had taken ownership of the problem and the study (Swantz, 2008:33-34; Van Dijk, 2008:353). This is further evidenced by their also supervising learners on site, in accord with the demands of the UFS Ethics Committee.

Collaboration with out-of-school partners could be helpful in addressing some of the financial needs. For instance, the Physical Science environmental management team bilaterally identified the development of the schools' integrated environmental plan as a viable option. This plan was to integrate aspects of the school's improvement plan (SIP) with the aspects of the municipal environmental health management plan. This would be useful to the learning of Physical Science and the provision of relevant municipal Environmental Health management services. The projects, such as learners' water leak detection and plugging, and campaigns in respect of sustainable use of water and electricity projects, were considered as possible aspects of the plan.

The contribution in kind by the local municipality through the involvement of the Environmental Health and Water Management services bears testimony to this. Their contribution was made during the preparation, through presentations to learners, the planning and actual implementation of the project. This collaboration was critical and contributed to an expedited ‘use of service learning to transform the learning of Physical Science’. Prior collaborative and participatory planning processes offered immense opportunity to possible solutions to the financial resources challenges. The study coordinator subsequently attended the local municipal integrated development planning (IDP) sessions for possible further enhancement of the collaboration, accommodation of and alignment with the transformational service learning of Physical Science (RSA, 1996a: s 153, Municipal Systems Act 32 of 2000, s23). The study exploited the ‘power of difference’ of the diverse multiple participants through collaboration (Steinberg & Kincheloe, 2010:145), helping to address part of the potential financial risk/threat to it.

Collaborative effort of diverse experiences and backgrounds is therefore imperative in addressing inherent financial realities that could impede the implementation of service learning to transform the learning of Physical Science. It also became imperative to engage and synergise the diversity to address pertinent financial problems or needs at hand, both in kind and directly. Also, the choice and use of powerful but cost-effective transformational service learning projects was understandably critical. This is why the Study Coordinating Team took some time to prioritise the projects based on criteria of time and financial resources.

4.5.3 The role of the teachers

The teachers’ pedagogical expertise, that is academic and didactic, that is not grounded in critical emancipatory research theory can impede the development and ‘use of service learning to transform the learning of Physical Science’ initiatives. Thus, good academic understanding (*e.g.*, in physics or chemistry) that is grounded in CER was indispensable. These had enabled this study to identify Physical Science learning opportunities from the learners’ daily needs, problems and backgrounds and enhanced the ensuing lesson designs and learning facilitation processes. These were based on learners’ backgrounds, such as the food preparation at home and the water management systems in their society.

The data showed that the Natural and Physical Science teachers worked in isolation, their approaches predominantly fragmented according to the different sections (Idowu, 2011:136-137). As a result, the former focussed more on life sciences or biology at the expense of Physical Science and vice versa. This practice had been blamed on the teachers' specialisation during their training at college of university, as clear from Rethuseng's statement:

> *… moo ke tla kenang haholo ke moo…ke titjhere ya biology le geography* (… where I will get in deeper is there... I am a biology and geography teacher)

This was Rethuseng's contribution to the discourse relating to the situational analysis, demonstrating her difficulties with the teaching of Physical Science. This would have a bearing on the development of service learning related material that involves the learning of physics, and determine her use of power in teaching biology more than, and at the expense of, physics and chemistry. This is evident in her unequivocal use of the pronoun '*ke*' (I) in the sentence "*I am a biology teacher*". The phrase '*ke moo*' (is there) referred to biology. The phrase '*ke tla kenang haholo*' (where I will go deeper) described biology as the section of the subject that she actually attended to thoroughly. This she amplifies by indicating that she is a biology teacher. In his concluding statement Rethuseng opened up for support as she made an invitation "*re kopane re bone hore part ele re e etsa jwang"* (let there be a meeting so that we see how that part can be attended). By this she was referring to the Physical Science section of the Natural Sciences subject (see Annexure DM 1).

Conversely, the argument on school subject preferences by the teachers was observed to have been experienced with regard to topics in the same subject. In that case, for example, the teacher would prefer to teach mechanics more than other themes, and in mechanics a further preference could be on mechanical energy rather than motion. Thus, the argument of teachers' preferences being as a result of teachers' specialised training could not be authenticated. This, however, was used to raise issues of academic integration between life sciences and Physical Science, the argument being that the scientific principles and concepts remained the same for both subjects and as such the two should as far as possible be taught in ways that complement each other.

The teaching of Physical and Natural Sciences in a fragmented manner encouraged disunity and competition amongst the teachers, legitimising uncritical and counter transformation approaches to learning Physical Science (DBE, 2011b:4-5; Sheyholislami, 2009:4-5). This in turn deepened power-related discrepancies amongst the teachers (Idowu, 2011:134-136), which is why the teachers could not work as a team, even when such opportunity was created. Conversely, the ignorance or lack of CER grounded knowledge in respect of academic integration between Life and Physical Science distorted the opportunity for collaboration amongst them. Teachers perceived team teaching as 'not working' (see Annexure T1).

4.5.4 Teacher support and development

The teacher support and development programmes that are detached from the teachers' and learners' contextual issues deter implementation of 'service learning to transform the learning of Physical Science' (Mahlomaholo, 2011). Often such support is inclined towards learners' achievement of results in Physical Science examinations and focuses more on completing the syllabus (Salleh, 2004:10). These were not connected to the learners' understanding of Physical Science, and lack of connection of the learning processes to achieving results, namely rote learning and teacher-centred approaches (Salleh,2004:8, 10). The prevalence of inadequacies in the teachers' competency levels is often related to these processes, and must be addressed so that the teachers can change the processes through which they are achieved. The said inadequacies were confirmed by Rethuseng:

> … *ha ke clear hantle ka fisiks, bat ke ya e etsa phate eo* (…I am not very clear about physics, but I do that part) (see Annexure DM 1)

Rethuseng was not confident and/or competent enough in/or about physics, and he did not stay back but taught 'part' of Physical Science. This was corroborated by the inadequate teacher preparations on the new subject content, as the syllabus had changed over a period of time (Jansen, 1998:321-331; Msila, 2007:146-160). The new themes that were introduced had not been part of the teachers' professional training, thus, lack of appropriate competencies could deter the implementation of transformational service learning strategy.

The work relationship amongst novice teachers and experienced teachers offers an opportunity for teacher support and development. This, however, is imbued with power differential realities that discourage teachers from seizing such an opportunity, as evident from Bohlokwa:

> *morao tjena re lebeletse bana ba tswang yunibesithi ba tsebe ho re feta. But ha ba fihla o fumana e le rona re bapalang roulu ya ho ba ruta. Ha ba fihla o fumana hore ka nnete ke bothata* (now of late we expect the newly trained teachers from the university to know better than us. However you find that the old teachers are the ones who teach them. When they arrive you find out that truly there are problems).

The pronoun '*re*' (we) refers to Bohlokwa and other experienced teachers, the phrase '*bana ba*' (those who) to the teachers who had recently graduated from the university. Used metaphorically (Stein & Mankowski, 2004:21; 23) 'those who' symbolises power that is subject knowledge power differential realities between the novice teachers and experienced teachers. Thus, Bohlokwa expected that teachers who had qualified recently would know more than the experienced ones (de Beaugrande, 2006:36-37). The knowledge that Bohlokwa referred to here was the Physical Science content as reflected in the syllabus. She perceived that her expectation had not met and observed more problems than anticipated, to the extent that the experienced teachers played a greater role in teaching the novice teachers.

Her observations had been influenced negatively by an underlying preconceived attitude towards the new teachers, subtly embedded in the text in the form of her reference to the teachers as 'those who' as 'teachers who'. The use of 'those' is general and as such is imbued with negative connotations of disrespect. It might be demeaning to someone, for what s/he does. It would thus be understood as metaphorical by Stein and Mankowski (2004:21-23), and amplified by the irony that 'the experienced teachers will have less subject related knowledge compared to the newly trained teachers'. This view was expressed against the background that the experienced teachers had an opportunity to be trained on new syllabus changes. It was additionally ironic because they also had social structures that represented and presented their views when curriculum changes were made (DBE, 2011b:5). Thus, it could not have been entirely the case that there were teachers who had more knowledge than others in this respect. Evidently, both the experienced and the novice teachers needed each other for mutual support and development.

The categorisation of teachers into '*bana ba tswang yunibesiting*' and the unqualified 'we' (*re*), was imbued with power relations differentials (de de Beaugrande, 2006:37-41). According to Bohlokwa's expectation, it was based on variances in Physical Science content knowledge acquired and/or in teaching experience. These power relations were balanced through collaborative learning efforts made through this study. As indicated above, the Grade 10 to 12 Physical Science teacher teamed up with the Natural Sciences teacher for Grade 8, as they prepared lessons together, discussed the feedback and worked on areas of potential enhancement of lessons.

The two teachers could however not be in the same class during presentation of the jointly planned lessons as initially intended. There had been a need to influence the drawing of the school timetable to accommodate teacher support and development initiatives, such as this one. A similar social arrangement between Ikaheng and Ahanang Physical Science teachers had progressed well, with the two ultimately exchanging views in respect of assessment of Grades 10 & 11 learners The engagement extended to joint planning for the following year.

The engagement of teacher training institutions in the transformation of learning of Physical Science through service learning was also considered as pivotal. It would help give feedback to respective partners in order for them to develop a sense of what is good and bad practices, of what is right and wrong practices and to learn from it (Hatcher & Erasmus, 2008: 50; Hickling-Hudson, 2006:9; Salleh, 2004:5). This would also enhance the university's achievement of its social transformation obligation or mandate to work closer with the community (Hatcher & Erasmus, 2008:50). This mandate is akin to CER's 'emancipation that goes with wider societal transformation' (Biesta, 2010: 43; Steinberg & Kincheloe, 2010:143,145, 148-149). In other words, the teacher support and development programmes of today should enhance the creation of emancipatory knowledge for teachers to be able to contribute to the transformation of the wider society. The teachers' role in social transformation is indispensable (Akiri & Ugborugbo, 2009:107; Imodu, 2011:136-138, Mahlomaholo, 2010:13, 16).

It also needs to capacitate teachers on issues such as the identification and management of power that is inherent in the pedagogical praxis. The teachers' capability of using appropriate emancipatory research tool such as CDA is thus critical (Liasidou, 2008:487). According to Koosimile (2004:490), it should for instance enable teachers to "move away from positions of being 'specialists and experts' in teaching science yet retaining the power to manage classrooms and live positively within them with their learners". Conversely, this should enhance teachers' understanding of power that it is "continually shifting … omnipresent, etched into the everyday actions of every person's life, exercised continually by everyone, not only the dominant elite, or the academy and academics" (Osman & Attwood, 2007:17). Equally important would be to help teachers use such power for the benefit of the downtrodden and the marginalised (Van Dijk, 2008:88-89).

There was potential at the school for support of the learning and learning facilitation of Physical Science, and Rethuseng subsequently worked with the teacher in Grades 10-12 to prepare lessons on electrolysis, displacement reactions and the periodic table for the Grade 8 learners. The latter's preparation also involved practical work, and because of the large numbers in class a worksheet was designed for them to complete when demonstrations were conducted. The demonstrations were done by learners under the guidance of the teacher. There had been an opportunity to obtain support from the neighbouring school teachers, and the winter classes had helped to blur the boundaries between the two schools.

The Study Coordinating Team also served as another possible structural arrangement that offered support through members of the community and municipality. To this end an arrangement was made through the strategic resources sharing project to host winter classes to be facilitated by retired teachers as well as young teachers. The sessions were subsequently merged with the initiative of the district through clustering of the schools. This arrangement was welcomed by the affected parents and teachers, however, there is a need to synergise the activities of these social arrangements.

It is thus imperative that teacher support and development should help teachers address issues pertaining to creation of emancipatory knowledge for social transformation (DBE, 2011b:4-5; Biesta, 2010:43; Steinberg & Kincheloe, 2010:143-

145). The guiding principles are embodied in the critical cross-field outcomes (DoE, 2003:; Mahlomaholo, 2012:48), and the changes that took place in the syllabus seemed had a significant impact on learning and learning facilitation (Jansen, 1998:321-331; Msila, 2007:146-160). Also, to transform the learning of Physical Science requires multiple experiences and varied knowledge (Biesta, 2010:43; Steinberg & Kincheloe, 2010:143-145), as well as the engagement of other people. Thus, the continual teacher support and development in physical science is imperative.

4.6 EVIDENCE THAT THE STRATEGIES TO USE SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE ARE EFFECTIVE

The literature records that service learning connects academic learning with community work (Kinsley, 2006:54-56; Osman & Attwood, 2007:25), and enhances the meeting of multiple goals, such as learners' cognitive or academic learning, intellectual development, spiritual and ethical development (Hatcher & Erasmus, 2008:55-57; Koosimile, 2004:483; Steinberg & Kincheloe, 2010:140-141). In this regard the study is considerate of the view that "all cognitive activity is connected to power relations" (Steinberg & Kincheloe, 2010:144). It does not limit teaching and learning situations to the school but advocates self-reliance in and amongst the participating community members, making it transformational (Biesta, 2010:55; Sallem, 2004:8). This chapter has confirmed these observations, demonstrating that service learning could be successfully implemented in schools and that it works through collaborative and participatory approaches to learning (Maton *et al*., 2006:11-12; Moxham *et al.*, 2010:1435-1436; Swantz, 2008:31-35).

4.6.1 Connecting academic learning with community work through a service learning project

The connection between academic learning and community service was made through a service learning project, with each learner participant establishing contacts with a member of the community identified as having been affected by the project. In the case of the water project, the affected people were those who had water leaks on their premises. The project on the ‘investigation of factors that affect the rate of chemical reaction’ on the other hand involved the learners’ daily chores, such as making fire and preparing food (cooking). These were relatively accessible to the learners, and given as part of their formal assessment (DBE, 2011a:3).

That the learners’ academic learning based on their performance in these service learning project contributed to the enhancement of their learning of Physical Science was evident in the pass rate percentages for the project, rising to 43% from 31% in the previous year. The differences between the two projects were fundamentally in the approaches used, with the latter more teacher-centric and the former from ‘the use of service learning to transform the learning of Physical Science’. A closer analysis of learner participants’ performances in their TSL project depict shows 84% and 77.6% compared to 32% and 34% of those who did not participate (see Annexure MS1). This improvement performance has been associated with the initiatives of the use of service learning to transform the learning of Physical Science.

The learners improved their attitude towards learning of Physical Science and their listening and communication skills had been improving since Bohlokwa earlier pronouncements. They ‘paid attention and focussed on their worksheets’ and by extension, on their learning of the subject, as noted in Lefuwe’s observations. Khotla, another learner who participated in the project, had a similar observation: “*… during the course most of the learners were listening… and showed the good attitude*.” (See Annexures ST1-7).

The learners of Physical Science subsequently stayed for extended times at school in their respective study teams (see Annexure for team monitoring tool) and enjoyed studying in this collaborative manner. Their work with study teams was filed separately from their respective individual files and where necessary their feedback was discussed with the teacher, whereupon more Physical Science study related issues were clarified. One study team was made available as evidence of the work done. There had been an enhancement on the learners’ learning styles, as clear in Lefuwe’s statement that they ‘brainstormed’ and ‘discussed’ ‘opinions’ and ‘ideas’ but ultimately responded by giving ‘facts’. The learners’ analysis of ‘ideas’ to ‘facts’ also enhanced their critical thinking and consideration of matters, as observed by Bohlokwa when she pointed out that learners ‘stared at books’ without pen or paper.

By that she meant the learners did not read to understand or to learn, a point confirmed by parents.

On the other hand, through the study, learners in their study teams brainstormed, discussed opinions and wrote down facts in their responses (see Annexure STF1: learners' study team file). This was reflected in their performance in the TSL project, as discussed above, thus they had been on course to demonstrating their achievement of the education policy imperative to being critical about rote learning (DoE, 2011b: 4).

The project's connection of academic learning curriculum with community service was the application of scientific concepts and themes on the water care and management services. The themes covered in this regard were in the context of the water services provision and included mechanics (force, weight, mechanical energy, motion); matter and materials (compounds, atoms, separation of matter); and electricity (current, electric circuits) (see Annexures CT2 and AS1). There had been a further improvement in the learners' performance at the end-of-year examinations. The scenarios depicted in the exams also reflected scientific principles that learners learned through the project.

The data further showed learners' development of their affective aspect of being (Molee *et al.,* 2010:240-241), as during the reflection session following the site visit. That they had disapproved of social practices associated with deterioration of the waste water treatment confirmed community practices referred to by Tshepang: "… *what happened upstream affected the activities downstream*". The upstream activities related to the community disposal of waste water and related contamination actions, while the downstream referred to the treatment thereof and associated challenges (see Annexure P). The learners could identify and categorise disposed items (upstream activities) under biodegradable and non-biodegradable items, with the latter being the ones that they disapproved of in disposal in the sewerage system (see Annexure 1-7).

Some of the items were associated with unethical and moral behaviour and conduct (Kincheloe & Kincheloe, 2008; Salleh, 2004:5), therefore the learners' used them to engage each other on their ethical conduct. These practices served to invoke further action in learners to make positive moral decisions (Steinberg & Kincheloe, 2008:142). They subsequently wanted to influence social change through good waste disposal practices, confirming the observation made by Salleh (2004:5) that "presently the scope of science hence physics extends into the socio-ethical-moral dimensions". Kgotso, for instance, proposed that they conduct a door-to-door campaign in respect of raising awareness.

The learners' water leak detection and plugging project afforded learners an opportunity to execute their respective civic or social responsibility. Thandiwe, for instance, experienced a friendly and less friendly reception from the members of the community during her campaign. She found out that her parents could save five litres in 24 hours, whilst Pulane also took the trouble of communicating with the plumber from the municipality to repair a leak that would have cost the affected family some R3000.00 per month due to negligence (see Annexure LP 1 & LP 2).

4.6.2 Service learning as transformational learning

The preceding section showed that learners debated ideas to the extent that they identified solutions to problems. Also, during their site visit they were challenged by the extent of pollution caused by certain practices. They worked out possible solutions to these social problems through debate and critical thinking and were conscious that they had to do something to address their own needs or problems relating to water management.

Their subsequent incorporation of possible solutions during their campaign and project resulted in them engaging sections of their community in addressing the challenges. Their transformational service learning project did not confine the learning of Physical Science to the classroom or the laboratory, but importantly it afforded them an opportunity to pursue their suggested solutions or what they aspired to achieve following the inspiration they received from their site visit. They had to navigate the challenges with which they were confronted when they engaged community members. The learners' pursuance of their project had been their resistance (Yosso, 2005:80-81) to practices that promoted social injustice. They had to navigate the inherent cultural and power differential realities through adapting the principles of humility, respect and trust they had learned and practiced during their study teams (see Annexures LP1 & LP2). This was evident in the manner in which Thandiwe dealt with difficult older persons regarding their waste of water. She engaged another older person who the former respected as a result of her age and level of formal education. After engaging the latter parent she requested him to talk to the former parent whose leaking tap or pipe wasted water. This happened against a background of frequent water shortages in the area. Thandiwe was also affected by the shortage and thus seemed to have been challenged to persuade the person to that extent. She navigated the matter through the power of the other parent to address what appeared to be their common problem. One can also argue that Thandiwe displayed an attitude of persistence or resilience towards addressing of social challenges. She had to approach the second parent with respect and trust that he would assist himself too.

4.6.3 Sustaining the use of service learning to transform the learning of Physical Science through participatory collaborative efforts in committed public services

The learners' study teams have been considered as key to collaborative learning. They confirmed their support for this method of learning facilitation to the extent of their request for their continued use in the following academic years. Thus, new teams were formed to introduce new learners to the strategy. The conditions were not conducive to the 'new' learners, because such conditions did not bar teams that already existed from continuing with their team study work. Furthermore, the number of learners who availed themselves for extra class initiatives in Physical Science with the older teams increased significantly. Most of the interactions that these learners had with their teacher were initiated by the learners.

The study pursued the extension of the principle of sustenance of transformation through collaboration and participatory action. It influenced, facilitated and joined or supported participatory and collaborative learning initiatives that affected the area of this study. This curbed the problems associated with contestations for time and other resources between and amongst the learning programmes and for learners. These created conducive conditions for the school-community coordination and the enhancement of formation of strategic partnerships at community and broader community levels. The Study Coordinating Team was a suitable representation of the transformational learning of Physical Science and therefore of the school.

It was important to structure collaborations in ways that enhanced facilitation of positive use of inherent power and cultural issues. This structure had been based on and directed by the principles of freedom of expression of views and ideas, equity, hope and social justice (see Annexures RP1-7). The transformational service learning projects were consistent with the same principles, addressing the potential challenge associated with misalignment and time limitations.

The collaborative efforts and the transformational service learning project have been organised and structured according to a number of elements, including the context; purpose; firmly located participants with clear roles; Performance Charter; clear outcomes; tangible products; reflection of experiences and assessment. The data provided in respect of these issues shed more light on how to sustain the 'use of service learning to transform the learning of Physical Science.'

The statement of the problem of the learners' project depicted the context (see Annexure CT 6). The statement portrays water care and water demand management with its inherent social and technical challenges as the context. This had been a problem because water was a scarce and costly resource that had been misused or not taken good care of. Without water there is no life and yet for it to sustain lives it has to be treated, and this at a cost to the community. Such cost had also to be borne by those from the least affluent families in the area. As a result the learners could potentially help address some associated challenges whilst learning from them.

The purpose was thus multiple, with aspects that addressed service provision and others geared towards academic learning. Each aspect had a specific focus on pertinent issues. For instance, the academic learning aspects also sought to address learners' apparent misconceptions that related to their comprehension of mass and weight; force, energy and pressure, concepts relevant to the Physical Science curriculum (DBE, 2011b: 58, 62). The service aspect, on the other hand, sought to address learners' mystification at the reality that issues of taking care of their physical environmental was solely a responsibility of the municipality. This issue was apparent from the views expressed by Ntsoteng:

> *Batho ba ipolella hore wi a khriating jops, ho na le masepala dei wil kham phik ap weist ba e ise ko weist saeteng. Athe bohlokwa ke hore ha re hlokomeleng environmente ya rona. Dat is de mein tjhalej dat wi a siting with, to chenj de maendset of de pipol from negatif to phosetif* (People have told themselves that they were creating jobs, the municipality would come to pick up the waste for disposal at the solid waste site. Yet the most important thing is that we should take care of our environment. That is the main challenge that we have – to change the mind-set of the people from negative to positive) (see Annexure T1).

The 'we' in the quotation referred to the people or community members in general. Their knowledge or information regarding whose responsibility it was to look after their physical environment and the apparent reasons they committed acts of illegal dumping had been grossly distorted. The study had taken up this matter for possible restoration of the positive attitude, as with the observation and appeal made by Ntsoteng. Further engagements would intensify the campaign in collaboration with the main partner, the municipality.

This strengthened and ensured that the participants were firmly located in the use of service learning projects and assignments to transform the learning of Physical Science. These participants were Grade 10 Physical Science learners of 2011. On the other hand, the transformational service learning project that was implemented was developed through the study for purposes of learners' continuous assessment. Therefore, it did not inconvenience but enhanced learning, and the firm location of participants in the learning of Physical Science was consolidated by the potential benefits at both academic and social level.

The inherent participants' diversified backgrounds, experiences and knowledge were accommodated through sharing of responsibilities. Thus the coordinating team facilitated a process through which participants' roles were identified and democratically delegated or shared amongst team members. Through this process, issues of balancing of power to avoid 'abuse' thereof; pursuit of social justice practices (water care) through service learning; ensuring prevalence of equity amongst the participants' diverse and variant realities; freedom of choice of roles to be performed by an individual participant based on his or her strengths, weaknesses, opportunities available; and threats and inherent risks to which a person was exposed, were pivotal. The adaptation of these principles to the learners' study teams through a democratic process was inevitable. The learners had an opportunity to establish their own teams and suggest how such teams should operate. The views expressed were incorporated into the study teams monitoring tool and guidelines (see Annexures CT8 and 9). The guidelines subsequently provided a basis for learners to cooperate and collaborate in teams, which aroused the learners' interest in the learning of Physical Science.

In order to ensure that the work in teams was peaceful and also to give hope that it could be done, parents were engaged in supporting learners (Yosso, 2005:79) in their negotiations and interactions with the community. The learners made their own arrangements (agreements) with property owners where applicable, to measure the water flow rate and to inform the owner about their findings. In cases where leaks were on their own school premises, permission to conduct their study was to be sought from the principal or HoD of Physical Science and Natural Sciences. The Study Coordinating Team, on the other hand, agreed on a Performance Charter in respect of which members' work schedules were aligned. The charter was also aligned to the Study Comprehensive Plan that was used as a guide. The charter itself was one of the most significant tangible products of the study.

Other tangible products were the service learning projects and assignments, the inputs to which pointed in the direction of enhancements of service learning to transform the learning of Physical Science for sustainability. The learners' study team guidelines and team monitoring tool were other tangible products, used to enhance collaborative learning that encompasses individual learner's active problem-based learning (see Annexures CT 8 & 9). At the Study Coordinating Team level, tangible products were the comprehensive plan that turned out to provide a framework according to which the study was conducted. The Performance Charter further enhanced the participatory action of the study. Copies of these documents are attached as Annexures.

The non-tangible products may be detected from the reflective sessions and assessments of learner performance on the assignments and tests based on the service learning related aspects.

The coordinating team held reflective sessions in which learners, parents and teachers reflected on the processes and progress of the study and their experiences about it. These were an integral part of the interpretive-analytic-educative processes through which the study was conducted. All 12learners whose written views about the projects were received expressed their appreciation and liked the learners' study teams as well as visiting the water purification plant for learning purposes. They also expressed their appreciation of the team's commitment. As Mohoto said:

> I saw that when we work in the study teams we can pass our class when we worked with others from different classes and grades to respond to the questions we do well and I have learned more about waste water treatment plant.

Similar sentiments were expressed by Thandiwe:

> What I really disliked, is someone who doesn't want to expose his/her mistakes, and making themselves like they knew better than others in the group like working alone and having grudge or personal things.

Lefuwe said:

> I have learned that a real team does not consist only of best friends, but strangers can make a team and at the time becomes friends. Also interacting and working with learners from different grades and classes had made me be able to succeed in different learning areas… but elder's supervision is still required to encourage all members in the team to be more focused. We will also appreciate if teachers are available so that we can go to them where we had problems.

The data provided in this discourse confirms what Kgotso and Bamo suggested during the study and before the use of study teams. They expressed their preferences towards working in groups and discussing among each other, saying that working together motivated them, which is what the three learners were suggesting. Thandiwe, on the other hand, was disturbed by learners who were not prepared to collaborate and who did not realise the value derived from team work. Lefuwe believed that no person could work in isolation. The three learners worked in different teams and did not stay in the same area.

The comments made by the learners in respect of their experiences necessitated the evaluation, assessment and monitoring of their performance. The processes of reflection and the items above were used to measure the extent to which transformational service learning was being implemented. The reflective moments during the course of study offered and served the study to monitor its progress on a continuing basis. The items referred to are academic (cognitive) learning from service; affective development & learning through service; service learning as transformational learning; sustainability through collaboration and participation in a committed sustained public service (context, purpose, firm location of participants, clear roles for participants, Performance Charter, clear outcomes, tangible products, and critical reflection (self-reflection, academic assessment. As indicated above, they were intrinsically incorporated during the interpretive, analytic and educative phases (Mahlomaholo & Netshandama, 2011; Steinberg & Kincheloe, 2010:148), thus they were also iterative and were as such disentangled through the use of CDA principles (de Beaugrande, 2010:31-53; Sheyholislami, 2009:3-4; Van Dijk, 2008:85-99).

Whether the 'use of service learning to transform the learning of Physical Science sustainably' enhanced the learners' understanding of concepts and principles could be determined along similar lines. The use of service learning projects that were used to transform the learning of Physical Science had items from purpose to application of principles and concepts at both the service and cognitive levels. Thus, the performance of learners in such a project or assignment tended to be inclusive and accommodative of diverse aspects that pertained to the 'use of service learning to transform the learning of Physical Science' (Kiely, 2005: 5, 7; Merriam & Ntseane, 2008:185). These multiple objectives are advocated in the official Physical Science curriculum statement (DoE, 2003; DBE, 2011b:4-5). A person with keen interest on academic aspects will for instance concentrate on academic assessment of learners. This is an aspect covered under critical reflections of the service learning projects that are used to transform the learning of Physical Science, and so conceived as a transformational knowledge creating process (Passarelli & Kolb, 2004:2-3).

In order to further track progress in respect of the learners' cognitive development and academic performance the study adopted and pursued the view of accountability tests. The water purification contexts were used as scenarios in the informal and formal assessment tests and examinations (DBE, 2011a, 2011b:). The data obtained in respect of the academic assessment pointed to the potential success of the ‘use of service learning to transform the learning of Physical Science’ in enhancing learners’ understanding of scientific concepts. The learners’ performance in their subsequent accountability tests and teamwork showed marked improvement. The accountability test is based on the work that the learners did in the service learning project. It also includes assessment of learners on the same scientific principles that are based on other scenarios or context other than water care management. Scenarios with which learners were familiar were easy to comprehend and could be used successfully to elucidate those that were remote and to which they would not be exposed to with relative ease.

The coordinator for the curriculum talked to learners who in his view and according to his observations had showed marked sudden performance improvement in Physical Science following the inception of the study. These were the learners who he said were among the earnest participants in the study teams. Their performances were subsequently checked on (monitored through) the official mark schedule and were confirmed as such. The performances showed marked improvement when compared with their previous performances and those of the previous year’s project. Following the implementation of the ‘use of service learning to transform the learning of Physical Science’, those learners who were committed to it obtained performance percentages that ranged up to higher levels of 5 to 7 (*e.g.*, 84.5% from 65% and 77.6% from 50%) to good performances at levels 3 and 4 (40% to 50%). The use of service learning to transform the learning of Physical Science also contributed to the improved performance. This was against a pass rate in Physical Science in the 2009 school year of 0% for Grade 12.

The service learning project formed part of the formal continuous assessment and thus contributed towards the learners’ final Physical Science mark in accordance with subject policy provisions. The items discussed under paragraph 4.2.5 are fundamentally the criteria for evaluation of the ‘use of service learning to transform the learning of Physical Science’. These have also been incorporated as aspects of strategy in Chapter 5. Based on the discourses immediately above, it can be argued that the outcome(s) which were derived from the aim and objectives of the study as per the comprehensive plan were achieved. At the coordinating team’s level, the outcomes set o have been the five study objectives as well as the team establishment. These focused the study on its aim and on responding to the statement of the problem. The outcomes of the performance charter have been simplified into their respective activities and tasks or sub-activities, which were then assigned resources and time frame to develop the charter into a plan. There were, however, limitations and challenges that were experienced, and these are covered in Chapter 6.

4.7 CONCLUSION

This chapter has focused on analysis and interpretation of data collected in respect of the formulation of strategies to use service learning to transform the learning of Physical Science such that it is sustainable. In the introduction the chapter outlined how data analysis was conducted using the socio-cognitive model of Van Dijk's critical discourse analysis. The data obtained in respect of the constructs of each objective was first analysed textually. The meanings embedded in the texts were then considered in relation to inherent power, cultural and historical imperatives. These discursive practices that have been unearthed were subsequently analysed against their respective social structural implications. This translated the original thought into these social arrangements, thus giving meaning to why people behaved and adopted certain values and philosophy towards learning Physical Science.

The chapter further explored and analysed the teaching and learning strategies that were mostly used in the Physical Science learning environments, namely the teacher-centred and evidence-based decontextualised examinations oriented learning facilitation practices (Salleh, 2004: 8, 10; Servage, 65). It subsequently considered data in respect of the components of transformational service learning; conducive conditions for the succesful implementation of the strategies; the risks and threats that could deter the strategy from achiveng intended goal(s) and evidence of applicability of transformational service learning. The next chapter discusses the transformational service learning strategy for the Physical Science.

CHAPTER 5

STRATEGY FOR THE USE OF SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE SUCH THAT IT IS SUSTAINABLE

5.1 INTRODUCTION

This chapter presents the strategy for the use of service learning to transform the learning of Physical Science such that it is sustainable. It captures the turn of events from conceptualisation through its development to the implementation and assessment in a secondary school. It uses the principles of CER as a mechanism to develop the strategy, which is then implemented through a process that incorporates periodic critical reflective moments to monitor its progress and assess the processes involved. This also covers the need for the use of the strategy, the components, the conditions under which it was implemented, the risks and threats that might prevail and considerations of learning experiences from areas in which it was successful.

This chapter presents key aspects of the strategy as setting up a coordinating team to coordinate and facilitate collaborative and critical activities to develop and implement it. The first critical activity for the coordinating team was to conduct a situational and contextual analysis, which should enabled the members to have a comprehensive view and common understanding of the political, economic, social and technological realities affecting them. The analysis culminated in them agreeing on a shared vision, mission, values, principles towards addressing their social problem and needs. Next, they invited partners to help address the identified problems and needs, followed by or simultaneous with the activity of aligning the participants' programmes with the vision of the study through its comprehensive plan. The partnership, together with the coordinating team, agreed on processes of monitoring and evaluation through reflective moments, then created opportunities for collaborative learning.

5.2 PREPARATION

The preparation phase (Kenworthy-U'Ren, 2007:817; Koosimile, 2004:492) represented activities that set up the successful commencement of the process to 'use service learning to transform the learning of Physical Science' (the study). This was fundamentally the responsibility of the study coordinator, who was also the initiator and leader of the study. The initiator should have sufficient knowledge about the use of service learning, as explained in respect of its scope, processes and procedures (Meredith & Mantel, 2006:237-239). In this specific case the preparation process involved the following steps.

5.2.1 Conceptual stage

The conceptual stage prepared the study coordinator with a complete picture and understanding of the whole study. It should fundamentally be an open and subjective process, and participatory in that should be subjected to 'intense' and 'robust' review and adjustment sessions with the project 'sponsors and owners'. In this study, the promoter/supervisor, supervisory teams, and colleagues from both the sustainable empowering learning environments (Mahlomaholo, 2010:11-12) and sustainable rural learning ecologies served this purpose. In its final stages, just prior to its approval, the concept was presented to the SULE/SURELEC team for further enhancements (see Annexure AS1). This process was conceptualised as signifying the enhancement of understanding of the project, its scope (Kenworthy U'Ren, 2007:819), aim and objectives. Thus it is imperative to have the approved and agreed upon issues documented, to serve as a tool to track the extent to which the original idea was achieved and deviated from. It could also be incorporated into the plans of the study or project to be developed later.

5.2.2. Identification and recruitment of participants

In the second instance, the prospective participants had to be identified and recruited for the study. These processes involved face-to-face interactions, in this case one-on-one, after the study coordinator contacted respective and prospective participants personally. These were perceived to be more effective and successful than written and indirect communication. The responsible person for the identification and recruitment of participants should also plan for this process, which means that there should be activities, duration, method for data collection and resources allocation in order to realise this task. A persuasive but humble and respectful attitude, like that of the researchers in the ‘Take Heart’ project was imperative (Dominiquez, 2008:4; Steinberg & Kincheloe, 2010: 142-143; Swantz, 2008:33-34).

The process and plan should also incorporate ethical issues to enhance the participants’ informed consents (DePalma, 2010:217-221) and the participants should be informed about their responsibilities and obligations as well as processes and procedures for handling grievances. Their consent to participate in the study had to be in writing as it constituted an important agreement or contract and strengthened the relationship between the parties and the study. In this way the study acknowledged and recognised the participants’ contributions.

Thirdly, keeping and recording the participants’ profiles, roles and tasks was critical as it enriched the relationship between them and the study. This became an additional source for data collection and facilitated the processes and activities such as the allocation of responsibilities. This, for instance, led to the study having its coordinating team members agreeing to serve as coordinators of the main aspects of the study. For instance, there was a coordinator for the municipal services and for curriculum related to service learning. The coordinating team, once established, made such an agreement based on the areas of responsibilities in the respective work situations and social arrangements. This also eased the attempt to coordinate the different social structures such that they worked and supported the project (de Beaugrande, 2006:43; Sheyholislami, 2009:4; Steinberg & Kincheloe, 2010:144).

The participant profiling was not once off, but evolved with the growth and development of the team. It was not compiled or completed during their identification and recruitment to the study, but was the result of the uncertainty about the information that the participants deemed significant and would be used as relevant or enriching. It was also influenced by the level of mutual trust amongst the participants at the different stages of the study, developing and strengthening with the duration of their stay and frequent engagements. That further facilitated their one-on-one engagements outside the normal and agreed upon scheduled engagement sessions.

At this stage all members interacted with the study coordinator (myself), but did not necessarily know each other. In order to avoid surprises they were all introduced to one another prior to meeting personally. The team members' personal relationships were considered as critical to the study, as they were perceived to be having the potential to contribute to or impede the study. An opportunity was created for the group to know each other better and to establish a team with a shared vision, mission, values, aim and objectives. This would be informed by the study coordinators' general observations and interactions with the prospective participants. There would for instance be some who would not be available even if they would have liked to be, and others who would be difficult and disruptive to the ideas and main purpose of the study. The study coordinator thus had the discretionary power to exercise at that point (Gboku & Modise, 2010:325; Liasidou, 2008:491; Van Dijk, 1995:20).

5.2.3 Establishment of coordinating team

It was imperative that the persons who were identified and who agreed to participate should work as a team, which meant that as team members they should work as a unit to achieve a common goal. Their efforts should be synergised in such a way that inherent weaknesses and threats are addressed through the deployment of prevailing strengths and opportunities of other team members as far as practicable. For this to be achieved, the participants should be afforded an opportunity to introduce themselves to one another in a way that will also highlight their interests and aspirations regarding the study. In this study we used the principles of opening communicative space as a communicative action, as espoused by Habermas (Kemmis, 2008:127-128; Wicks & Reason, 2009: 245).

It was thus imperative for the initiator and mediator (Kellner 2000:3; 7-8; Rocha-Schmid, 2010:345) to facilitate processes of opening of communicative space. The teambuilding (Donald *et al.*, 2010:16-19) effort was necessary to initiate the process of team establishment, a process that commenced with personal introductions of members to each other. Team members gave the team relevant and useful information about themselves and their traits, including strong and weak points, whilst sharing their work experiences and saying how they would contribute to the use of service learning to transform the learning of Physical Science.

After the introduction of team members to each other, the team engaged in a teambuilding exercise which facilitated discussions amongst the participants. Although the exercise was of short duration the result prevailed through the study. The coordinating team developed and matured with the study as it progressed, thus the opening up of the communicative space was regarded as a process that should be part of the study. It helped the study to unearth the team traits from those of the coordinating team members, notably flexibility, responsiveness, dynamic, caring and diligence.

The teambuilding efforts also helped reconcile the team traits with the principles of hope, peace, freedom, social justice, and equity (Mahlomaholo & Netshandama, 2012:43), as well as with the values of respect, humility and trust (Rocha-Schmid, 2010:355; Steinberg & Kincheloe, 2010:142-143). This meant that the exercise helped to encourage and build relationships of trust, respect and care for each other and for the Physical Science learning environments that we sought to sustain (see Annexure CM 2).

Similarly, the coordinating team extended the communicative action and the creation of the inter-subjective space to the entire study. This happened during the engagements of learners, parents and teachers during processes that involved the development of the learners' study team guidelines and monitoring tool (see Annexures CT 8 and CT 9), as well as in the reflective sessions that led to the identification of potential service learning projects (SLPs). The learners' study teams extended the communicative action and afforded learners an opportunity to take charge of their learning so that it could be problem-based; learner-centered (Rocha-Schmid, 2010: 355); self-directed (Parker *et al*., 2009:592) and self-regulated (Niemi, 2002:764). In these processes learners were afforded an opportunity to learn to respect and trust one another, giving them hope and courage that they could do well.

It was evident that communication was critical in the preparation phase, and through it the participants opened up (transparency) to one another on issues pertaining to their strengths and weaknesses (competencies, skills, knowledge and experiences) (Kenworthy U'Ren, 2007:819; Merriam & Ntseane, 2008:195). In that way they are able to offer and volunteer their support to the extent that they were able to continue to work together in the study. This enhanced their efforts to develop and agree on common goal (vision), values and objectives. The significance of a clear understanding of the use of service learning to transform the learning of Physical Science layed in the study coordinator and the teacher (mediator) being able to prepare thoroughly and anticipate potential challenges ahead of his/her preparations. It was critical for the mediator to approach the project with an open mind that is accommodative of diverse views with humility, respect and trust for fellow participants. These values have the capacity to ease the recruitment of willing and committed participants. The process of preparation should involve the organisation of resources and materials in anticipation of the needs of the participants. These resources and materials would also be required during the subsequent planning and review sessions.

5.3 PLANNING

Following its establishment, the coordinating team held a planning session, the purpose of which was to ensure that the coordinating team members had a mutual understanding of the concept underpinning the study (Kenworthy U'Ren, 2007:819). It was thus an interpretive and analytic process (Mahlomaholo & Netshandama, 2012: 35-48, Steinberg & Kincheloe, 2008:148-149) that sought to organise and synergise the participants' views and perspectives (Hickling-Hudson, 2006:2), and to interpret them through development of pertinent actions and activities. Therefore, during that process, the coordinating team members conducted contextual and situational analysis and interpretation of pertinent contexts issues and trends (Rocha-Schmid, 2010:345).

The outcome of the session should be the agreed upon goal, vision, values and an action plan, fundamentally an interpretation of the approved scope of the study, which in this case was the approved study proposal (Meredith & Mantel, 2006:237-239). The vision, values and action plan are fundamentally the study's operations strategy (Pycraft, Hemmanth Singh, Phihlela, Slack, Chambers, Harland, Harrison &

Johnston, 2003:73, 75). For instance, these were carried out over three coordinating team meetings, the first of which was the inaugural meeting. This operations strategy informed and was tightly connected to the risk assessment plan for the study and the coordinating team's Performance Charter. These three documents were in turn intricately linked to and used as a reporting, monitoring and evaluation tool. Ultimately, none could be divorced from each other and were referred to as the 'Comprehensive Plan' for the use of service learning to transform the learning of Physical Science.

5.3.1 Comprehensive planning for the use of service learning to transform the learning of Physical Science

The planning process should comprise the study's operations strategy (Pycraft *et al*., 2003: 73, 75), which includes vision, values, situational analysis, action plan, risk assessment plan that seeks to minimise the risks and threats on the implementation of the study; the coordinating team's Performance Charter, and the implementation plan that operationalises the objectives of the study.

5.3.1.1 Situational and contextual analysis

The situational and contextual analysis (Koosimile, 2004:494) of the learning and teaching processes as they relate to and affect Physical Science should be conducted. It is imperative to invite and engage participants (external) from other relevant sectors (*i.e*., from public and private), such as institutions of higher learning, and community organisations to and in this process. This would give this interpretive analytic and educative process (Koosimile, 2004:490; Mahlomaholo & Netshandama, 2012:43-48; Steinberg & Kincheloe, 2008:145) an urge to be broadminded and critical in its consideration of issues (Stein & Mankowski, 2004:22-23). The participants from the diverse and broad backgrounds would enable the coordinating team and therefore the study to have a global (macro) view of the current trends that affect the learning of Physical Science. These trends may be in the political, economic, social and technological realms.

The principles of the FAI technique (Mahlomaholo, 2010:20; Mahlomaholo & Netshandama, 2012:11) may be helpful to start the discussion and to engage therewith. The use of a broad open-ended question that addresses the main study question encouraged participants to talk and contribute to the discourses. The process of engagement with issues was not interrupted, notwithstanding the relevance or otherwise of the views or perspectives raised. This afforded an opportunity to seek clarity and as such encouraged in-depth engagements and understanding of issues. The summary synergise the thoughts and views expressed pursuant to the acts of interpreting and knowing (Stein & Mankowski, 2004:28-29). Follow-up discussions on pertinent issues continued, even after the desired convergence of views was attained. This deepened participants' understanding of pertinent issues and processes and improved their preparedness to initiate actions commensurate with the study (Steinberg & Kincheloe, 2008:148).

Pertinent issues relating to strengths, weaknesses, opportunities and threats in the various contexts of political, economic, social and technological trends were identified, interpreted and analysed. These were derived and organised from the 'messy' data in the discourses. Also, the relevant data was unearthed for further analysis, through the educative process of making sense of the data that was analysed. CDA was pivotal in relating the voices (texts) of the participants through the cognitive aspects to their social structural arrangements. This facilitated the process of enhancing the understanding and meaningfulness of the data collected (Mahlomaholo & Netshandama, 2012).

The process of situational and contextual analysis requires thorough understanding of issues and processes to enhance its preparation and planning. The coordinating team should plan and prepare for the session in advance. For instance, in this study the agenda or programme for the session was jointly developed (Annexure AGMT1), representing the participants' interpretation of the processes in anticipation of how it would unfold. The different items were facilitated by different study coordinating team members. The file that was prepared for this session contained: the approved study proposal (the scope), proposals regarding the frameworks or guidelines for the Performance Charter, implementation plan and programme for the session. This was to ensure that realities outside but reminiscent of the area of this research were brought forth for learning purposes and for enhancement of the study.

The situational analysis thus laid a firm basis for subsequent meetings and initiatives (Annexure T1), and the SWOT grid in respect of some aspects (Annexure CT0). The SWOT grid matched the study strengths, weaknesses, opportunities and threats against the following references: team building possibilities; community-based service learning centre; curriculum; and information obtained from participants during the strategic planning session.

5.3.1.2 Vision, mission and values statements

The coordinating team adapted the aim of the study into a vision and common goal, because the aim of the study was understood to be a 'vision' of 'giving voice' (Stein & Mankowski, 2004:28) to the Physical Science learners. It was to revive their hope and motivate them to have peace of mind and improve their performance in Physical Science. The team considered developing the study objectives into a mission statement and the values underpinning the CER (see coordinating team charter, Annexure CT 1) as well as those that defined team traits. For instance, in this study the vision was a transformational learning of Physical Science through service learning for sustainability with the use of service learning. The mission statement that was subsequently agreed upon order to achieve this vision was to:

- design a high school service learning strategy (SLS) towards the transformation of learning of Physical Science in high schools, to create sustainable learning environments; and
- establish a community service learning center for the sustenance of Physical Science' transformational service learning and of learning in general beyond the research study project.

The coordinating team's engagements were guided through a set of values, which Agger (1991:108) argues should not be used "ideologically to foreshorten people's imagining of what is really possible in an advanced technological society". It was thus imperative to engage the participants in this regard through a teambuilding exercise. The values that the coordinating team agreed upon were humility (Steinberg & Kincheloe, 2008:142) trust, responsiveness (also see Kenworthy U'Ren, 2007:816) and respect (Hickling-Hudson, 2006:4) for one another and the participants***.*** These values were to enhance the realisation of the transformation of learning to give learners' hope that they would do well in Physical Science. These values were furthermore to ensure that the participants' views were given an equal and equitable consideration during the discourses. Through respect the participants would uphold each other's constitutional freedom of expression and access to information.

5.3.1.3 Operational planning

The coordinating team developed an operational plan or implementation plan from the action plan that formed part of the operations strategy. The action plan referred to here is the interpretation of the approved proposal for the study that went through the UFS's Ethics Committee and the Committee for Title Registration (CTR). It is as such a description of the scope of the study as crafted by the study coordinator with the support and guidance of the responsible department through the promoter and supervisory team (see annexure AS1).

Thus, the action plan should be the starting point for the operational planning process to ensure and enhance synergy from the vision, through values and actions to and with implementation. In this study, this alignment process of the operations strategy with implementation plan was organised through the five objectives of the study, as outputs 2.2 to 2.6. Output 2.1 was about the team establishment. For each output the team identified activities, assigned responsible persons and for each activity, sub-activities or key tasks were determined. The resources required for the realisation of tasks and objectives were allocated and/or estimated. Lastly, timeframes for objectives or sub-activities' achievements were estimated after having identified and allocated possible sources of funds. This plan was also used to track progress and static information such as possible sources of funds. Responsible persons were replaced with columns on progress, recorded alongside the respective task and activity for each objective (for copies of the implementation plan and report form see Annexure CT2 and CT3 respectively).

5.3.1.4 Risk assessment and planning

The threats and risks that have the potential to hamper the use of service learning to transform the learning of Physical Science were identified throughout the planning and engagement processes. They were developed strategies according to which they would be addressed. The coordinating team thus dedicated some of its meetings to risk assessment, focussing on all aspects of the study from the coordinating team engagements to learners' SLPs and fieldwork, as well as engagements with parents, teachers and learners. In this study, the coordinating team engaged in risk-mapping exercises to prioritise risks accordingly, and subsequently developed a risk plan (Olum, 2004:17-19; Yarger, 2006:1). The risk plan became the third section or component of the strategy after the second section, namely, service learning implementation plan (SLIP). The risk map and the risk plan are attached as Annexures CT4A and CT4 respectively. Risk prioritisation criteria (Maxwell, 2002:30-34; Covey, 2002:37:39) were the extent of risk impact and possibilities of its occurrence. The risk plan also assigned responsible persons for the risks as well as mitigation factors or strategies.

5.3.1.5 Alignment with participants' programmes and plans

The implementation plan and risk assessment plans was aligned to the participants' work plan and programmes, as far as is practicable. This would streamline activities and further enrich the study. It would for instance optimise the utilisation of available human resources in the form of the study coordinating members, increasing the chances of accessing the resources and facilities that would otherwise not have been accessed by learners. For instance, in this case the learners had access to the waste water treatment site for learning of Physical Science. This was achieved mainly through the efforts and active participation of the environmental health practitioner (coordinating team member), whose active engagement tallied with her work-related responsibilities and the plan of the study. This did not cause problems with her employer as it became part of her work activity.

The alignment of participants' plans was aimed at enhancing the identification and implementation of the service learning project(s) (Kenworthy U'Ren, 2007:813). That alignment furthermore addressed possibilities of addressing risks and threats that were associated with funding and other related resources. The study was also aligned to the curriculum programme. The learners' formal assignments, practical investigations and service learning research project were aligned with the official work schedule of Physical Science. Annexures CT5, 6 and 7 are worksheets for the fieldwork, learners' water project; and standard practical investigation report format respectively. It was imperative for the learners to work collaboratively, to which end their study teams were established and the necessary arrangements made to ensure functionality.

5.3.1.6 Coordinating team members' Performance Charter

The achievement of performance of the actions and activities contained in the operations strategy and the implementation plan, as well as the risk plan signified respect for the participants and the learners. Lack of respect for time was perceived as tantamount to lack of respect for learners' learning activities and participants' work schedules (Koosimile, 2004:493). To address this problem in this study, the coordinating team agreed on a Performance Charter (Parker et al., 2009:588), the purpose of which was to: harmonise the team members' individual activities with the study and of each other; to solicit mutual support, care and respect amongst each other; to outline an agreed set of principles and set out a schedule of meetings and events determined and decided upon by the team members. Finally, the Charter outlined the coordinating team members' responsibilities in broad terms. A copy of the Performance Charter is attached as Annexure CT1.

The Performance Charter also provides strategic direction for the study, serving as a leadership and management tool for the coordinating team and the study coordinator. The strategic direction in this instance was towards the development of the strategy to use service learning to transform the learning of Physical Science. This strategic direction was based on the study vision and mission statements that were derived from the study aim. The strategic direction that the study took was furthermore informed by the values of the study. The values in turn derived from the traits of the study coordinating team members. The unity of the team was further strengthened through effective team communication and team structure. These sections of the team charter constituted and/or informed the strategic considerations of the study.

It was imperative for the implementation of this plan to be sensitive to the observance of the strategic considerations espoused above. The study coordinator (or researcher) was thus cautious about the implementation of the performance charter. So the study was able to level off cultural, ideological and power relations differential issues (de Beaugrande, 2006:31; Koosimile, 2004:490; Stein & Mankowski, 2004:21). These were inevitably embedded in and emanated from the participants' diverse situational experiences, training, age and positions of power and responsibility. The operational plan was critical as it sought to address the study objectives, which were in turn informed by and derived from the study aim.

5.3.1.7 Learners' study teams: guidelines and monitoring tool

The learners' study teams were established in order to inculcate the idea of a collaborative and cooperative work ethos amongst the learners. This was critical because service learning and transformation are collaborative (Hickling-Hudson, 2006:9; Magill, 1996: 471-473; Kiely, 2005:6-7, Servage, 2008:65-73). The learner performance and engagements in their respective study teams were to be guided and monitored through the study team guidelines and monitoring tool respectively. These were to ensure that the learners were guided through the process of working in teams, as that was used to a very limited extent.

As a result the learners, parents and teachers were to be involved in the process of developing study team guidelines and monitoring mechanisms and tools. This was to ensure their ownership of the processes and possible subsequent operationalisation of what they have agreed upon. The guidelines provided information in respect of the principles and values agreed upon to guide collaborative learning in the teams, *viz*. respect, humility (Mahlomaholo & Netshandama, 2012:42-44; Maton *et al*., 2006: 16-17; Steinberg & Kincheloe, 2010:142-143), care, timeliness and responsiveness. It also outlined actions that were undertaken by the learners, teachers and parents in order to ensure effective team work; a way of keeping team records of work; and allocation of supervisors to teams. This method was proposed during the learners-parents-teachers reflective sessions. It (this method) was enhanced and documented through the learners-teacher engagements. It was further improved through the inputs of teachers and the coordinating team members. There was a need to train participants in various aspect of the study, including the use of the study team guidelines and monitoring tools.

5.3.2 Pre-project training

Pre-project training refers to the training needed and offered to participants prior to the actual learners' fieldwork and SLPs. The training needs may be identified during the situational and contextual analysis as well as planning processes. They should be geared towards empowering the participants to achieve their obligations and responsibilities. For instance, in this study, the training or workshop sessions covered the approved study proposal, the FAI and CER, ethics issues, collaborative study teams monitoring tool and guidelines, health and safety, and orientation and preparation for fieldwork.

5.3.2.1 Statement of intent and ethical considerations

It was imperative for the participants to work as a team to be successful in using service learning (Kenworthy U'Ren, 2007:819). It was therefore necessary to ensure that the team members had a common understanding; were collectively involvement and owned the vision they shared (Stein & Mankowski, 2004:24). It was as a result that that the team spent some time discussing the study proposal, ensuring they had a common understanding of the aim of the study. The proposal gave members salient information on specific issues that pertained to the study. For example, data collection methods, ethical issues and the theoretical framework were used. It sought to enable members and the participants to identify areas of their possible contribution to the transformational learning through the use of service learning project(s). It was from these discussions that a need for the discussion of the FAI was identified.

5.3.2.2 Training on free attitude interview and critical emancipatory research for data collection

The service learning coordinating team held special sessions in which it discussed and shared information on the approved research study proposal. Each member was given a copy of the study proposal to study in his or her own time. Specific issues that warranted attention by request and demand by the members were the FAI and CER. These issues were addressed during the coordinating team members' special sessions. These sessions served to empower and build capacity of the coordinating team members in areas that were relevant to the study. Furthermore the coordinating team adopted a principle that facilitation of meetings was going to be alternated amongst members, and that each member would have an item on the agenda on which to lead the team (see Annexures AGMT 1 to 8).

5.3.2.3 Learners' collaborative study teams monitoring tool and guidelines

Transformational learning is collaborative, as is service learning, so to serve and learn requires working with other people and accommodating diversity. The collaborative learning has innate challenges of diversity relating to power and power relations differential issues. This study however provides evidence that there are ways of dealing with the latter issue using CER principles and critical PAR as an approach. The learners' study team guidelines were owned by the learners and parents. It was thus imperative for the learners especially, to commit to active learning through problem-based self-directed learning strategies. The monitoring tools workshop was conducted with team coordinators, parent supervisors and teachers. This session was to be as relaxed and informal as possible in order to create space for each partner's free participation.

The work monitoring tool recorded names of team members, details of the work, time and date it was done and the time the team engaged the teacher for feedback. The monitoring side of the tool recorded monitoring indicators such as learner attendance, cooperation with the team, submission of the team effort or response, individual attempt and responses, as well as feedback by the teacher. Finally, the tool afforded parent supervisors and team coordinators space to make general remarks and comments. Copies of these documents are in Annexures CT 8 & 9.

5.3.2.4 Health and safety on site and during fieldwork

Fieldwork, especially on the waste water treatment plant, had numerous threats and risks, which the learners and other participants had to be sensitised about. This involved the identification of the learners who required special arrangements to be made for them to participate. It was also critical to sensitise the learners and parents of potential dangers for sensitive persons. The risks and threats identified in this regard were addressed in the risk map / plan and were used to emphasise the point of their possible impact and mitigation. The fieldwork-related risks were verified and confirmed shortly prior to training and site visits. In this study, the coordinator and coordinator for services, together with the plant operators, visited the site for pre-fieldwork inspections. The earlier visits to the site by other study coordinating team members enhanced the deliberations immensely.

The plan was such that the three activities happened within two days to ensure that the conditions on the field did not change. The activities referred to are the pre-fieldwork inspections, the health and safety inspections presentation to learners and participants, and the fieldwork. The health and safety presentation also addressed social practices that frustrated the water care and management services, human health, and the local physical environment. These were also shown to have connections with the curriculum content of Physical Science and to maintain orderliness and discipline on site, teachers and parents were invited for support. The presentation on health and safety was facilitated by the coordinator for services, who also organised her colleague, the project management unit manager, to orientate the participants on some technical issues pertaining to the site to be visited.

5.3.2.5 Orientation and preparation for fieldwork

It was critical to orientate the participants, and the learners, about the plant or fieldwork prior to the visits. This improved the overall preparation and planning in respect of areas and aspects that related to the curriculum. The preparation was inevitable and had to be thorough (Kenworthy U'Ren, 2007: 817) to ensure the successful use of service learning. Furthermore, the orientation and preparation were considerate of the fact that the learners needed to be afforded an opportunity to complete their worksheets. Thus the completion of worksheets by the learners also occurred during their interactions with the respective municipal officials on issues they required more information. In this study the fieldwork orientation presentations were prepared by the municipality's project management unit manager. The issues pertaining to the scope of the presentation were outlined and discussed with the Physical Science teachers, and the coordinator for the curriculum to the study was also engaged in the process. The contributions of other participants were solicited, also in terms of non-curriculum related issues.

The content of the presentation included the layout plan of the waste water treatment, the description of sewage, and challenges experienced by the waste water treatment processes and water services in general. The presentation was also aimed at provoking the learners' thoughts with a view to spur them into action to address the related community needs and problems. Connections of the identified aspects with curriculum content were also established, to strengthen the learning component throughout the process. The scoping sessions between the teacher and responsible municipal official covered each of the three main sections and highlighted their respective purposes, general issues pertaining to logistical issues (*e.g.,* date and duration, learners' grade, scientific principles they are to learn, venue, and number of learners involved).

For instance, the layout plan detailed the preliminary and primary, secondary and tertiary treatment stages, which could be related to the curriculum theme on matter and materials, physical and chemical properties of matter (sewage) as well as separation methods used. This also afforded an opportunity of integration with Life Sciences (*e.g*., the biological components), and could also be related to aspects of the theme on mechanics, *viz*., gravitational force, mechanical energy, pressure, rate of flow or speed. The second aspect regarding the description of sewage was related to the physical, chemical and biological properties of matter. Thirdly, the challenges experienced during water services provision were related to their impact on the physical environment, economy of the family and the community as well the water cycle. These were considered at their social and technical levels.

The presentation thus covered these issues in sufficient detail for both the learners and the teachers. The scope of the presentation included pertinent information that helped them relate it to their community experiences, curriculum content as well as their prospective actions (see Annexure P for presentation). The presentation that was made in respect of the waste water treatment plant was thus also made available to learners to use it for reference purposes. This was done with a view to identifying pertinent SLPs.

5.3.3 Arousing curiosity for transformation of the learning of Physical Sciences

It was critical to evoke the learners' interest and curiosity to learn Physical Science concepts and principles, as well as the relevance (Koosimile, 2004:494), usefulness and meaningfulness (Kenworthy U'Ren, 2007:817; Mahlomaholo, 2010:11-12). This will encourage them to search for more information through talking (communication) and engaging other people and other (re)sources. The learners' search for more information could also be through their practical application of principles and concepts or from instances in their immediate environments (Koosimile, 2004:485) where they were applied.

This approach does not take for granted that learners know the said concepts and scientific principles from their previous grades or lessons. The learners' prior frames of references (Kiely, 2005:8, 10-12; Merriam & Ntseane, 2008:184) and knowledge is essential and should be brought to light first, then used as the basis for their 'new' service learning experiences. It should be that the contextual experiences from the service learning experience would confirm or refute the learners' prior frames of reference and knowledge, and thus be respected (Koosimile, 2004:493). In this way, the learners', parents' and teachers' understanding of Physical Science principles and concepts is enhanced (Arenas *et a*l., 2006:27; Kenworthy U'Ren, 2007:815; Koosimile, 2004:491-493).

In order to achieve the above it was imperative to prepare, plan and give learners' activities and assignments that challenged their curiosity to learn more about Physical Science concepts and scientific principles (Arenas *et al*., 2006:27). These were based on the concepts and principles prescribed by the curriculum and then related to a real-life situations which the learners can access (Kenworthy U'Ren, 2008:818; Koosimile, 2004:491). The site visits were therefore supposed to create dissonance "between the participants' prior frame of reference and the contextual factors that shaped the service-learning experience" (Kiely, 2005:8). In this study, for instance, the dissonance was between the learners' and coordinating team members' prior attitude and knowledge about waste water treatment and the actual process as they experienced it (Hickling-Hudson, 2006:5). This aroused interest for learning (Kiely, 2005:10-11) and as a result learners become motivated to search further and learn more to address the knowledge incongruence that prevailed.

The visit to the waste water treatment site served to create dissonance between what the learners knew and their actual experiences from the water treatment process. It also served to enhance integration and assimilation of information which the learners gained from the presentation with their actual observations on site. This was also used as an opportunity for identifying possible SLPs there or elsewhere in the system. It facilitated the enhancement of closure of the knowledge gap that the participants indicated having had about the waste water management per se. Furthermore, the learners had an opportunity to complete their assignments as contained in their worksheets (see Annexure CT 5).

5.3.3.1 Site visit: exploration of the real-life situation

The visit to a real-life situation offers Physical Science curriculum learning opportunities. The visits afforded the participants an opportunity to identify service learning projects, activities and assignments. It also helped them complete their worksheets. For instance one question that was asked was that the learners should identify possible challenges experienced at the treatment plant. These were the technical challenges experienced by the system as well as social practices of the community members that impacted negatively on the system and the water treatment processes. Furthermore, the learners were to identify their roles in addressing the challenges they identified. These challenges were to be identified for the critical stages of the waste water treatment process. One such stage was considered to be the preliminary treatment stage. At this stage the items that were not supposed be disposed of in the sewage system were removed from the sewer. The worksheet asked that the learners should comment about the items and the methods that were used to separate the items from the sewerage. Furthermore, the learners were asked to indicate how they could assist in curbing the impacts that were broad about by the negative social practices. The learners were asked to start implementing the activities which they suggested as far as it was practicable. One such activity was the advocacy in respect of discouraging throwing of non-biodegradable items in the sewerage system.

5.3.3.2 Reflective sessions: consolidation of experiences through free attitude interview

Reflection and self-reflection (Hammond *et al.*, 2001:2**;** Hatcher & Bringle, 1999:114-116; Rocha-Schmid, 2010:345-346; Tatto, 2006:239) moments formed an integral part of the use of service learning to transform the learning of Physical Science. In this study, the learner participants' views about the site visit were solicited during a reflective session that was held a day after their visit to the plant. The purpose was to consolidate their experiences into the study SLPs as far as practicable. This was also critical as it sought to ascertain the learners' assimilation of information and their real life experiences of the site, while it was still fresh in their minds. A free attitude interview mode in which they could be viewed as a focus group was used, ensuring that learners were free to air their observations and impressions. The session was thus facilitated by the Physical Science teacher with whom they were relatively free to express their views.

It is important to find out other participants' experiences and views about the project at the different stages. The reflective session following the site visit was during the study, but prior to the learners' SLP. This is notwithstanding that the site visit itself may be considered and used as a SLP. The worksheet covered the measurable curriculum content aspects and those of the service components of service learning, thus the project serves two main purposes, namely triggering action that encourages social responsibility and being a SLP itself. The reason the visit is considered for the first may be clarified by the prioritisation of the SLPs.

5.3.3.3 Prioritisation and selection of possible service learning projects

In order to increase the learners' curiosity and interest in the learning of Physical Science, they were also engaged in deciding which service learning projects could be attempted. A project should help address all the components of the service learning as provided for by the literature search (Osman & Attwood, 2007:16). This presupposes that a clear indication of what is to be achieved will be spelt out. In this study, service learning is clearly supposed to have the components as spelt out in Chapter 2 and for which empirical data is obtained and analysed in Chapter 4, namely, community-school coordination; focus on community needs; active participation; structured time for reflection; academic curricular integration; development of sense of caring for others; extended learning opportunities and thoughfully organised experiences.

The issues pertaining to transformation were also central to the prioritisation process and considerate of sensitivity to the 'taken-for-granted' issues of embedded power and power relations when the strategy was developed. The SLP's prioritisation criteria in this study were a manifestation of empowerment and transformation inhibiting power differential realities; fostering of a value-driven learning processes; affording opportunity for synergising collaborative effort and addressing real-life needs or problems (Hickling-Hudson 2006:4; Koosimile, 2004:490; Swantz, 2008:33-35).

The prevalence of power relations struggles, ideological differences and diverse cultural backgrounds are inescapable (Osman & Attwood, 2007:17), however, they should be managed in such a way that they offer learners the opportunity to enrich their learning process. This can be achieved if the participants realised the possibility of using that power positively (Steinberg & Kincheloe, 2007:145), thus a SLP should offer learners opportunities to confront and be confronted by these issues (Hickling-Hudson, 2006:4-5, 7-9). Service learning is learning-oriented and learner-centered

(Kenworthy U'Ren, 2007:818) and thus requires that the learner handle the matter personally.

The coordinating team members and parents need to support the learners in cases in which such power surpass and impede on their learning, therefore these issues need to be considered thoughtfully and critically to ensure the achievement of other components of service learning. The components such as focus on strengthening school-community coordination and opportunities for application of skills and knowledge are likely to be sacrificed. The power differentials in the community-wide project are larger and more complex than a learner can reasonably grasp. A further consideration for prioritisation was a mechanism that learners could readily access and use to level off the said power realities.

In this study, the CER principles and values were used to level off excessive power relations struggles between and amongst learners. These learners also learned about them as they were prevalent in their study teams, as well as generally being part of their lives at home and at school. It was therefore ensured that the learners were conscious of the significance of respect, trust and care for one another. The visit to the waste water plant and subsequent reflection were used to a large extent to address this objective. The closing remarks and/or summary of the reflective session referred to the items that were reflective of upstream activities that showed carefree and disrespectful attitudes in the community. Cases of stolen items found in the sewerage system, did not only block the system but also reflected negatively on the community.

Throughout the planning and preparation stages, the goals and objectives of the study were aligned to those of the theoretical framework to ensure synergy and coherence of the different aspects of the study. The conceptual theories and/or aspects thereof were thus carefully chosen and aligned to the theoretical framework. It was also imperative to align the study plan to the official programmes of the study team members, learners' study programmes and school programme or year plan. In addition, the study coordinating team members were made sufficiently aware of the theoretical framework and the study objectives, thus contributing to the common understanding of issues amongst the team members (Kenworthy U'Ren, 2007:819). The use of the Study Comprehensive Plan became helpful. Pursuant to the achievement of synergy through the collaborative effort of the participants, the SLP needed to enhance addressing of the participants' real-life needs or problems. These were the needs they identified themselves.

The prevalence of real-life social needs and problems were considered as having prospects for the manifestations of forms of oppression. For instance, pollution of water through social practices such as illegal dumping of solid waste, was understood as a socially unjust practice, and thus necessitated thoughtful consideration in the prioritisation process. The SLP that was undertaken had clear and direct learner participation in addressing the community needs and problems. The learner participants were to be engaged to identify the need and problem within the broadly agreed upon context, *viz*., water care and management service. The information obtained from the preparatory health and safety, as well as the site visit orientation presentations and experiences gained from the actual site visits influenced the reflective session immensely.

The SLPs identified by the learners during the reflective session were discussed further with the coordinating team, a process that also involved the HoD. The HoD in this case was a teacher and a member of the coordinating team (see Chapter 3 paragraph 3.3.1.3). His contributions towards the choice and development of the SLP were helpful. This activity was made to coincide with that learners' formal research project as required and prescribed by the Physical Science curriculum. The realities pertaining to the actual implementation date in relation to the planned date were taken care of. The Physical Science teacher played a pivotal role in communicating (Kenworthy U'Ren, 2007:819) and soliciting further inputs from the learners in this regard. This happened through the discussion of the project with them and as they asked questions about what was expected of them. Further enhancements emanated from their enquiries during the implementation process of their respective SLPs.

5.4 IMPLEMENTATION OF THE COMPREHENSIVE PLAN FOR THE USE OF SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE

The implementation of the comprehensive plan of the study involved periodic reviews and respective adjustments. This meant that progress was reported against the activity that was executed and where applicable adjustments were made to the plan. For instance, when the activity could not be conducted as planned on an agreed set date because of unforeseen and unavoidable challenges, it was postponed or brought forward. Conversely, adjustments could be effected on the activities and responsibilities depending on the possible change of programmes of the coordinating team members or even the school programme.

5.4.1 Periodic review of the Comprehensive Plan

It was necessary for the coordinating team to frequently consider the extent to which the activities in the Comprehensive Plan were achieved. In this study the coordinating team reviewed the plans monthly and adjusted them accordingly. The adjustments that were made were also in respect of the special meetings and training sessions that were decided upon from time to time. Thus, following the development of the Comprehensive Plan the coordinating team meetings considered and appraised it.

5.4.1.1 Comprehensive Plan reviews

The Comprehensive Plan consisted of three sections, namely, the strategic operations, implementation plan and the risk assessment plan. These guided the study implementation processes and were as such reviewed periodically. The reviews fundamentally considered the alignments and possible realignments of different aspects of the original plan. The aspects, were the objectives, activities, resources allocated (*i.e*., time, responsible persons, financial and others), to ensure that the plan and therefore the study remained within set frameworks.

For instance, the availability and unavailability of resource persons, including the study team members, had a bearing on the secured date for the site visit and the timeliness for the completion of worksheets and the execution of SLP. It also affected the prior site visit risk assessments. These were inevitably some of the critical activities that needed continual and critical consideration. For this, regular contacts between the study coordinator and individual study team members were imperative. These regular contacts enhanced the critical discourses during the study team meetings which fundamentally paid more attention to reviews and adjustments of the plans.

This therefore required the study coordinating team, through the study coordinator, to manage the changes to be effected on the Study Comprehensive Plan. In this regard a mechanism that was devised to track and record them was that of reporting against each of the activities of the plans (see Annexure CT3, activity number 2.3.2, which makes provision for the identification of an appropriate, *i.e.,* more learner-centred and activity-based project for the transformational learning strategy). The project was evidently and inescapably preceded by numerous assignments that used service learning approaches and formed part of the daily lessons. They were thus planned and presented by the teacher with the support of the HoD, and further required the learners' engagement through their collaborative study teams. These were multi-graded, at times mono-graded, and were also supervised by parents. This enhanced the execution of the water project for the Grade 10 learners (see Annexure CT6).

5.4.1.2 Service learning water project plan reviews

The SLP was a critical output/outcome of the Comprehensive Plan and of the study. The processes of its development, implementation, and its monitoring and assessment/evaluation affected the Comprehensive Plan and its dynamic characterisation also influenced the periodic reviews. The factors that influenced the review of the SLPs emanated from the supplementary learners' assignments and activities, based on the water services as the study context. The second factor was found to be the inherent aspects of the project itself, particularly the critical areas in the process of the project implementation which contained activities that needed appraisal. These are outlined below.

The reviews of the SLP were influenced by the observations and inputs from the learners' related service learning assignments, that is, supplementary work and activities. The numerous assignments that preceded and were implemented concurrently with the project included site visit (*i.e*., completion of worksheets); daily assignments (*i.e*., normal Physical Science classes); and collaborative study teams (*i.e.,* learners-parents-teachers' engagement). Some aspects of the project were covered during the site visit and by the orientation presentation, as well as the curriculum content with which the learners interacted in class. Regarding the latter, during normal school hours and the extended learning opportunity over weekends and during school vacations, the learners tackled concepts such as mass, weight, pressure, force, energy and force of gravity. During these extended learning periods approaches such as problem- or activity-based, learner-centred, self-regulated and collaborative learning strategies were used (Niemi, 2002:764; Parker *et al*., 2009:592; Rocha-Schmid, 2010: 355).

For instance, the learners' activities in addition to those given in their field worksheets and the water research project were about the scientific principles used in the toilet cistern. This afforded an exploration, use and learning of concepts such as mass, weight, pressure, volume, and gravitational energy. The learners were further challenged to explain how they could use that knowledge to help the parents in the choice of sanitary ware. These challenges were given as assignments and the teacher developed and gradually improved them as the learners responded to the questions asked. The assignments were geared towards enhancing the successful implementation of the following SLP.

The critical consideration of the possible SLP for the development of the transformational learning strategy became imperative, based on the emergence of many options, including the community-based service learning centre to water quality monitoring, water leakage detection and plugging as well as the advocacy of water care and management. The SLP about determining the loss of water as a result of a leakage identified on a site in the community was preferred for our purposes. It evolved from the research project for the Grade 10 learners (see Annexure CT6). This SLP was reviewed and its different aspects implemented using a variety of service learning related approaches. The review was influenced by the learners' questions, curriculum coordinator's inputs and the assessment by the study coordinating team. For instance, learners were concerned that they could not find water leakages on school premises while the coordinating team was concerned about its broad scope. This led to the revision of the project scope and a re-consideration of premises other than the school, including residences and other public institutions.

The changed scope of the project introduced other critical elements, namely seeking permission from owners of affected properties; preparing factual messages in respect of their findings in terms of the amount of water loss per month and its cost implications; identifying social challenges such as water shortages; and gauging the environmental impact of the prolonged water losses. This was in order to give feedback to the affected parties and required learners to take further action that would help address the challenge, for example plugging the leaks. The solution to the problem was to be sensitive to the other components of service learning to the extent of enhancing their achievement. Support and integration of Physical Science to other subjects included language, through communication and preparation of messages (*i.e.*, report writing and communication skills); accounting and mathematics on costing and projections as well as environmental studies.

Embedded in the interaction between the learners and property and information owners were the power relations struggles (Osman & Attwood, 2007:17). In order to minimise their intensity the learners were to consider residential sites (houses) within the area where it was relatively possible to seek and obtain permission to conduct the research, and public buildings, for example library toilets and public schools. The learners were also supposed to obtain information in respect of unit costs for buying of water for their calculations. They had to prepare reports and messages to the site owner to sign as evidence of the execution of the project. The message was to be prepared in accordance with the values and principles that learners adopted in their teams, notably respect, mutual care, the environment and humility. The gist of the message was to inform the owner about the learners' findings, for example, how much water and money could be saved per minute and per month if the leak were to be plugged, the benefits that could be derived from such savings, sparing the use of scarce water, less conflict with neighbours and the municipality, as well as positive environmental impacts.

The possible solutions to the problem were then a product of the discussion between the learners and the owner, which included soliciting support from the responsible municipality unit. The information thus obtained, that is the evidence signed by the owner and/or the picture of the leakage, formed part of the report. The learners could then compile their research report through their collaborative study teams.

5.4.2 Adjustments of the Comprehensive Plan

The adjustments effected on the Comprehensive Plan emanated from the study coordinating team meetings and appraisal discourses. They pursued the execution of activities and tasks towards the achievement of set objectives, manifested *inter alia* through the study tangible products as discussed in Chapter 4, and included the Comprehensive Plan, SLP, worksheets and the learners' daily activities and assignments.

The key adjustment was the consideration of merging the three sections into one strategic document for the study. This enhanced the development of the strategy, its implementation, reporting, monitoring and assessment processes. It consolidated the activities and enhanced focus of the study team in that only one document or guide was used. Further adjustments involved the development of a reporting template from the plan, which eased the monitoring and assessment of implementation of plans. From time to time new assignments were re-allocated by the coordinators in accordance with the respective activities sought in relation to the areas of work, competence and accessibility.

Examples were the development of an activity plan for the community-based service learning centre by the coordinator for governance and management, the development of worksheets, learners' assignments and SLP to coordinators for environment, curriculum and teachers (see Annexures CT2 & 3). Upon receipt of feedback the Study Coordinating Team then engaged and interacted with the draft documents for further adjustments, as part of the coordinator's responsibilities. He kept the report form and typed in the respective columns the suggested and agreed upon adjustments and/or inputs.

The documents that illustrated this aspect clearly were the worksheets and the SLP plan (see Annexure CT 2 output 2.3 activity 2.3.1 & 2.3.2 and output 2.6, activities 2.6.2). The adjustments made on the worksheets were predominantly the result of the input of teachers and learners. Some of the questions were incomprehensible to the learners, based on the type of questions they asked. Their questions evoked introspection and self-reflection (Hammond *et al.*, 2001:2**;** Rocha-Schmid, 2010:345-346; Tatto, 2006:239) on the part of the questioning techniques and necessitated relevant adjustments. This also enabled the incorporation of the teachers' input. The scope of work covered in the worksheets was adjusted in relation to the themes and concepts in the official curriculum-related work schedule, as well as social responsibility issues. Further adjustments were made to respond to the limitations imposed by inadequate time for control and lack of working space, particularly the time-related adjustments.

The above mentioned review of SLP culminated in the adjustments which could be effected in the next cycle of the implementation plan involving new Grade 10 learners. These included communication skills, in preparation for engagement of site owners in respect of identified leaks, and specific curriculum-related activities, for example those based on speed/velocity, pressure and force, and impacts on the physical environment, such as health hazards, soil erosion and pollution. These issues were addressed in separate daily assignments and worksheets, but some learners still found it difficult to integrate the knowledge gained and thus make it more meaningful and useful to them.

These adjustments required intense and critical reflections (Agger, 1999: 119; Molee *et al*., 2009:591-593) at the various stages of the project, namely, conceptual, and implementation after the completion of the project. These reflection sessions were considerate of the amount of work to be covered and the levels at which such should be pitched at. The expertise of the study coordinating team members was thus critical in these reflection sessions.

5.5 REFLECTION

Reflection, an integral part of the use of service learning to transform the learning of Physical Science, should be a transparent and critical process to the extent that participants are able to conduct self-assessment and self-reflection (Hammond *et al.*, 2001:2; Rocha-Schmid, 2010:345-346; Tatto, 2006:239). It should also allow other participants to reflect on their work as they shall have experienced it without creating tensions and animosity. In this study, reflective sessions took place prior to the learners' conducting their SLP, and thereafter, during coordinating team sessions and learners-teachers-parents' sessions.

5.5.1 Pre-service learning project implementation phase reflections

Reflective sessions on the pre-service learning project implementation phase took place at the levels of both the study coordinating team and the learners' SLP and involved critical consideration of the progress made at the conceptual and preparation phases of the projects.

5.5.1.1 Coordinating team

The original plan was to have the reflections facilitated through the principles of the FAI, to afford each study team member an opportunity to express his or her critical views about any of the preparations. These preparatory elements and aspects for the SLP implementation included team establishment, study planning session, study coordinating team meetings, and tangible research study product preparations. The reflection session was held after the pre-project training sessions and the significance of this enhanced the justification for the study. Most importantly, it fostered collaborative work amongst team members.

Notwithstanding focus on enhancing collaborative working amongst the team members, the data obtained from these sessions pointed to members showing keen interest in the water service provision. The study did not take for granted that team members, just because of their relative chronological ages, were familiar with water care services issues. Their desires to update and acquaint themselves with developments in this context were attended to. The coordinating team members thus integrated their learning experiences from their respective site visits with the reflection discourses on SLP identification preparations and implementation.

The significance of making time for reflective sessions with the coordinating team members lay in their respective enhancement of the strategy to the extent of cooperative teamwork, facilitation of convergence of thoughts, and focus on shared study vision, as well as closing knowledge gaps that might have existed in the context of the study.

5.5.1.2 Learner participants

The reflective session for learners was conducted with the use of the principles of the FAI, immediately after the site visit, and was facilitated by the study coordinator (*i.e.,* Physical Science teacher). This afforded the learners and the teacher an opportunity to share and exchange their experiences of the site visited the previous day, and a further opportunity to raise issues and to explore their respective social and academic challenges emanating therefrom. In addition, learners were able to contribute their views and suggest actions to address the social problems and needs they identified.

In summary, the facilitator of the session enumerated the possible solutions that learners identified, namely to conduct awareness campaigns in respect of water use and care, sludge treatment for the ‘manufacturing’ of fertilizer (with the resultant possible job creation opportunities), posters covering the context and different themes of the curriculum, water leakage and plugging, as well as water quality monitoring projects. These were required to be conceptualised further, resulting in project plans within the scopes and timeframes determined in accordance with the curriculum. In the case of the prioritised project, it became necessary to allot time for reflection on the project during the process of its implementation.

5.5.2. Reflections on the implementation of the service learning project

Reflections on the implementation of the SLP were held after the submission of the projects by the learners. They had an opportunity to engage the coordinating team members and parents during the process of implementation. For instance, they would ask for support in cases where it was not easy for them to convince the owner of the premises on which there was a leak to permit them to measure the water losses or even to talk to them about the results. Furthermore, the learners had an opportunity to discuss the project in their respective study teams. It was therefore necessary to engage them to ascertain whether they had carried out their projects.

5.5.2.1 Coordinating team

The study coordinating team found it imperative to establish how the learners and other role-players viewed and experienced the project as a whole. This data collection process by the coordinating team paid attention to service learning as a strategy for teaching and learning Physical Science. To this end, the team proposed the use of reflective diaries in which they kept a record of their own views and of others with whom they interacted. Members were thus issued with booklets and pens to keep record of their further experiences of the study. They also had to keep records of their engagements with learner participants as far as practicable. These reflective diaries were not returned, but had to enhance the members' critical participation during the study project's periodic review discourses.

The risks and threats inherent in the study potentially affected parents, learners and teachers alike. Some of these were perceived as inescapable yet difficult to identify, notwithstanding their potential significance to the learning of Physical Science. The time-related threats and risks, and realities related to teaching and learning practices required the engagement of parents, learners and teachers together. The coordinator for curriculum thus facilitated a session using the FAI technique to reflect on the teaching and learning practices at the school. The parents, learners and teachers together reflected on this issue at length.

5.5.2.2 Learners-Parents-Teachers

This reflection session afforded the three key stakeholders an opportunity to engage each other on the teaching and learning matters, and thus contributed towards the development of service learning strategy (SLS) development. It revealed pertinent issues that included the least extent to which service learning strategies were used for learning and teaching of Physical Science; the extent to which learners' physical environments, socio-economic and cultural realities (resources) were 'dis-integrated' or divorced from the Physical Science learning environments; as well as the extent of support required for learners, teachers and the learning processes. This reflection unearthed realities associated with deficiencies in the midst of the wealth of knowledge that the collective had in relation to curriculum content, learning and teaching support structures and systems. These were evident from the facilitator's exploratory questions and summary of discourses (see Annexure T 2).

The reflective session, however, was marred by tension, which presumably arose from embedded familial differences and power relation struggles between the multiple stakeholder interactions. The presumption was that, for instance, a learner-teacher relation was likely to be influenced by the presence in the same meeting of the same learner-parent, other learners-parents and learners-learners relationships. A further consideration was that each interaction would naturally be sensitive not to expose its weaknesses or shortfalls (Donald *et al*., 2010: 43; Tudge *et al*., 2009:3; Leu, 2008:17-22), notwithstanding the good intensions that the interaction or reflection sought to achieve.

The tension and contradictions explained the scant contribution made by the participants at the beginning of the reflection session. A further possibility for this was considered to be the practice of learners and parents critiquing teaching strategies, which also focused on the possible enhancements of teaching strategies from the perspectives of the learners and parents. As the reflective discourse continued, the participants became freer to air their views and hence contributed significantly to the discourse, suggesting that the fear to critique experienced at the beginning of the reflection session could be dispelled through frequent transparent and robust interactions. The extent of success of the use of CER-aligned the FAI approach in these interactions was significant. The reflection was extended to the post-project implementation stage to learn more about possible SLP benefits for the development of SLS.

5.5.3 Post-service learning project implementation

The two reflection sessions conducted during the post-learning service project phase were recorded in writing, because of contextual and time-related factors. It was during the fourth term and the FSDoE had constricted research studies. Furthermore, learners were preparing for their end-of-year examinations (see the FSDoE approval letter for this study Annexure CL2B).

5.5.3.1 Coordinating Team

The study coordinating team's post-SLP implementation reflection was made by each member, through keeping a record of his/her views, impressions and experiences of the study. The information recorded was to be shared during the project review sessions and thus incorporated accordingly in the study comprehensive report. Some data collected here was used as information for the enhancement of explanation for the study design and methodology.

The observation that the study coordinator made in respect of the writing of views was that the participants did not like it, mainly through preference and/or comfort. There was a perception that writing involved unnecessary effort, however this did not impede the reflections as this emergent discursive practice created space in the learners-parents-teachers engagements.

5.5.3.2 Learner participants

The learners were also asked to submit their written inputs. For them, an open-ended scenario-depicting question based on their experiences of service learning was asked. They were thus at liberty to express themselves with regard to any one or all issues from inception through implementation of the project. A separate sheet was prepared for this exercise so that they could complete it in their own time.

Notwithstanding the small number of comments received, those that were returned were incorporated as part of the data analysed in Chapter 4.

The advantage of the written reflections in this instance was the opportunity it afforded the teacher to identify overt possible learning barriers for the learners. From those returned, for instance, the teacher was able to identify learning barriers associated with language use (communication), *viz,* the learners' inability to communicate their thoughts. This would then enable the teachers to dig deeper to establish possible problems, in turn leading to the identification of possible covert or implicit causal factors such as reading skills and/or analytic skills. This challenged the teacher of Physical Science to be considerate of learning barriers and, where possible, provide support. This can be achieved through sufficient integration of the medium of communication for the Physical Science being integrated with teaching. It affords the teachers space for this through one of its components, i.e., academic curricular integration. This has also been shown to be a requirement by the curriculum statement of Physical Science (DBE, 2011b:11), but one that posed a significant challenge to teachers and their preparation programmes. It also required them to be able to anticipate appropriate evidence and assessments.

5.6 ASSESSMENT

The assessment, based on the Study Comprehensive Plan, was to track the performance of the research study project and assess SLP and its implementation. This was based on the learners' SLP plan and sought to assess the extent of achievement of project's aims and learning outcomes. The latter aspects were related to and derived from the curricular content.

5.6.1 Assessment of performance of the study

The use of service learning to transform the learning of Physical Science had to be assessed to determine the extent to which it had achieved its aim and objectives. Since this involved learning and teaching these should form the basis of such assessment. Thus, the coordinating team and the participants had to consider identifying performance indicators against which to establish the extent of the performance of the team and of the learners. These indicators should reflect on the learners' motivational levels based on their reflections on the study as well as their performance in the Physical Science SLP and other formal and informal assignments.

5.6.1.1 Coordinating team assessment

The assessment of the progress made by the participants and by the study was based on the plans that have been developed and according to which the study was implemented. This should flow from the vision and aim of the study to the objectives and activities that were continually considered during the implementation process through reflective sessions. The study aim was in this case depicted in the operations strategy of the comprehensive plan and the objectives derived in such a way that they gave effect to the aim and vision. These were depicted as outputs in the operational plan section of the comprehensive plan, for each of which there were more specific activities that were in turn allocated resources for them to be achieved. The plan thus established a clear link between the research study aim and its outputs. The activities and the resources allocation operationalised the plan towards the achievement of outputs and, ultimately, of the aim. It was that connection that enhanced the success of the study. In addition, the progress reported against each activity made assessment relatively easy.

On a regular basis, the coordinating team reviewed the plan, thereby appraising the study project. The result was the effectuation of adjustments on the plan. One such review consideration was the pronouncement by the team that its performance charter, risk assessment plan, and the service learning implementation plan (SLIP), constituted the Study Comprehensive Plan, which turned out to be the strategic plan document for this study. In order to assess the progress made by the study, therefore, the strategic plan document became central, as it provided 'elements' or 'constructs' at which performance could be pitched. The elements or constructs referred to were the time-bound and resources-allocated sub-tasks of the activities identified in the strategic plan document. The key tasks which were formulated provided reasonable assurance that the study objectives could be reached.

Assurance had been given by the progress reported against the comprehensive plan activities and sub-tasks, as explained above.

The assumption that the assessment of the comprehensive plan had made, however, was that each sub-task would be executed in full or to its logical conclusion. That explained and consolidated the significance of regular reviews and adjustments of the sub-tasks and therefore of the plan. It was also necessary to consider the priority, connections and makeup of the activities to gain oversight of performance, but this was not necessarily the sum of or mathematical or statistical average of the extent of performance. It had rather been a subjective consideration of all aspects, including contextual realities (*e.g.,* policy provisions; health and safety issues; the condition of the environment, and power relation issues). It was however imperative to focus on the vision and establish the extent to which sub-tasks contributed towards its achievement. The contribution made through a sub-task was considered as a whole contribution.

The challenge seemed to emerge when attempts were made to categorise or prioritise the objective according to significance. A competition of constituent parts made the same whole, which would probably have degenerated into a self-defeating act akin to overt self-demeaning arrogance. Such competition was considered undesirable, because it was perceived as inherently counter-transformational. The engagement of stakeholders (*e.g*., study coordinating team members) in the assessment of SLP was thus considered critical.

5.6.1.2 Learners' service learning project

The learners' service learning project was a teaching and learning assessment matter that affected learners and teachers directly. It could not be divorced from the prescriptions of the official Physical Science curriculum statements, but rather sought to strengthen the connections between curricular statements aims and outcomes of learning. It also sought to affirm the links between Physical Science' specific aims and the learners' achievement of respective outcomes. That affirmation was preceded by and happened concurrently with the use of service learning approaches in preparation for SLP (DBE, 2011b:119-122). The Grade 10 Physical Science learning environments were privileged in this regard.

The pertinent learning outcome for Physical Science was found to be the nature of science and its relationships to technology, society and the environment. The demonstrable achievement of this outcome was considered to have been the skills that the learners were to acquire, including scientific notation; conversion of units; comprehension of the concept of rate and their applications in physics (*e.g.,* power) and chemistry (*e.g,.* reaction rates); direct and inverse proportions; and skills needed for practical investigation (DBE, 2011b:119-122). The connections and links between these skills and the outcomes were obscured and thus had the potential to perpetuate or legitimise the learners' disempowerment. The crux of the outcome was perceived as being to enable learners to identify and critically evaluate scientific knowledge claims and the impact of this knowledge on the quality of socio-economic, environmental and human development. The study sought to go beyond identification and evaluation and to find possible solution that learners could implement to address the identified problems or needs.

It was for that reason that the pertinent skills for the achievement of the outcome were connected to the aspect or component of 'service'. The latter offered many opportunities for meaningful and useful realisation of the identified skills. The envisaged connections were found to be potentially resident in either one or a combination of the SLP's components and common features, identified through the analysis of the best practiced SLPs. The features being referred to are explained briefly pursuant to further justification of assessment at this level.

In the first instance the **context for this study** was water care and management, a service provided by the municipality to the community that included the area of the study. The problems and needs identified that frequently affected both the community and the service provider included scarcity of water, water quality, waste water system blockages, and water leakage. The choice of the context was informed by the prevalence of water-related themes in the Grade 10 curriculum. It was also found to be relevant and accessible to all participants, with great potential for the enhancement of school-community coordination, which is one of the identified components of service learning, and this suggested that the purpose for the SLP was resident in its context.

Secondly the **purpose** of the project was inescapably dual namely, to serve and to learn. The two components were to be mutually inclusive and sought to address specific real-life needs or problems associated with water wastage and scarcity, as well inherent negative environmental impact. The process of addressing the identified specific challenges ran concurrently with service, which meant that the participants had to actively participate in serving-cum-learning process. The extent or grade at which learning took place was determined by the official curriculum statement and policy. This was associated and closely connected with the service learning component, namely active participation, which in turn could be associated with critical participatory action and influenced the study design methodology according to which data was collected.

In the third instance, the **participants were embedded** in a critical action of serving and learning. The engagement of the learner participants, community members, teachers and learners sought to address their own problem and needs. That was the case because scarcity and poor quality of water affected all of them. They needed to understand how and where that happened in their respective case. After that diagnostic search they felt challenged to act in a positive way according to their demands. That became different in that it was not a case of us-and-them, in which the municipality would have been on one side and the learners and parents on the other. That again had been directly linked to other service learning components, *viz.,* focus on community needs and school-community coordination. The participants' roles had to be clarified at the outset in order to enhance focus on the project.

Fourthly, **clear roles of participants** had an empowering function that motivated them to exert their efforts. Furthermore, the recognition, acknowledgement and consideration of the participants' views inspired positive participation. Parents supervised their respective study teams and facilitated the opening of communicative space with the community for the learners. On the other hand, the learners' assimilation of curriculum content with the community service and cultural/social wealth enhanced their respective performance in Physical Science. In the same vein, the study coordinating team members coordinated and facilitated their respective study review sessions well. The roles that each participant played afforded each an opportunity to extend learning and application of the skills and knowledge gained. The delegation and sharing of responsibilities expressed other components of service learning, *viz*., opportunities for extended learning and for the application of knowledge and skills. These increased the participants' conscious and amicable commitment to perform, thus the Performance Charter.

The **Performance Charter** was the fifth aspect that enhanced study focus and performance. Its mission and values assisted the project significantly, whilst the schedule and duration of meetings and activities' enabled performance within set overall timeframes. This principle was extended to the learners in that they had to ensure that they worked together in their respective teams. The guiding principles and values which directed the conduct of the participants had been helpful, and included respect, trust, care for each other and the environment, and humility. It was evident from the considerations of the Performance Charter that there was also a connection with the component of service learning, *viz*., the development of a sense of caring for others. It charted a way for the development of clear outcomes.

The Physical Science' specific skills as set out in the policy statement and briefly referred to above depicted clear outcomes that were linked to the comprehensive plan's activity 2.3.2 (see Annexure CT3). The skills themselves were more abstract without context, and it was at that juncture that the role of the teacher was found to be critical. This was because the learners' comprehension of the learning content was perceived as being dependent on the context and strategies used. These could mystify or demystify the knowledge learned and hence the skills to be acquired. The choice of contexts and strategies was the prerogative of the teacher, albeit within the provisions of the respective curriculum policy statements. The choice and use of contexts and strategies that mystify knowledge acquisition or knowledge creation disempowered the learners.

The disempowerment, however, did not end with learners in the school, but continued beyond the school bounds. Conversely, that choice and use was perceived as legitimising oppressive discursive practices that distorted policy positions and ultimately entrenched same through 'own' as opposed to 'public' social structural arrangements. Such contexts and strategies were further perceived as 'narrow' and ‘egocentric’, focusing on specifics or parts of a whole at the expense of the whole itself. They were further perceived as uncritical of issues they raise themselves and appraised their own without or with less appreciation of the other (‘self-appraisal’). It was on those bases that the transformational learning of Physical Science through service learning was imperative.

The strategy illustrated the point that specific outcomes as prescribed in the curriculum statements could be pursued through the transformative modes of teaching and learning. In that instance (*i.e.,* current SLP) the learners were to determine the extent of water wastages in terms of quantity and cost to the water user and the community; impacts on the physical environments in terms of erosion associated with rate of flow, health-related issues associated with pollution and pollutants and social responsibility issues pertaining to their respective contributions, as well as in relation to the enhancement of learners’ communication skills. Evidently, the SLP used in the study also catered for another component of academic curriculum integration. Communication and language, accounting, mathematics, Physical Science and real-life problems featured prominently. This meant that specific learning aims were not confined to the classroom.

In the sixth instance the aspect of **tangible products** of this study could be related to extent of water wastage and fruitless and wasteful expenses over a given time. Thus, the extent of savings could be determined following the interventions that specific learners initiated. The learning of Physical Science in these cases related to speed, flow rate, pressure and their effects to the physical environment. Furthermore, the developed SLP served as a benchmark and also influenced the development of service learning-related daily assignments for learners and worksheets. The discursive practices (de Beaugrande, 2006:31; Stein & Mankowski, 2004:21) that resulted from the project in turn led to the establishment of study teams for learners. It was apparent that the problem of lack of engagement of parents in teaching and learning could be addressed. The feature on tangible products also enhanced components of ‘opportunity extended learning and for the application of knowledge’. That was the case because the products were developed in collaboration with other participants and inputs and contributions were obtained through reflection sessions.

This seventh feature connects directly with the service learning component that deals with structured **time for reflection**. This was realised through interactive sessions that were arranged in accordance with the principles of human development. The critical reflection sessions of note were the learners-teacher and learners-parents-teachers engagements as these allowed, the participants to critique the pedagogic practices, such as preferred teaching strategies and stakeholders' participation in the learning environments.

Through these reflective engagements, the learners appreciated their roles in the community regarding respect and care for their environment and others. That was specifically observable when they debated issues regarding campaigns. One view was that the community members would not show any interest whilst others contended that the government and the municipality should be responsible because they were resourced. On the other side of the debate was the view that learners, where possible, should also play a role to make the community aware of the extent of damages. That group contended that some of the undesirable social practices were perpetuated by young people (learners included).

This discussion facilitated a process of identification of possible SLPs, which enhanced the participants' critical skills in problem identification and analysis, with the ultimate result of finding and applying the best possible solution. The participants were thus afforded an opportunity to have practical experience through the application of their acquired knowledge and skills to address their respective problems. That also enabled them to experience the value of teamwork, with which they could practice values of mutual respect while learning from and supporting each other. That mutual support and collaborative learning were achieved despite the diverse views that the members in the teams might have held. Such diversity was observed from the teams' respective arrangements of their respective study times, curriculum-related matters to be jointly worked on and times for the interaction with the teacher about team progress on specific matters attended. The work that the study teams performed was subjected to further assessment by the teacher, affording further opportunity for critical reflection between the teacher and the learner's study teams.

The SLP, learners' daily assignments and developed study worksheets served as the eighth aspect, **assessment** tools. These assessed the learners' performance on curriculum content and sought to enhance their assimilation or integration of real life needs and problems with learning. That assimilation manifested in actual solving of the problems at hand while at the same time improving comprehension of the scientific principles. Further assessment was made at a formal level, with control tests and examinations that covered aspects of the context of the study. The scenarios picked up, also sought to enhance the integration of Physical Science, with mathematics, the physical environment and other related subjects.

Through the assessment process, the coordinator for curriculum critically considered the research project and related assignments. His and the teams' review and inputs enhanced the project significantly. Also considered during the assessment process, were the responses provided by learners. It became imperative for the teacher to respond to the technical aspects of testing, for example questioning technique and balance between questions. That affected the issue relating to coverage of the social (affective) and cognitive aspects. The debate was inconclusive, and required further probing.

It is evident from the above assessment discussion that SLP assessment required due consideration of its features and components. Such components were not allocated scores and/or weightings lest they be reduced to other strategies. It is also evident that the assessment focused on affective as well as cognitive aspects, which could be related to service provision that is addressing real-life needs or problems through knowledge gained from curriculum and learning, as curriculum content also enhanced through its application to community needs and problems. In this sense, the assessment showed that service learning was not 'co-optive' but transformational.

The assessment, as it is, may not be performed by the teacher alone. The role of other participants was found to be helpful, as seen during the reflective session in which learners and parents showed the courage of recommending teaching strategies to teachers. That implicitly suggested that they had the potential to contribute to the enhancement of learning, notwithstanding challenges they may have regarding the command of the subject content. The participants played a role during the assessment process, with the teacher's and curriculum coordinator's roles being more overt and inescapable, while those of other participants focussed on the outcome of the learner performance. The learners' contributions in this regard could be traced to the quality of their responses and the extent to which they sought clarity on the questions they were asked. This meant that the teacher focused on both the content, context and the substance of the question.

Textual critical analysis was helpful for formal assessments such as tests and examinations, as also noted by the coordinators for both the study and for curriculum. They were introspective at items and agreed that teachers could send confusing messages to learners if they were not sensitive to or critical about what they said or wrote. Self-reflection and self-assessment were imperative and consolidated a trait of being open-minded in teachers and learners alike. It furthermore helped to encourage the participants to open up and disclose their problem areas without fear of criticism. Evidently, teachers needed to be empowered with tools and techniques akin to those of textual and discourse analysis. In the case of the study the critical discourse analysis technique addressed that challenge to a large extent. Furthermore, such tools needed to be couched in frameworks that sought to empower people to the extent that they were able to address their own challenges and problems. That could happen mainly if learners' socio-economic, cultural and political backgrounds were considered critically, as in that way their assessment would not be confined to numbers and figures, as often happens.

5.7 CONCLUSION

The chapter has presented a framework for the development of strategy for the transformation of learning of Physical Science. The strategy consists of five key reiterative and intricately interwoven steps, namely, preparation, planning, implementation, reflection, and assessment. This privileges service learning approaches over other strategies and attempts to illustrate how it can be used to transform the learning of Physical Science. It does not take for granted the power relation struggles, ideological inconsistencies or possible legitimisation of teaching and learning distortions that could be brought through teaching strategies, but demonstrates how learners can be motivated to learn through participatory and empowering action after having been challenged by their respective negative discursive social practices. The chapter demonstrated the aforementioned by discussing the suggested strategy and justifying it through its key elements of preparation; collaborative planning (or critical participatory action planning); pre-project training; creation of ‘dissonance’ for transformation through service learning strategies, implementation of SLP; critical reflection sessions; and assessment of SLP.

The preparation stage was depicted as a critical stage during which the conceptualisation of the project is enhanced. This was found to be critical in easing the processes for the identification of prospective participants and their subsequent recruitment to participate. That presupposed that people are most likely to participate in actions they understand fully. Subsequent to the establishment of the study coordinating team with well-briefed and informed participants, the team would then plan together and implement their plans as a collective. The planning phase in this regard focussed on tools and mechanisms that would enable the team to achieve the study aim.

The planning process identified training needs of the participants and committed itself to addressing them. The pre-project training discusses this issue at length and uses it to justify its consideration as an important feature of the strategy. The critical issues could impede the progress of the study if they had not received attention. These included, ensuring that members understood their mandate as contained in the approved proposal. It was also critical that all members of the coordinating team were familiar with technical issues, including CER and the FAI, as these affected data collection directly. The training on issues of safety during the fieldwork was also critical and was attended to accordingly.

In motivating the learners to learn the visit to the waste water treatment plant was found to have had the necessary stimulus. The participants were challenged at various stages of the sewer treatment process about their counter-productive discursive practices that burdened the treatment process negatively. The critical reflections afforded space to express views, experiences and suggested potential emancipatory actions towards redress or the addressing of real-life needs. These the chapter justifies as critical prior, during and post implementation of the SLP. Finally, the assessment of the strategy is another important feature, and as multifaceted as the SLP itself. It should not be reduced to figures and numbers.

Having outlined the framework for the strategy and justified with evidence its applicability at a secondary school, in the next chapter we summarise the study objectives and findings, making recommendations in respect of each of the five study objectives and the strategy.

CHAPTER 6

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS FOR THE USE OF SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE

6.1 INTRODUCTION

This study attempted to show how service learning could be used to transform the learning of Physical Science such that it is sustainable. This chapter provides a summary of the issues covered in each of the preceding five chapters, followed by the summary of findings of the study. The findings are organised in accordance with the study objectives relating to the need for transformational service learning of Physical Science; the components of the strategy; favourable conditions for its applicability and risks and threats that could potentially frustrate its operationalisation in relation to the evidence of its applicability. It also highlights limitations that might have been or would be experienced pursuant to transformational service learning of Physical Science. The gaps identified, as well as the extent of connections between the data and respective constructs, afford space for recommendations and issues for future studies. The conclusion also reflects briefly on the value of the study to learning facilitation praxis.

6.2 AIM OF THE STUDY

The aim of the study was to transform the learning of Physical Science through the use of service learning such that it is sustainable. This aim was presented in detail in Chapter 1, as part of the problem statement, allied to the main research question, **How can service learning strategies be utilised to transform the learning of Physical Science such that it is sustainable?** Pursuant to this aim and to the response to this question, the study demonstrated and justified the need for the use of service learning to transform the learning of Physical Science, including a search of the literature for components of service learning for possible adaptation' to transformational learning.

The components from the literature were thus compared with the data obtained to establish the extent of their relevance to the area of this study. Next, the study searched the literature for the conditions under which transformational service learning could be operationalised. It sought possible mitigating factors to build into the strategy to enhance its successful operationalisation. Lastly, lessons were drawn from the best practiced service learning initiatives for possible enhancements of the transformational service learning strategy for Physical Science.

6.3 SUMMARY OF THE STUDY

Chapter 1 introduced and orientated the readership to the study, highlighting the study question, aim and objectives. It reflected briefly on the teaching and learning of Physical Science, which tended to be inconsistent with the overall purpose of Physical Science and relevant legislative and policy imperatives. It also briefed the readership about the literature reviewed in respect of a theoretical framework, study design and methodology, as well as the use of CDA to analyse data. It opened a discussion on the use of service learning to transform the learning of Physical Science.

In **Chapter 2**, the study explored the literature deeper to establish the extent to which the study aim in this regard would be covered, learn from it and contribute to the prevalent body of knowledge. The literature was also reviewed in order to identify the most appropriate theoretical framework and appropriate approaches discussed which encapsulated the principles consistent with the CER were chosen. The operational concepts were also discussed with a view to enhance convergence of thought of the readership. The literature from the RSA, Botswana, Nigeria, Tanzania and Australia were searched for pertinent data and information regarding the use of service learning related strategies.

Through **Chapter 3,** the study then discussed in greater detail the study design and methodology that were consistent with the theoretical framework and respective operationalising approaches and principles. The principles of participatory action research (PAR) were central in this regard as they informed the three aspects of the study design, namely, the coordinating team, roles and tasks of the participants as well as the Study Comprehensive Plan. The chapter discussed issues that pertained to methodology, namely the data collection procedure, instrumentation and data analysis through critical discourse analysis. The socio-cognitive model of CDA was found to be helpful and appropriate.

The empirical data collected was interpreted and analysed in order to make sense in **Chapter 4**. This used Van Dijk's socio-cognitive model of critical discourse analysis and the data obtained in respect of each objective of the study was thus analysed covering its textual, discursive and social structural arrangements. The analysis process also attempted to relate the interpretations made to the literature, and it was on the basis of the analysis and interpretation of data that the study developed and implemented the strategy through which service learning was used to transform the learning of Physical Science for sustainability.

In **Chapter 5** the study presented the strategy to be used in respect of transforming the learning of Physical Science through the use of service learning. The pertinent aspects or components of this strategy are thus justified through supporting data. The key aspects which defined the strategy were preparation; planning; implementation of service learning project and assignments (or action); reflection and assessment. These were listed for convenience and once the interpretive phase commenced they were all activated. This is because they are reiterative and intricately interconnected. This characterisation was also found to complement and synergise with CER's steps, namely interpretive, analytic and educative.

Lastly, in this **Chapter 6**, the study presents summaries of findings, draws conclusions and makes recommendations. It further highlights critical areas that have been relatively difficult to achieve through the study. The summaries of the findings are also organised according to the study objectives and aim. In conclusion, the chapter highlights the critical areas of the research.

6.4 THE NEED FOR THE USE OF SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE SUCH THAT IT IS SUSTAINABLE

The findings for this objective are provided with due consideration of its respective constructs and constituent aspects. Following the findings of each construct the section presents the conclusions based thereon and makes recommendations based on the conclusions.

6.4.1 Legislative imperatives

The finding of the study in this respect was that the ‘learning and teaching practices of Physical Science were classroom-bound; examination-oriented and abstracted the learning of Physical Science. Thus, they tended to be uncritical and were mainly oriented to rote learning. As a result they were not capable of equipping the learners with skills, knowledge and values that would enable them to participate meaningfully in society as citizens of a free country. Nor were they capable of facilitating the transition of learners from education institutions to the workplace [or] to use science critically in line with the provisions of the critical cross field outcomes as provided for in the policy statements (DBE, 2011a:4, DBE, 2011b:4-5).

The conclusion drawn from this finding is that of possible disregard and disrespect for the education-related public mandates, as reflected in the official policy documents and legislation. Conversely, it could be concluded that such disregard and disrespect for legislative imperatives was a result of the quality of teacher training programmes and lack of continual teacher support and development. Issues pertaining to social transformation, human dignity, hope for a better life and social justice would be difficult to achieve. These principles are also legislative imperatives and public mandates.

6.4.1.1 Recommendations

The study therefore recommends that the Physical Science policy imperatives should be aligned with and should inform the teaching and learning practices of Physical Science. This will dispel discursive practices that are imbued with distorted policy positions and the arrogance associated with the subjugation of the principles of learning and teaching of Physical Science.

The study further recommends that the teaching and learning of Physical Science should be aligned with the critical cross field outcomes and the learners’ real life situations, preferably through teaching and learning practices oriented to participatory social transformation. One’s experience was that the alignment of policy imperatives with planning and teaching of Physical Science was empowering.

6.4.2 Mediation for transformation

The principles of social transformation, social justice, freedom, hope and peace on which teaching and learning are based explicitly call for mediators for transformation. The finding in this regard is that there were no structures or coordinating team that specifically focussed on ensuring that the teaching and learning of Physical Science also addressed them. The coordinating team of mediators with versed participatory interest in this also contributed their knowledge, skill and other relevant resources, to give voice to the learners and parents as well as the community whose views and viewpoints have been suppressed and excluded from the main Physical Science teaching and learning discourses. These mediate between the learners, considering their learning needs in relation to legislative imperative, and teachers, parents and other participants in education.

The conclusion drawn here is that, without a coordinating team of mediators for transformation who are committed to teaching through sustainable learning empowering environments (Mahlomaholo, 2010:11-12), transformation and efforts will lack leadership and management. They become amenable to ideological distortions and dominant political views and viewpoints that seek to perpetuate acts of exclusion, subjugation and marginalisation of ‘underclass’ groups such as learners and parents.

6.4.2.1 Recommendations

The study therefore recommends here that teachers should be afforded space for building their capacities within a postcolonial perspective. This should be part of their professional training and continual support and development while in practice, thus making greater sense of their engagements with the learners, the parents and the broader society. These should understandably also be integrated and related to their technical training.

6.4.3 Contextual and situational issues

The teaching and learning of Physical Science was found to be predominantly divorced from the learners' immediate real-life situations and contextual issues, that is their contexts and situations were for a better part of teaching not used to enhance or facilitate the creation of knowledge that was sustainable and empowering. Thus, the learners' prior knowledge, experiences and learning styles that they unavoidably brought to the classes were not used to initiate discussions. They were mostly taken for granted and ignored, leaving unaddressed those misconceptions of Physical Science related to learning and teaching. Furthermore, mutual understanding, learning and sharing of experiences between teachers and learners were scant and not recognised as useful.

As a result of the above, it is concluded that the learning and teaching of Physical Science could not have been sustainable as it was divorced from the learners' backgrounds. It did not create empowering knowledge as it did not dispel misconceptions or address the dissonance between newly learned concepts and what learners already knew. Thus, learning of Physical Science remained abstract.

6.4.3.1 Recommendations

The study therefore recommends that the learners' prior knowledge, backgrounds and experiences from previous encounters at school, home and society be considered in the teaching and learning processes. These factors should be used to enhance and enrich the learning of Physical Science as much as possible.

The study further recommends that the real-life situation contexts that are accessible and relevant to learning and addressing of needs and problems, *i.e*., service, of learners, parents and the community, should be used to enhance the learning of Physical Science.

6.4.4 Shared vision

The study discovered a lack of shared vision, mission and values towards the attainment of social transformation, social justice through the teaching and learning of Physical Science. This was customised to and informed by broader public mandates and legislative imperatives, found to have subsequently led to a lack of teaching and learning operations strategy. This in turn led to a lack of effective and efficient leadership and management of teaching and learning of Physical Science, thus there was an apparent lack of synergy and cohesion between and amongst the diverse and variant efforts related to teaching and learning.

It is thus concluded that the lack of cooperation between teachers and between teachers and parents, as well as the perceptions about the learners' negative attitude about and towards learning of Physical Science, were as a result of a lack of shared vision, mission and values. Conversely, the presence of a shared vision as well as teaching and learning operations strategy that is developed and owned up to, not imposed on, by its developers can bring about cohesion, mutual benefit and synergy between academic learning through contextual realities and service (addressing of real life needs and problems of the affected people).

6.4.4.1 Recommendations

The study therefore recommends that the teachers, in particular, should be provided with high quality support that would enrich their understanding and encourage them to commit to the course and vision of social transformation and social justice. Their understanding of postcolonial perspectives as part of their professional development and continual support programmes would be useful in this regard. As far as practicable this should also be intricately connected to the development of their technical competencies, notably academic content.

6.4.5 Strategic partnerships for transformation

The finding in this regard was that there was a lack of as far as it is practicable oriented to social transformation and social justice through the teaching and learning of Physical Science, at both micro and macro levels, that is within the school and between the school and external participants. These relationships had been predominantly imbued with excessive projections of legislative and institutional power struggle realities and were characterised by emphasis and application on the knowledge of so-called ‘experts’, to the disregard of ‘novices’. The imposition of the employer’s (representative) views and interpretations on employees was akin to the ‘master and servant ‘relationships that suppressed the views and perspectives of others to problem-solving and addressing common problems.

The conclusion arrived at in this respect is that relationships that are characterised by emphasis on status and power legitimise and encourage perpetuation of ideological practices of oppression, marginalisation and exclusion. As a result, they also encourage and focus on competition, which in turn leads to situations and social structural arrangements that classify and categorise institutions (e.g., failing, underperforming schools) and people (*e.g*., learners at risk, failing teachers) according to their economic and social categories. This in turn betrays arrogance in the language we use in public spaces on education-related discourses about one another, instilling fear and resulting in teachers not opening up for support.

6.4.5.1 Recommendations

The study therefore recommends that the relationships of mutual trust and respect for others and their views and perspectives be inculcated such that we establish and work as partners, signifying equitable consideration of our voices and views, of humility and commitment to addressing social needs and problems through teaching and learning of Physical Science. These would help the participants to feel free to consult, share their frustrations and misunderstanding and shortcomings.

6.4.6 Alignment of teaching and learning practices

The study found misalignments of Physical Science teaching and learning plans and strategies with the programmes of the participants, their interests, aspirations and work-related activities. The participants included social partners, such as the local municipality and community development organisations. The study further discovered that some of the challenges, such as shortages of teaching and learning resources, could be addressed through alignment of awareness campaigns.

It can thus conclude that the alignment of activities, efforts and interests of participants with diverse situational and contextual experiences, knowledge and backgrounds is a critical technique and tool that enhances cohesion and synergy towards a common goal. It also concluded that alignment is possible when different sectors, for example, education and local municipality, are involved. This alignment is possible within a single sector, albeit at macro- and micro-levels.

6.4.6.1 Recommendations

The study therefore recommends that the alignment of Physical Science teaching and learning at micro-levels earnestly consider the macro-level legislative imperatives. These include teaching and learning for social transformation and social justice to give voice and hope to the downtrodden, with Physical Science seen as a means through which they can address their local needs and problems. In this way the teachers can be free and transparent about their challenges, such that they can anticipate mutual and peaceful support from one another pursuant to their commitment to a social transformation agenda.

6.4.7 Reflective moments

The study found that critical reflections were not creating space and time during the processes of teaching and learning of Physical Science, thus denying teachers, learners and parents opportunities to raise related perspectives and views. Nor could they establish the extent of their collective strengths or weaknesses in the learning styles, opportunities for supporting the teaching and learning encounters, or threats that needed to be taken care of.

This led to the conclusion that reflections are pivotal to, and enrich the enhancement of Physical Science teaching and learning strategies and styles. The critical reflection and self-reflection can help users of these strategies to assess and support the learners' attainment of set cognitive skills and competencies, as well as the development of their social skills. Thus, critical reflection need not focus on academic aspects of learners' development only.

6.4.7.1 Recommendations

The study therefore recommends that critical reflection and self-reflection should be made an integral part of the teaching and learning of Physical Science. The purpose should thus be focussed on the extent to which learning is achieved, and reflections should also focus on the extent to which teaching strategies of Physical Science are learning-oriented, learner-centred, self-directed, problem-based, oriented to social justice, and transformational. Most importantly, reflective moments should allow those making them to contribute their views freely and equitably.

6.4.8 Collaborative learning opportunities

There was a lack of collaborative and participatory teaching and learning practices amongst the Physical Science teachers, which finding was attested to by the prevalence of such negative attitudes and practices as being impassionate about the teaching, as well as poor communication, abandonment of team teaching due to a lack of cooperation, disrespect for one another and their views, and a lack of planning the work together, even in instances when teachers taught the same subject in the same grade.

The conclusion in this regard is that teachers could not have been free to express their frustrations or weaknesses regarding the teaching of Physical Science to one another. This practice was extended to the prospective external supporters of Physical Science teaching and learning and as a result, teachers and by extension learners, could not learn from one another.

6.4.8.1 Recommendations

The study therefore recommends that means and mechanisms should be established and operationalised to establish collaborative teams, which would motivate the teachers and learners alike to develop relationships of mutual respect and trust. This in turn would strengthen the creation of collaborative learning among teachers, learners and between teacher, parents and learners.

6.4.9 Teaching and learning through sustainable empowering learning environments

A finding of the study was that the teaching and learning of Physical Science practices tended to lean towards being teacher-centred, examination-oriented and rote learning oriented, thus uncritical. They were inclined to be classroom-based and as such, in practical terms, incapable of facilitating the transition of learners from education institutions to the workplace. It was also found that the teaching and learning of Physical Science did not necessarily consider the learners' immediate backgrounds or out-of-school experiences as informing their understanding of scientific principles and concepts.

Based on these findings, the conclusion drawn is that learning and teaching of Physical Science was not sustainable, nor could it empower the learners with the social skills and critical thinking capabilities that would enable them to contribute effectively to social transformation.

6.4.9.1 Recommendations

The study therefore recommends that the learners' immediate backgrounds and out-of-school experiences should be considered for teaching and learning of Physical Science. This will enhance the creation of emancipatory knowledge that is meaningful and useful to learners, whilst also motivating them to learn Physical Science and not be more concerned about the time it would take.

6.4.10 Summary of findings, conclusions and recommendations

This summary of findings, conclusions and recommendations on the need for the use of service learning to transform the learning of Physical Science is based on those made above. First, the use of service learning to transform the learning of Physical Science such that it is sustainable has been demonstrably justified. Secondly, the conclusion is that the use of service learning to transform the learning of Physical Science also addresses issues of social transformation, through the creation of emancipatory knowledge. It can thus equip learners with the skills required in accordance with the provisions of the policy framework. Thirdly, the study recommends that means and mechanisms should be put in place to enable teachers to apply the strategy without being coerced by any means other than their understanding of postcolonial perspectives.

6.5 THE STRATEGY TO USE SERVICE LEARNING TO TRANSFORM THE LEARNING OF PHYSICAL SCIENCE SUCH THAT IT IS SUSTAINABLE

The key elements and features of the strategy presented in Chapter 5 are used in this section to organise and discuss the issues relating to the remaining objectives of the study. The main features that are referred to here are: preparation, planning, implementation of the comprehensive plan, reflection, and assessment. These are privileged because they were used to address the objectives of the study (see Annexures CT2 and CT3). As a result, the strategy reflects and represents the implementation of the recommendations made above. Similarly, the strategy provides and serves as evidence for the applicability of the use of service learning to transform the learning of Physical Science.

6.5.1 Preparation

The study found that preparation was vital to the use of service learning to transform the learning of Physical Science, permeating all aspects and features of the strategy. The study coordinator and coordinating team had to prepare for each activity that took place and it was found that written preparations were more helpful as it served as record and evidence of the activities. It was through the process of preparation that the study coordinator identified, engaged and recruited relevant participants to take part in the study also as coordinating team members.

Through the preparatory processes the study found, for instance, that team-establishment and teambuilding processes were progressive, communicative, and oriented to action. It evolved from the conceptual stage, through identification and recruitment, to the establishment of a team, but required patience and passion for what one does and hopes to achieve, that is a vision and mission. Through the preparation processes one found the key role of the coordinating team to be mediation for transformation of learning through service learning and the need for this to be clearly articulated. The coordinating team was to mediate between the learning of Physical Science and service provision as well as their respective myriad of challenges and opportunities, threats, weaknesses and strengths. This is because social transformation involves the community and the society, notwithstanding that it is also an indication or reflection of the extent to which individual learners acquired empowering and emancipatory knowledge.

We conclude that for the establishment and building of a coordinating team, the critical initial step of the strategy is to use service learning to transform the learning of Physical Science. The legislative imperative supports and creates conducive condition for the implementation of collaborative efforts and partnerships. The major threats for the team could be availability and uncoordinated programmes, as well as change of participants' work schedules. Its effective and efficient functionality can also be affected by a lack of leadership and managerial capabilities. This is the case because of the nature of issues with which the team had to deal, including the application of relevant knowledge and skills to address inherent ideological and political disparities and clarity in respect of what the study sought to achieve.

6.5.1.1. Recommendations

The study therefore strongly recommends that a coordinating team that facilitates and coordinate learning and teaching support initiatives should be carefully selected. The selection process should take into consideration the skills, competencies, knowledge and experiences required. It should be an equitable representation of these diverse and sometimes variant issues. It is also critical that the personal traits of team members that may be a weaker area should be known for possible enhancement of mutual understanding and application and adoption of relevant values such as responsiveness, respect, flexibility and diligence, as in this study.

6.5.2 Planning

The study's finding is that the planning processes were as critical as the preparation processes. These were intricately connected and mutually interdependent. The planning processes in this study considered, for instance, the development of the teaching and learning operations strategy, which included the development of a vision, mission, values, action plan and risk assessment. It drew up a Performance Charter and preceded by preparation of the venue, planning material and documents, as well as catering and invitations to the relevant participants. Depending on a number of factors, such as the demographics and logistical arrangements, the preparatory phase also included the contextual and situational analysis. The rationale behind the inclusion of the situational analysis was to find issues that needed to be considered and that would inform the activities of the plan.

For instance, whilst carrying out contextual analysis, identifying the strengths, weaknesses, opportunities and threats that related to teaching and learning of Physical Science, it was found that it was important also to consider political, economic, social and technological impacts and trends. It became imperative to the planning sessions of the study also to consider issues of the scope of the study as well as issues that pertained to data collection and analysis procedures and processes. It also had to address issues that pertained to the role of the participants in these regards. The approved study proposal served as a source document.

Based on the above explanation it can be concluded that this type of process and work required diverse experiences, knowledge and backgrounds. Thus it was vital to establish and build a coordinating team before concluding the plan which would otherwise be disowned by the coordinating team members. As it transpired, they decided to keep participation open and invited other people who could support the process to participate and contribute accordingly. This decision was informed by the lack of information and competencies, so subsequently training needs for the coordinating team members and learners were also decided upon.

6.5.2.1 Recommendations

The study recommends that the planning process should be the initial action that should be executed by the coordinating team. For the planning sessions to be successful, thorough and timely preparations need to be made. In view of the constraints of time and changes in the participants' daily work schedules, it is critical for the team to make arrangements that are flexible and accommodating. In this study the coordinating team encouraged engagements that were even outside the normal and agreed upon scheduled meetings.

6.5.3 Implementation of the comprehensive plan

The development of a mechanism according to which the study's operations strategy was implemented is another crucial finding. The coordinating team found it to be central to tracking progress of the study by objective, activity and key task. The implementation plan, as referred to in this study, also incorporated the risk plan. The alignment of the implementation plan with the Performance Charter, which also detailed schedule of meetings for the study coordinating team, was also found to be very helpful. Collectively referred to as the Comprehensive Plan, they were found to be complementary and so were kept together.

This act was helpful and all activities and actions were coordinated through only one document. Each coordinating team meeting reviewed and adjusted the Comprehensive Plan based on the progress made and reported. It also covered the components of service learning and transformational learning as activities and tasks (see Annexure CT3), which helped the study not to lose valuable information in this respect. This was inevitably found to be very helpful, as illustrated through the ***community-school coordination.***

In regard to community-school coordination the study found that coordination between the school and community depended heavily on the role of the Physical Science teacher. It is therefore critical that in the transformational service learning context he or she remains a parent, leader and a manager. He or she (the Physical Science teacher) plays these roles at school and in the community while acting in his or her formal and official capacity of being a teacher. The community also considers the role as credible.

6.5.3.1 Recommendations for the community-school coordination

The study therefore recommends that the execution of responsibilities and activities should be done in collaboration with community members. This collaboration will enhance the efficient leadership and management of the collaborative teaching and learning initiatives. The enhancement will emanate from the potential contributions of the diverse experiences and knowledge of the participants pursuant to supporting of the learning processes and organising of the resources from the community and public institutions.

Furthermore, the study considers as imperative the engagement of institutions of higher learning, for example, universities, with their capacities and expertise in physics, chemistry and teacher development programmes. Their participation in what the study refers to as a ‘community-based service learning centre initiative’ would inevitably enhance and enrich teacher support programmes, and most importantly the community members in respect of their participation in the socio-economic discourses. This is recommended because it would help address the challenge of the apparent lack of teachers' understandings of postcolonial perspectives. This would in turn encourage teachers to act as mediators who are also agents of transformation through the use of service learning to transform the learning of Physical Science. Another key issue would be to support teachers, schools and communities to prepare, plan, implement and reflect together on issues of common interest and value to the society.

This recommendation implies that teaching and learning should, as far as practicable, inculcate in learners a sense of belonging to their respective communities. Teaching should thus not divorce learning from the community and the homes of these learners, nor disregard the issue that learning and development are fundamentally global. Teaching should enable learners to notice their respective role in the community during and beyond their schools days. There should therefore be synergy between schools and the learners' home and communities and as far as possible be driven through purposeful learning and development processes. This study provides a practical illustration of how this could be achieved, namely through a study coordinating team that involved other partners. Teaching and learning should not be left to teachers alone, but rather that other role players should be encouraged to participate through their clearly defined and respected roles. A further motivation for other partners' participation is the relevance to their interests, needs, and problems.

This coordination is also found to be imbued with power, cultural and ideological differential realities to which the teacher and the study coordinating team should rise above through their leadership and management, with humility, respect and trust, whilst ensuring observance of freedom, equity, social responsibility and hope. This required critical communicative action to open up and broaden the communicative space, which meant that the learning facilitation and learning of Physical Science practices were open, transparent and accessible to all participants. Thus, there needed to be a coordinating structure for enhancement of harmony and orderliness.

With regard to the **focus on community needs**, the study found that addressing community needs fundamentally establishes and affirms aspects of empowerment and emancipatory knowledge that the participating learners acquired. This also relates to social transformation and it is concluded that addressing the community needs through the use of service learning may not be entirely divorced from learning. Such separation, if it happens, would be intentional and no longer be service learning. The use of service learning requires that there be mutual benefit for both academic learning and performing a social service to address a social need or problem.

6.5.3.2 Recommendations for the focus on community needs

The study therefore recommends that this component be pursued, as it would help to address issues of social transformation and empowerment of learners with emancipatory knowledge. The context of water services can help address social problems associated with water scarcity, water quality and caring for public resources for the sustainable service provision. This in turn will sustain learning of scientific concepts and principles meaningfully and more usefully.

This recommendation implies that the teaching and learning of Physical Science processes should ensure that schools are rendered relevant to their respective communities. The service learning strategy, as practically demonstrated in this study, focuses on addressing community needs to achieve this. It is imperative that the needs being addressed are thoughtfully, but critically planned in line with the pedagogic provisions as contained in the curriculum. Depending on the nature and extent of the need, the other participants should be identified for their critical and active participation. To this end teaching and learning process should encourage the identification of potential barriers to learning and service. These manifest in the forms of disempowering and oppressive practices. Some of which should be addressed by the active participation of other stakeholders.

The study also found that the learners' **active participation** in the learning endeavours through study teams embraced the principles of sustainable empowering learning environments. The learners' study teams considered and respected the learners' contextual realities and challenges. They helped the learners with alternative study methods that have a potential to address learning barriers such as the lack of listening skills, poor or ineffective learning styles and loss of interest in learning Physical Science. The styles referred to here are problem-based, learner-centred and oriented to social responsibility, thus making use of service learning to be learning-oriented and to promote active learning. It can therefore be said to be sustainable and hence worthy of implementation in our schools.

6.5.3.3 Recommendations for active participation

The study therefore recommends that the participants' active participation be encouraged, as should the service learning strategy. These would enhance the achievement of multiple learning objectives of which the participants must be made aware of, from the onset. In this study, the learners' active participation was encouraged through the use of diverse learning and teaching strategies, namely individual learning, and peer-learning (*i.e*., in pairs and in mono-grade and multi-grade learners' study teams), which are fundamentally self-regulated and problem-based strategies.

6.5.3.4 Recommendations: opportunities for application of skills and knowledge

The study further recommends that the use of service learning to transform the learning of Physical Science should be encouraged. The use of service learning afforded the learners an opportunity to apply their acquired academic skills and knowledge in real-life situations. For example, this was evident in the water leakage project, the preparation of meals and the cistern strategy. Thus, academic learning can be integrated with service provision out of which the learners can still be developed cognitively while acquiring social skills. In this way they are prepared for the transition from school for the workplace, that is those who may not afford the costs of studying further. This is evidently commendable.

6.5.3.5 Recommendations: extended learning opportunities

The study recommends that the learners should be afforded extended learning opportunities to give them hope that their performance and competency in Physical Science will improve. Teaching and learning of Physical Science through the use of service learning strategies affords learners an opportunity to learn from one another and from the service they perform. The learning acquired from service further provides opportunities that also include the acquisition of social skills that are capable of preparing the learners for workplace situations. In this way the learning opportunities are extended.

The service learning strategy should furthermore afford learners opportunities to learn from regional, national and global experiences. The strategy should endeavour to relate current learners' experiences with real-life 'global' scientific learning opportunities. These opportunities should *inter alia* critique such applications to the extent that they are sustainable or enhance sustainable development. The alignments should also consider organisation of resources that could further facilitate the enhancement of comprehension of scientific principles and concepts. The use of technological devices and resources should be considered as far as practicable. It is however imperative that teachers do not take for granted that such learning support devices and resources will be efficient and effective. It is critical that the strategy ensures that such resources do not mystify scientific knowledge and that they do not deprive learners of the opportunities to think critically. It is thus imperative that all these experiences are thoughtfully organised around and towards a set aim and objectives.

6.5.3.6 Recommendations: thoughtfully organised experiences

The study recommends that the relevant programmes and plans of the participants and the work schedules should be aligned with the development of a comprehensive plan. This alignment should be a collaborative and participatory action-oriented process to make it useful. The alignment process should be made through preparation and planning processes that should take place as part and parcel of the service learning strategy development and implementation. Thus planning processes should be integrated.

Furthermore, the study recommended that the planning and alignment of plans should ensure that efforts are made to reconcile and integrate the scientific concepts, definitions and principles with and within wider perspectives and global considerations. These should be carried out from within the subject and extended to the other subjects and even real-life situations. This should be done prior to the implementation of the plan, that is, as part of the planning processes. It is advisable to keep records of plans and implementation outcomes for future consideration.

A critical reading of the above shows that the discussion has integrated issues relating to the other objectives of the study. These are the conditions that are conducive for the use of service learning and risks or threats that might impede or impeded the optimal implementation of the strategy and evidence of its applicability.

The study affirmed and confirmed the importance for having time for critical **reflection** when using service learning for purposes of transforming the learning of Physical Science. This was found to be instrumental in ensuring continual enhancement of the development and implementation processes and mechanisms of the strategy to use service learning to transform the learning of Physical Science. It was also found and confirmed that its usefulness lay in it being an integral part of the processes of development and implementation of the strategy.

In order to enhance the effectiveness and efficiency of reflection, and based on the strengths and opportunities offered by preparation and planning processes, it can be concluded that reflections should be prepared and planned for. This should help in making them more focused, as they would address issues that pertain to the use of service learning to transform the learning of Physical Science. These issues would be mostly in the Comprehensive Plan, which it is further recommended should not be used to restrict or stifle discussions and inputs without rendering it useless. This will enable informed consideration of adjustments and review of the Comprehensive Plan, and by extension of the strategy.

6.5.3.7 Recommendations: reflection

The study therefore recommends that the service learning strategy should make provision for critical reflective sessions between and amongst the participants. The facilitation techniques used during these sessions should enable free and critical participation of the participants. The sessions should thus be sufficiently flexible to accommodate diversity in respect of the participants, as well as issues to be reflected upon. They should be structured in a way that will ensure effective and efficient use of time allocated. It would appear that these could be achieved through one or a combination of techniques, for example, taking place immediately after the incident; being directed by principles such as those used in Van Dijk's free attitude interview (FAI) techniques; being verbal and using face-to-face communication and being in writing. In these ways, diversity is accommodated and the participants can indicate the potential contributions of their respective skills and knowledge.

Through structured critical reflections, inherent risks and threats that may otherwise not have been identified, are ascertained. Those included in this study, refer to: lack of understanding of teaching and learning related realities by teachers (conceptual issues); lack of mutual respect and trust, to the extent that learners', parents' and teachers' frustrations that relate to teaching and learning of Physical Science are not brought to light and the withdrawal of resources from the teaching and learning environments (financial issues). Evidently, these issues may not be identified easily or ordinarily, but rather require critical yet structured value-based reflection couched within the principles of CER and an understanding of postcolonial perspectives.

Furthermore, reflection was found to be pivotal during the processes of monitoring, evaluation and assessment of the development and implementation of the strategy. This is because each of the assessment criteria of the use of service learning was found to require critical reflection and self-reflection. For instance, review of the learners' water project was a result of the teacher's self-reflection after a discussion with learners, which was also supported by the head of department's feedback.

It can thus be concluded that reflection was an integral part of the use of service learning to transform the learning of Physical Science. It can further be concluded that it cannot be separated from the intricately woven steps of CER, namely, interpretive, analytic and educative steps. It is thus recommended that the users of the strategy of service learning to transform the learning of Physical Science should integrate reflection in their efforts.

6.5.4 Summary of findings, conclusions and recommendations

As a summary of findings, conclusions and recommendations on the components of the strategy to use service learning to transform the learning of Physical Science for sustainability, the study found it imperative to base the preparations, planning, implementation and reflections for the study on the study aim and its objectives. This laid a firm base for addressing each objective through the use of its respective simpler, measurable, achievable, realistic, and time bound constructs and priorities. In this way the study found it relatively difficult to divorce the components from the conditions under which they were operationalised. Also, it was unclear how it was possible in practice to separate the two, that is components and conditions, from their respective threats and risks. In order to address this challenge the coordinating team decided to integrate these components and conditions, into a comprehensive plan through a process of alignment. This was done through a participatory action-oriented approach. It can further be confirmed and concluded that this action was in line with CER based mechanisms and principles discussed in Chapter 2.

Based on this, the study recommends that when using service learning to transform the learning of Physical Science, an implementation plan should be developed and subsequently used to track progress through critical reflections. The development and alignment of the implementation plan with other plans and programmes should be done in conjunction with the participants.

6.6 LIMITATIONS OF THE STUDY

The use of service learning to transform the learning of Physical Science such that it is sustainable can be constrained by lack of joint planning, mutual support and understanding amongst the participants. The absence of mediators of transformation was perceived as another limitation. The lack of communicative action creates a further limitation to the use of service learning to transform the learning of Physical

Science. This limitation is justified by the realisation that communicative action could give voice to the marginalised voices of the learners and the parents who seemed to have lost hope that teachers' and learners' performance in Physical Science would not improve. Thus, the lack of shared vision to inform collaborative effort towards the development of teaching and learning operations strategy; its alignment with policies at macro-level (*e.g.,* with critical cross-field outcomes) and micro-level (within the school), was central.

Another limiting factor was the use of power in such a manner that tended to undermine and disrespect the efforts made by the participants to address problems related to teaching and learning. This practice derailed progress of the study, as a result of the lack of transparency, humility, mutual trust and respect amongst the participants. Such instances were observed in cases where teachers or learners were not transparent about their problems or challenges in respect of teaching and learning of Physical Science. As a result, this tended to invite an imposition of interventions which usually appeared strained relationships among those affected.

6.7 CONCLUSION

This study attempted to develop and implement the strategy to use service learning to transform the learning of Physical Science such that it is sustainable. In this chapter the study began by restating the aim and objectives. Next, it made a summary of Chapters one to five, then presented the critical findings on the need for the use of service learning to transform the learning of Physical Science such that it is sustainable.

The chapter focused on the constructs of this study objective, drew conclusions and made recommendations in respect of each finding for each construct. It then summarised these in order to synergise and argue their implications for the objective as a whole. These were inevitably and inescapably related and affected the constructs that defined the components of the strategy; conditions that were found to be conducive to the implementation of the strategy; the risks and threats that could impede and impeded the functionality of the strategy and evidence of applicability of the strategy. This was carried out in order to show the relevance and significance of pursuing the objectives of this study.

Following this, the chapter used the main features of the strategy, namely preparation, planning, implementation of the comprehensive plan and reflection, to present the findings, draw conclusions and make recommendations in respect of its critical components. Following this, the chapter reflected on what was experienced as critical limitations to the strategy to use service learning to transform the learning of Physical Science.

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ANNEXURE CL1

511 Renang Street
MOHOKARE
9745
10 June 2011

Mookamedi wa Sehlopha
Ahanang Secondary School
Physical Science Grade 10 D
MOHOKARE
57945

Morutwana

KOPO YA HO NKA KAROLO HA HAO DIPHUPUTSONG TSA HO ITHUTA THUT'A MAHLALE KA MOKGWA WA TSHEBETSO (SERVICE LEARNING).

Ke etsa diphuputso tsa thuto le Yunibesithi ya Foreistata ho leka ho matlafatsa tsela eo bana ba ka ithutang le ho rutwa thut'a mahlale ka yona. Ke kopa o nke karolo diphuputsong tsena. Diphuputso ha di o tlose dithutong tsa hao di mpa di kgothaletsa ho sebetsa ka thata ho ithuta ka mokgwa o kenyeletsang maemo ao o phelang ho oona; ho ithuta ka oona le ho a ntlafatsa. Diphuputso tsena di tla nyalanngwa le dithuto tsa hao tsa thuto ya mahlale ka kotloloho mme di tla kenyeletsa ho etela dibakeng tsa tshebetso tsa tlhwekiso ya metsi tsa lehae. Bakeng sa potso tse keneletseng se qea-qeye ho mpotsa. Nomoro ya ka ya mohala ke 081 733 2400 mme e-mail ke: phehella@webmail.co.za

Ho nka karolo ha ho tlame mme o ka emisa hang ha o ka ba le kgwao ya hore maemo a diphuputso a fetohile ka tsela eo ho neng ho sa dumellanwa ka yona . Diphuputso di tla etswa ho ya ka melawana le dipehelo tsa ho etsa mofuta ona wa diphuputso tsa yunibesithi. Dintlha tse hlokolosi tse ka hlahiswang ke diphuputso di tla sebedisetswa molemong wa ho ithuta feela mme di tla bolokwa e le pinyane. Ha ho letho le tla dumellwa ho hobosa kapa ho mpefatsa boemo ba monkakarolo tlasa maemo afe kapa afe.

Ke kopa o tekene karolwaneng e fanweng ka tlase e le ho pakahatsa kananelo ya hao ya taba tse boletsweng ngolong lena:

Ke leboha tshehetso ya hao e sa le jwale.

______________ ______________

Lebeko Phehello. **Date**

ANNEXURE CL1

FOROMO E TLATSWANG KE MOTSWADI KAPA MOHLOKOMEDI BAKENG SA HO FANA KA TUMELLO HORE MOITHUTI / NGWANA WA HAE A KA NKA KAROLO DIPHUPUTSONG TSA THUTO KA MOKGWA WA TSHEBETSO

Bona ke bopaki ba hore motswadi / mohlokomedi mmoho le moithuti kapa ngwana bao mabitso a bona a fannweng mona ba dumela hore moithuti / ngwana wa bona a ka nka karolo diphuputsong tsa thuta ka mokgwa wa tshebetso tlasa dipehelo tse boletsweng mme le ngwana / moithuti o dumela ho nka karolo ka tsela e tshwanang.

A. MOTSWADI/MOHLOKOMEDI

Mabitso : ……………………………………………………………………………………

Aterese : ……………………………………………………………………………………...

……………………………………………………………………………………………

Mohala ……………………………………………………………………..

Tshaeno : …………………………………………………………………….

Letsatsi : …………………………….

B. NGWANA / MOITHUTI

Mabitso : ……………………………………………………………………………………

Aterese : ……………………………………………………………………………………...

……………………………………………………………………………………

Sehlopha (Grade) : ……………………………………………………………………..

Tshaeno : …………………………………………………………………….

Letsatsi : …………………………….

ANNEXURE CL 2

11 Dewe Street
MOHOKARENG
02119

10 June 2011

The Head
FS Education Department
Private Bag X 20565
BLOEMFONTEIN
9300

Dear Sir / Madam

REQUEST FOR PERMISSION TO CONDUCT A RESEARCH

This serves to request permission to conduct educational research based at the Ahanang Secondary School in the Education District. This study is done through the University of Free State. The topic is: transformational learning of physical science through service learning for sustainable learning. This is inspired by the need to enhance the learners' achievement of critical cross field outcomes through the production of useful scientific knowledge that they can relate to their real life situations.

This study will be coordinated by me, as the researcher also a Physical Science teacher at the designated school and a team of other five colleagues who may willingly avail their time and expertise for its credibility. These will include the school management development official, head of the mathematics and natural sciences department at school, a teacher and a member of the school governing body. Participants will be the grade 10 physical science learners. Other members of the coordinating team will be from the municipality as well as from the service learning unit/division of the University of the Free State. The study programme will be

ANNEXURE CL 2

informed and aligned to learners' and other participants' programmes as far as it would be practically possible in order to achieve the attainment of common goals *viz.* learning & service.

I am prepared to observe all ethical stipulations of conducting research such as among others the following: making prior arrangements to obtain consent from possible participants in the study, informing participants that their participation in the study will be voluntary and that they may withdraw at any given moment if they feel that conditions for participation have changed and that all data collected will be treated confidentially and will be used for the purpose of this study only.

My contact details for more information in this regard are the following: cell 081 733 2400 and e-mail phehella@webmail.co.za

Thanking you in advance.

Yours in education

________________ ________________

Phehella **Date**

ANNEXURE CL 5

11 Dewe Street
MOHOKARENG
9745
10 June 2011

Motswadi / Mohlokomedi

MOHOKARENG
9745

Ho : Motswadi / Mohlokomedi

KOPO YA HO DUMELLA NGWANA WA HAO HO NKA KAROLO DIPHUPUTSONG (RESEARCH) TSA HO ITHUTA THUT'A MAHLALE (PHYSICAL SCIENCE) KA MOKGWA WA HO SEBETSA (SERVICE LEARNING).

Ke etsa diphuputso tsa thuto le Yunibesithi ya Foreistata ho leka ho matlafatsa tsela eo bana ba ithutang le ho rutwa thut'a mahlale ka yona. Ke kopa ke hona hore o dumele, le ho dumella ngwana wa hao ho nka karolo diphuputsong tsena. Diphuputso ha di na ho mo tlosa dithutong di mpa di kgothaletsa ho sebetsa ka thata ho ithuta ka mokgwa o kenyeletsang maemo ao a phelang ho oona; ho ithuta ho oona le ka oona le ho a ntlafatsa. Diphuputso tsena di tla nyalanngwa le dithuto tsa ngwana ka kotloloho mme di tla kenyeletsa ho etela dibakeng tsa tshebetso tsa tlhwekiso ya metsi tsa lehae. Bakeng sa potso tse keneletseng se qea-qeye ho mpotsa. Nomoro ya ka ya mohala ke 081 733 2400 mme e-mail ke: phehella@webmail.co.za.

Ho nka karolo ha ho tlame mme moithuti ya nkang karolo a ka emisa hang ha a ka ba le kgwao ya hore maemo a diphuputso a fetohile. Diphuputso di tla etswa ho ya ka melawana le dipehelo tsa ho etsa mofuta ona wa diphuputso tsa yunibesithi. Dintlha tse hlokolosi tse ka hlahiswang ke diphuputso di tla sebedisetswa molemong wa ho ithuta feela leho bolokwa e le pinyane. Ha ho letho le tla dumellwa ho hobosa kapa ho mpefatsa boemo ba monkakarolo tlasa maemo afe kapa afe.

Ke kopa o tekene karolwaneng e fanweng ka tlase e le ho pakahatsa kananelo ya hao ya taba tse boletsweng ngolong lena:

Ke leboha tshehetso ya lona e sa le jwale.

________________ ________________

Phehello **Date**

ANNEXURE CL 5

FOROMO E TLATSWANG KE MOTSWADI KAPA MOHLOKOMEDI BAKENG SA HO FANA KA TUMELLO HORE MOITHUTI / NGWANA WA HAE A KA NKA KAROLO DIPHUPUTSONG TSA THUTO KA MOKGWA WA TSHEBETSO

Bona ke bopaki ba hore motswadi / mohlokomedi mmoho le moithuti kapa ngwana bao mabitso a bona a fannweng mona ba dumela hore moithuti / ngwana wa bona a ka nka karolo diphuputsong tsa thuta ka mokgwa wa tshebetso tlasa dipehelo tse boletsweng mme le ngwana / moithuti o dumela ho nka karolo ka tsela e tshwanang.

A. MOTSWADI/MOHLOKOMEDI

Mabitso : ………………………………………………………………………………………

Aterese : ……………………………………………………………………………………...

………………………………………………………………………………………………

Mohala ………………………………………………………………..

Tshaeno : ………………………………………………………………

Letsatsi : …………………………….

B. NGWANA / MOITHUTI

Mabitso : ………………………………………………………………………………………

Aterese : ……………………………………………………………………………………...

………………………………………………………………………………………

Sehlopha (Grade) : ………………………………………………………………..

Tshaeno : ………………………………………………………………

Letsatsi : …………………………….

ANNEXURE CL 6

11 Dewe Street
MOHOKARENG
9745

10 June 2011

The Municipal Manager
Mohokareng Local Municipality
PO Box 6234
MOHOKARENG 9745

Attention: Councilor Tsipho

REQUEST TO ENGAGE MUNICIPAL WATER TREATMENT PLANTS IN THE ACTION RESEARCH PROJECT FOR THE DEVELOPMENT OF A TRANSFORMATIONAL SERVICE LEARNING MODEL FOR PHYSICAL SCIENCES

This serves to request permission to conduct an educational research based on the municipality's water treatment works for the enhancement of Physical Science teaching and learning. This study is done through the University of Free State. The topic is: *transformational learning of physical sciences through service learning for sustainable learning*.

This study is inspired by the need to enhance the achievement of the transformation agenda items through the production of useful scientific knowledge that learners can relate to and actualize in their real life situations and needs. The study is a component of the bigger project viz. Sustainable Learning Environments lead by Dr. Thabang.

The study will be coordinated by me, as the researcher and a team of other five colleagues who may willingly avail their time and expertise for its credibility. These will include from the municipality's side the environmental health practitioner (i.e. as study coordinating team member), water treatment operator(s) (e.g. during learners site visits) and a community development worker (e.g. as study coordinating team member) for possible future community engagements and respective advocacy programmes to be developed through the study.

Other members of the organizing team will be from the department of education, UFS and the designated school. Participants will be the grade 10 physical science learners. Other members of the coordinating team will be from the municipality as well as from the service learning unit/division of the University of the Free State. The study programme will be informed and

ANNEXURE CL 6

aligned to learners' and other participants' programmes as far as it would be practically possible in order to achieve the attainment of common goals *viz.* learning & service

I am prepared to observe all stipulations of conducting research such as among others the following: making prior arrangements to obtain consent from possible participants in the study, informing participants that their participation in the study will be voluntary and that they may withdraw at any given moment if they feel that conditions for participation have changed and that all information obtained will be treated confidentially and be used for the purpose of this study only.

It is envisaged that the study will contribute significantly towards making learning in physical science more meaningful and practical to learners. There is also an important aspect of serving the community while learning through which the municipality and therefore the community will benefit. Learners will for instance develop and implement community awareness programmes on issues pertaining to environmental health where necessary.

The study programme will be aligned with the municipality's relevant divisional programmes especially the Environmental Health and Water Management Services for mutual enhancement and benefit. Finally, it is envisaged that the study will culminate not only in the development of a transformational mode of learning through service provision but also in the establishment of a means e.g. Community Service Learning Center to sustain it beyond the study and a school..

For more information please do not hesitate to contact me at 081 733 2400 or phehella@webmail.co.za. I will gladly welcome an opportunity to present this to the relevant committee of council should such need arise.

Thanking you in advance.

Yours faithfully

_______________ _______________

Phehella **Date**

ANNEXURE CL 7

11 Dewe Street
MOHOKARENG
9745

10 June 2011

The Municipal Manager
Mohokareng Local Municipality
PO Box 6234
MOHOKARENG 9745

Attention: Councilor Tsipho

REQUEST TO ENGAGE MUNICIPAL WATER TREATMENT PLANTS IN THE ACTION RESEARCH PROJECT FOR THE DEVELOPMENT OF A TRANSFORMATIONAL SERVICE LEARNING MODEL FOR PHYSICAL SCIENCE

This serves to request permission to conduct an educational research based on the municipality's water treatment works for the enhancement of Physical Science teaching and learning. This study is done through the University of Free State. The topic is: *transformational learning of Physical Science through service learning for sustainable learning*.

This study is inspired by the need to enhance the achievement of the transformation agenda items through the production of useful scientific knowledge that learners can relate to and actualize in their real life situations and needs. The study is a component of the bigger project viz. Sustainable Learning Environments lead by Dr. Thabang.

The study will be coordinated by me, as the researcher and a team of other five colleagues who may willingly avail their time and expertise for its credibility. These will include from the municipality's side the environmental health practitioner (i.e. as study coordinating team member), water treatment operator(s) (e.g. during learners site visits) and a community development worker (e.g. as study coordinating team member) for possible future community engagements and respective advocacy programmes to be developed through the study.

Other members of the organizing team will be from the department of education, UFS and the designated school. Participants will be the grade 10 physical science learners. Other members of the coordinating team will be from the municipality as well as from the service learning unit/division of the University of the Free State. The study programme will be informed and aligned to learners' and other participants' programmes as far as it would be practically possible in order to achieve the attainment of common goals *viz.* learning & service

I am prepared to observe all stipulations of conducting research such as among others the following: making prior arrangements to obtain consent from possible participants in the study, informing participants that their participation in the study will be voluntary and that they may withdraw at any given moment if they feel that conditions for participation have changed and that all information obtained will be treated confidentially and be used for the purpose of this study only.

It is envisaged that the study will contribute significantly towards making learning in physical science more meaningful and practical to learners. There is also an important aspect of serving the community while learning through which the municipality and therefore the community will benefit. Learners will for instance develop and implement community awareness programmes on issues pertaining to environmental health where necessary.

The study programme will be aligned with the municipality's relevant divisional programmes especially the Environmental Health and Water Management Services for mutual enhancement and benefit. Finally, it is envisaged that the study will culminate not only in the development of a transformational mode of learning through service provision but also in the establishment of a means e.g. Community Service Learning Center to sustain it beyond the study and a school..

For more information please do not hesitate to contact me at 081 733 2400 or phehella@webmail.co.za. I will gladly welcome an opportunity to present this to the relevant committee of council should such need arise.

Thanking you in advance.

Yours faithfully

Phehella **Date**

ANNEXURE T1: TRANSCRIPT – INAUGURAL MEETING

INTRODUCTIONS, TEAM BUILDING, CONTEXTUAL AND SITUATIONAL ISSUES IMPACTING LEARNING AND TEACHING OF PHYSICAL SCIENCE

DATE 07 AUGUST 2011 DURATION: 2:15:11 VENUE: THUSANANG TEACHERS' CENTER

PART A: INTRODUCTIONS

Phehello (study coordinator's opening remarks)**:** Ke le memme tjena hobane re re re na le planning session ya transformational service learning model for the teaching of Physical Science. E, mahareng a rona re na le Mohlomphehi Tshepang. Ke a kgolwa boholo re a mo tseba ntle le Ausi Ntsoteng. Ke Ntate Tshepang enwa Ausi Ntsoteng. Em, em, ke nahana hore jwale ka Me Bubi re ka buisana hore na le wena re o tlama jwang ho kena tabeng ya boitlamo ba ho etsa learning, but ke leboha haholo ha o ile wan ka monyetla wa ho ba karolo ya team ena. Tshepang jwleka ha ke ile ka bontsha ke memme batho ba mmalwa the leha ba so ka ba fihla mohlomong bat la tloha ba fihla. But our team that coordinate the structure its myself ke le convener le the leader of the team, re na le ausi tshedi, environmental health practitioner ha masepala, a kere ausi? Maar hobaneng ke le buella, a ko ipuelle (voice interjects: o tla re lebala. And meeting responds with laughter). **Ntsoteng** (*o itsebisa kopano*): Dumelang Nna ke Ntsoteng, ke environmental health practitioner ko ha masepala. Ntate Phehello o mmeme ho nka karolo ya study. **Bohlokwa** (*o itsebisa kopano)*: Bomme le bontate dumelang. Nna ke Bohlokwa, ke hlooho ya lefapha lena la natural sciences and mathematics sekolong sena sa Ahanang moo ntate PHEHELLO a leng hona teng. Re sebetsa mmoho hona teng. **Phehello** (*o tsebisa Mme Nkoya bo siong ba hae*): Ho feta moo re na le Mme Nkoya, advocate Nkoya ke chairperson ya SGB ka Ahanang. O ile a tsebisa hore ka bomadomabe date ena ha e dumellane le yena ka hore o ne a ena le business meeting Swatsing. So be re amohela kopo eo ya hae ya tshwarelo. (*o hlakisa dipalo-palo tsa boteng ba team*) So team ka bo yona out of 5, 4 yona e teng. Ntate Tsotello ke kopa o itsebisa. **Tsotello**: (*o itsebisa kopano*): Ke Tsotello Sebata, SMGD Motheo. Nkile ka sevisa dikolo kwano feela kolo tsa ka di Mohokare. Ke a leboha. **Phehello**: Ho feta moo ke ne ke ile ka mema ntate Moeletsi. Ntate Moeletsi itsebise wena o mang? (kopano e a *tsheha*) nna ke Moeletsi, retired Principal, ha ke tsebe hobaneng ha a mmemme. O kile a ntlhalo-tlhalosetsa, ke nahana ke yena a ka hlalosang hore ke ne ke le eng. Hantle ke 'retired', ke le principal, initially ke ne ke ruta science. Ka mokgwa oo a hlalosang ka oona mokgwa oo ke neng ke mo ruta ka oona o bona hore project ena ya hae e ka una molemo o itseng. He is one of the students bao ken eng ke ba ruta physical science. O hlalositse mabaka a hae… mme le nna ke ile ka utlwisisa hore ke tese ho hong nka kgona ho mo thusahong. **Phehello** (*o etsa motlae qetellong ya boitsebiso ba ntate Moeletsi*): Eee, ae, ntle le hore o ne o re shapa haholo…(*phutheho e hasana ke ditsheho*). Hantlentle ke ne ke hopotse hore Tshepang, at the end of the study, to sustain service learning, ho be le community based learning center. Ka mantswe a mang e be driven from the community. Mme ke ne ke nahanne hore ntate Moeletsi, ka baka la boiphihlelo ba hae a ka kgona ho re thusa ho ba karolo ya that community based center, just to sustain tseo re tla beng re ile ra di fumana. And then pela ka ke na le lekgowa (*phutheho e ya tsheha*)O wa bona ke o jeketse ke dutse pela makgowa. **Lebohang** (*o itsebisa kopano*): Nna ke Lebohang. Ke principal Ahanang, ke sebetsa le ntate Phehello, ke sebetsa le Me Bohlokwa. Ha ke yo lefapheng la di sciences, empa tjhe ntate Phehello o hlalositse lebaka la ho ba teng during the session, le ka mora mona dintho tseo ebang di tla etsahala. Ke ka hook e boning ho le bohlokwa hore nka ba teng..**Phehello** (*ka ho swaswa, o kopa Tlhokomediso ho itsebisa*): Lekgowa le leng ke lena. **Tlhokomediso:** Eee, nna ke **Tlhokomediso**. Ke principal Ikaheng mane. Ke ne ke ntse ke le titjhere ya science. Ntate Phehello re sebeditse le yena haholo, re ntse re sebetsa le yena di-scienseng mono, mme ke dumela ho na le hong ho re ka ho etsang hoba re etsa ntho e le nngwe at school level. Thank you. **Bubi**: Nna ke Bubi, ke sebetsa sekolong sa Ikaheng. Ke hloho ya lefapha la giografi. Ntate Phehello o ile a mmema hore ke tlo ba teng kwano. Ho tlo buuwa taba tseo e leng hore mohlomong ka mora mona ke tla kgothala (*phutheho e ya tsheha*). **Phehello** (*o netefatsa ho tsebisa Tshepang*): Ke a kgolwa Tshepang wena ke ne ke se ke o tsebisitse! (*Tshepang o araba ka ho kopa ho itsebisa mme o dumellwa ho etsa jwalo*). ***Tshepang***: Ntate Phehello, ee, le team ya hao ka nnete re lebohile haholo ka memo ya ho re bitsa re tle kwano, re tlo ba kwano tsatsing lena la kajeno. Ntate Phehello, ntate Moeletsi le team, ee, ke e mong wa… (*ha qetele polelo otswela pele ka e nngwe*), re na le…(*ha qetele* *polelo o tswela pele ka e nngwe*) ke qadile mona UFS ka January lemong sena. So.., ho fihlela hona jwale re kgonne ho rekruta 30 sinia students and 21 of them ba etsa PhD and 9 ba etsa Masters. Jwale it's a very grueling experience to get registered and go through the motions and so on. So…, Ntate Phehello was one of the first 4 people ba kgonneng hore ba ye through the title registration. Ke hore ke,.. you really get grilled through the process. So, he is one of the first four that went through, and ee, ho tla ha rona mona ke ho tla sheba hore na will this kind of an approach of doing research and learning, will it really, really, really work for the rest of the team. So, lentswe leo a sa le rateng leo re le sebedisang ke la hore ke 'guinea pig' ee, **ke yena pele eo eleng hore…** we are trying to collect data at the same time provide the service to the community. So, maikemisetso a rona for the whole team, hore we will have similar projects for all the 30 people. And they are spread throughout South Africa, Mme Bonolo o na le motho ya sebetsang le yena mono, they are also involved in something related to this, mme ebile yena o tlile mona hore a tlo sheba hore na a ka nka malebela a feng. So ba teng batho who are doing something tse related although not exactly the same but who are using similar projects. Jwale Mohokare mona ntate Moeletsi re batla re na le ee.. really soft sport ya hore this could really be the nodal point moo e leng hore this whole process other than Thabure le Thaba-di-Mahlwa moo e leng hore re a hola teng. So, ntho e nketsang excite eo ke ratang ho bua ka yona hanyane; ke bo teng balona as responsible community people. Ka nnete bo teng ba lona really to support this in a sustainable beyond just the research. We are hoping hore ee.. ke hore hona le ditlhoko tseo eleng hore bana ba dikolo, especially ba natural sciences o fumanang hore ha di paswe hantle; tseo eleng hore as a country really bokamoso ba rona bo itshetlehile moo. Ha re ka ra fumana a strategy ya ho titjha those kids very effectively e leng ke bona eka ntate Phehello is proposing, re tla be re na le a model eo re ka ra e replicatang throughout the country. So, ntho eo re e hlokometseng hape ke hore 'to educate a child it takes the whole nation' hase effort ya matitjhere feela; that is why participation ya lona e leng bohlokwa ho tlisa dimension of the community moo e leng hore re le mahatammoho kaofela moving in the same direction; especially with your expertise and experiences ya lona Ntate Moeletsi, Mme Bohlokwa your connection with the communities and so on. Ke hore ke the value eo ke nahanang hore we are adding to the project as a whole. Ntho eo a mpolellang yona ke hore o batla ho tla ka study e tlo enhansa understanding ya bana ya physical science through them contributing significantly to the community, hore they are providing a service to community, the kids; but in the same process that they are providing a service, they are learning. And in that sense learning ha ebe feela an academic enterprise but e na le that community responsibility dimension. So, last point o re, in the end mohlomong ke di sciences feela but the intention ke hore it could broaden up that jwale ka batho ba Masepaeleng wa Dinokaneng really we can be proud of, etla re nyolla taba tsa hore academic e le ya rona, jwaleka batho le bana ba rona and everybody ho tla ba le di activity tse exciting maybe on weekly or monthly basis moo eleng hore the university will be there, the community will be there, teachers will be there and other communities from all over will be there. So ke ka mokgwa oo ke e utlwisitseng ka teng and this is what really makes me very excited, very emotional with the process. Ke moo e leng hore ke hlokomelang hore there is so much expertise eo re nang le yona, e leng hore if we can really pool it together… ! Ha ke sheba batho around the table, batho ba di sciences mona are in majority, and ee ke nahana hore if we really can pool our resources together we can really make a significant contribution. So, ee.. ke ka moo ke ikutlwileng ho iketsa introduce ka teng. **Phehello**: Ke a leboha Tshepang (*o sheba moeti ho tswa Mohlakeng*) hobaneng o le teng moo? **Bonolo**: Tshepang o ntlhalositse hore ke karolo ya study…so as a ‘genuie pig’.

PART B: TEAM BUILDING EXERCISE

2. Getting to know each other better & team building

Phehello: Re mpile ra ba tlasa pressure ke hore other colleagues did not turn up. Leha ho lejwalo I thought ho bohlokwa re tswele pele ka programme. Hantlentle programme ya rona kajeno hona le activity ya team building, so we did not want ho senya nako ya the bigger team. Ee so beneficiariy maybe e ne a tla ba batho bao re etsang ntho ena le bona. But maybe as an indication kapa ho e hlakisa feela: re le bahlano, re ne re itse re batla ho tseba hore na ke eng seo e mong le e mong a se tlisang to the team and therefore to the study in the form of his or her personal traits, characteristics and so on and so forth, but ka sepheho sa hore **one**, re tsebe ho mo hlokomela ha re ntse re tswela pele to the benefit of both the study and the participant, the team member. **Second**, eem.. e le hore re bone hore na ke eng sena seo a se tlisang ke eng seo re ka se sebedisang molemong wa team. Mme re na le dipotso tseo re neng re di botsitse jwale maybe for purpose ya rona se potlakileng re tla sala re etsa consolidation ya taba eo ka morao. Hore re kgone ho fetela stepeng se hlahlamang. Ke hore feela Ausi Ntsoteng, Ntate Tsotello le Mme Bohlokwa together with myself re hlalose feela hore na what is it that is our best attributes or worst attributes that we bring to the team, and then re be re sentse re bolela hore na if we were to liken or resemble our team to an object what would that object be and why, and then re be re discussa feela in short what is that they think the team e tlamehile e be le yona eo re sherang in common. Because ke ka dintho tseo re di sherang in common re ka kgona ho sustaining the life of the team le hore team e se key a shwa. E re ke qale ka Mme Bohlokwa. **Bohlokwa:** Le hoja hangata ke sa thabele ha ho qalwa ka nna, empa he ha o qadile ka nna ke a leboha. Feela o se ke wa mpotsa hobaneng. Hobane pots e jwalo it's a panic question. Hangata ha o qala o mpotsa hobaneng I tend to defend myself. Re ne re tseba hore ha o botsa hore hobaneng eba phoso e teng mme se latelang re a se tseba. Mme ke bone le bana ba rona bana le bothata bona.. E…ke motha ya ithatelang di jokes haholo Mme ha discussion ha dib a serious di nketsa intimidate, haeba ho hlokahala. Mme ntho ya bohlokwa haholo ke rata ho ba nakong ho qala ka nako ho qeta ka nako. Kopano tse kgutshwanenyane e seng tse telele. Mme ke ye utlwe batho ba re ke motho ya bonolo, ke motho ya mamelang, ha o bua o bua o iketlile. Nna ha ke imametse ke ye utlwe eka ke potlakile. Ntho eo ke sa e rateng ka ho fetisisa ke ho faela. Ke hore ha o qala o mpha ntho o re ke e faele o mpha bothata. Team ena ..empa tse ding tsa ron empa hantse re ya pele ho tla bonahala hore ke motho ya jwang. **Phehello:** Ke eng e molemo eo o tlisang seoo study study se ka e una le wena wa se una. **Bohlokwa:** Bothong ke nahana study se ka una, ke rata ho rarolla mathata, haholo khalkhuleishene. Ke a kgolwa le hona saenseng …hona le di khonsepte tse ke nahanang nka thusa ka tsona…

Tsotello: Ke a kgolwa e nngwe ya di best attributes tsa ka ke nako, leha kanako e nngwe e ba negative hoba boholong ba nako ke ba panktjuale mme ba le bofokodi ba ho hloka mamello ha nako e sa respectuwe. Empa ntho enngwe jwaleka Mme Bohlokwa ke motho ya nang le huma (humor) ebile ke a e rata. Ke nahana e tla re sebeletsa kae-kae. Ntho e nngwe hape eo ke nahanang kena le yona ke hore ke kgona ho sebetsa extended hours, ke a kgolwa e bile batho ba bang bay a tseba hore boroko ba ka bo bokananyana. Maybe it can be an advantage haeba hohlokeha. Jwale se ke se tlisang mona e kaba taba ya position ya ka, the contact eon ka bang le yona le batho ba curriculum, the district as well as le ba management haeba ho ka hlokeha re interact le bona foe some or other reason, le taba ya hore e be motivation for the team e le hore re se ke ra fella tseleng. **Ntsoteng:** Ke a leboha ntate Phehello. Emm..ke arabile ke re ho best attribute ke nahana hore ke rata ho ruta nna more than anything. Ke rata ho shera noleje le batho. E re ke setate ke re environmental helth is very diverse so ke rata ho bolella batho hore, this, ke bue aspect tsa environmental health ke ba bolelle hore how they are related to us and how they are related to the community. Ke a ruta. Ke hore ha nka etsa mohlala, from ko technicon ba romella di student ho tla dira community training for a couple weeks. Ha re dire feela the practical part, **nna** ha ke dire feela the practical part le bona ke hore ke batla hore before re tswa re ya filding ke be ke ba rutile ke be ke ba botsitse hore le ilo dira eng today: ha re re vector control re bua ka eng, lo e tseba ho fihla kae. Ke rata ho ruta. Ebile ha ke le monnyane ke ne bitswa titjhere le today they still call me a teacher. Ke, ke nahana that’s the best attribute ever eo ebang ken a le yona. Emm.. ‘ja’ ke a rata ho shera knowledge. But the worst of them all ke ‘temper’(*pause*); mare ke a leka ke ya leka, I do my best ho trya ho e controla, mare e ya tsamaya ntho e, e (*emphatic*) seng kgolo mare e e tonna eo ka lebellang e be sa nkwatise, e nyane e o sa lebellang e be nkwatisa. Ke ne ke tlotlela ntate ka mola ke re last re ne re tswanetse hore re submite report ya me e be ho na le motho ya e delitileng (*deleted*)... **Phehello** (interjects): mare ha se se ntho e nyane eo (*meeting laughs*). **Ntsoteng** (*continues*): Mare moo project ee ke nahana nka thusa kapa nka leka ho shera that nolej I hev, ke e shere le batho. Object eo nka e tshwantshang le yona, nka e tshwantsha le ‘tennis ball’. Because when you hit it very hard, it bounces back, a kere. The harder you hit me the harder I bounce back…. **Phehello** (*enquires from Mme Bohlokwa*): Ha re a utlwa Mme Bohlokwa hore objecte ke eng. **Bohlokwa:** (*responds, jockingly*): Ke ile ka utlwa hore o se o ntse o le ‘guinea pig’ (*meeting laughs*)…o ya tseba ho na le dintho tsena tse bo plastic tseo o tla e suwa, o e suwe e ye kwana, e ye kwana e ye kwana. But ultimately o fumana hore e ‘retaina’ its shape. Ke nahana hore ke iketsa associate le ntho e jwalo, for I am aware hore le study se tlo re suwa se re suwe re ye kwana re ye kwana, but re tla lokela ho to retain shape ya rona. **Phehello:** Ke rata hore ke a leboha colleagues hoba mme Makgabane ha a yo. But the idea, mme ke tlo kopa ha re dumellana re emise exercise ena mona, but e ntse e tlo tswela pela, I think between meetings I will pursue this further, because unless we know each one a ka ba strong kae, ha re na ho sebetsa. For instance ke utlwile ntate Tsotello le Mme Bohlokwa ba rata ho boloka nako, and personally ha ke motle ka nako ha ke tsebe ebe o jwang ka nako Ausi Ntsoteng? **Ntsoteng** *(responds)***:** Ha ke motle ha kalo ka nako**…,** Personally, ke motho ya ratang ho tsheha, ya bulehileng, ya tenehang at times. E leng bofokodi boo ke bo boning. Mme matla a ka ke bone eka ke kgona ho hatella maikutlo ao. But he ke nahana hore working together with colleagues re ka atleha. Object eo ke nahanng re ka associate team le yona, ha se object ke phoofolo, ke tlou. Ka seboka ke motaung feela ke utlwile ke rata tlou hobane ha e je fatshe mona, ene e ja ntho tse thata tse seng tse bonolo. E hlile e refohile, tjhehe leha ke le mokgutshwanyane (*phutheho e ya tsheha*) e hlile ke refohile. So that is just my view, the strength, ntho eno ya hore e fihlela le ho labalabela things tse higher, tse hodimo. Hodimo e signifaya hore the sky is the limit tjhe ke morena feela the sky e ba the limit ha etla…,. So, ke nahana re emise mona but the whole idea is based on this information re leka ho bona na how best do we built the team traits tsa rona re le team and how do we enhance ntho ya ho tswela pele ka study, le hore re mamellana jwang for the sake of the team the study and ourselves. **Phehello** (*on performance agreement as discussed among and with team members prior to the session today*): What I also think we will be doing later ke hore our progTlhokomediso re tlo di align le study such that ha re disadvange one another mosebetsing wa hae. Ke nahana hore ha re qetile re tla be re saena performance agreement, ke guideline feela eo re e entseng ya…, ke nahana ha re ka ra shebisana feela. Guideline eno e re thusa ho bontsha, re tla ba le vision, mission, values. Values ke se ke ntse ke utlwile taba ya time management, taba ya perseverance, things like that will then be included then re tla be re na le annexures to the performance agreement, and then re tla outline roles and responsibilities. Kgopolo e ne e le hore tsatsing lona lena re tla completa execise ena mme re qetele re saena, there is a draft already. Maybe to share with Ausi Palesa and Palesa and Tshepang, we have discussed this, le bo ntate le Mme, mare we cannot sign it today, re ne re hopotse re tla e saena tsatsing lena, but then we have to incorporate these on the plan, refine it, because the whole idea ene e le hore this session be re se re ntse re di lokise. But e ne e le ntho tseo re neng re tla iketsetsa tsona re bang jwale ke nahana ha re le tjena re se k era serva interest tsa rona re le bang. Ke chart e tla beng e re thusa hore re be focus hotla ba le issues of time, hotla ba le issues of respect. Re tlameha re tlo tseba hore na ke eng dintho tse nyane tse ka etsang hore Ausi Ntsoteng a … (*voice from meeting completes the sentence*) a ntshe batho kotsi... **Phehello** (*continues)*: Yes. Ke ne kehopotse re fetele pele moo re tlo etsa situational analysis, ntle leha eba ho na le ho hong. Programme ya rona item ya bobedi ke moo re tlo etsa situational analysis. Ke mona moo re neng ke memme bo ntate Moeletsi, Tlhokomediso, Mme Bubi, le Ntate Tshepang. Ntho eo re sa kopang tshwarelo ka yona ke ba memuwa ba sa kgonang ho finyella. Mohlomong Ntate Tshepang o tla bua ka yona ha a re ateresa.

PART C: SITUATIONAL ANALYSIS

Phehello: Ke bona bana ba rona ba sa sebetse hantle science. Mme ha ke ne ke fihla ka sekolong re ne re se na ngwana leha a le mong ya neng a pasitse physical science, ke bolela grade 12. Ke bolela lemong se fetileng. Ha ke tsebe ka Ikaheng ba ne ba pasitse jwang, ha rona re ne re na le zero. Mare re ne re na le bana ba tlang sekolong, re na le matitjhere a neng a ba ruta, re na le bontate Moeletsi ka experience, re na le ntate Tlhokomediso neighboring school mohlomong o ya atleha, re na secondary school ka toropong ba nang le di resources mohlomong laboratory; mare failure rate ya science e bonahala e ntse e phahama. At first ha ke ne ke utlwa hore bana ba feitse ka tsela eo, ke ile ka lwana ka re matitjhere a ntse a sa ba rute. Unfortunately lemo se hlahlamang ke ha ke le ka hona ka sekolong seo, ke a kgolwa ke sebeditse kgwedi sebeditse ya pele, ya bobedi ke ha ke re ke kgutlela matitjhereng ao ke neng ke re a ntse a sa rute bana, bo ntate Ncwada, ka fihla ka re ho bona ba ntshwarele, ke ne ka sa tsebe tab eo ke neng ke e bua (*ho ya tsheuwa*). Jwale se neng se etsa taba ena ene ele hobane ke re boleng bo neng ke bo bone ba bana bao re nang le bona, and le lemo se fetileng ke sokotse jwalo feela, hobane out of bana ba 29 bao ken eng ke ba ruta ho pasitse feela 2. Jwale ntho e neng e nkutlwisa bohloko ka ho fetisisa ke hore ke ne ke ya afternoon bas a tle, key a extra clsses dikolo di kwetswe jwalo. Really the purpose ke hore feela ha nke ke utlwe Ntate Thabang, Ntate Tlhokomediso, Mme Bubi;..ke eng eo le bona eka ke bothata, ho ka etsuwa eng. Hona ka mora moo ke tla be ke kopa Tshepang mohlomong hlakoreng la unibesithi hore o bana e ka bana bao re ba romellang unibesithi, bona bana ba pasitseng grade 12 how do they fare ba sebetsa jwang di science ba sebetsa jwang, what are the numbers, ba qeta, what could be the problem. Also re sheba your experience maybe ha o ntse o tsamaya dibakeng tse fapaneng, ke eng eo reka ithutang yona ho kae. Ha ke qetela, bekeng e fetileng e ne e le science week, re entse eng ke ruta science ha ke tsebe, ho etsahetseng re enste eng locally, re arengitse eng… Ntate Thabang na o na le hoo o ka ho sharing?

Lebohang: Aaa… ntate Phehello I think ke ne ke batla ke shera the same sentiments one, eitse ha ke ke bona diresults tsa science di ntse di dropa sekolong 'it became a worrying factor to me, hore na ho etsahala eng ka science. And at the end of the day I also started blaming teachers; to say ha le etse mosebetsi wa lona, you are not doing your job I don't understand. Ntate Phehello o ne a ntse a re thusa in the past ha a ntse a le department of education before a ya municipality and bana ba ne ba ntse ba pasa all of a sudden ho na le this drop of the results. And all the time e fana ka ntho ya ho re ho etsahalang. Ke bana kapa ke matichere. Let alone that the under resourced schools hore o fumane hore laboratory ke laboratory ke eo re a e bona but it does not have requisite material re ne re fumana material re adima ho ERC. But kena le worry ena ya hore na do I really have to blame learners, or teachers; do I really have to blame the department. Ha ke sure hantle hore na currently na ke mang eo ke tshwanetseng ke mo bleime. One other thing eo nna ke ileng ka e realisa ka bana kenang ho rona, ke hore they decide to take science ba se good at science or maths ba ya dihelana le di friends; ke ya kamoo hoba tichere o ruta hamonate ke ya kamoo. But at the end of the day o iphumana a le stuck ka moo ha a sa kgona ho ya pele…but all in all I cannot ke bleima bana feela, I still have questions ka department hore na e re thusa jwang hore bana ba bone boleng ba science I still blame teachers because ha ke so bone basically hore ho etsahala eng, ke eng. Ha ke a etsa science ke e dropile le mathematics ka etsa histori. But I like science hona jwale I find it fascinating…maybe ho ka ba le di interviews ho dulwe fatshe ho etswe research ho lekwe ho fumanwa mabaka a hore ho ka etswa eng. Ha ke tsebe leh eba ka Ikaheng di a dropa le ka teng but ke tseba Ikaheng doing well in sciences. Another thing eo ke ileng ka e understand ke hore universities are complaining to say le bona ba pasitseng ha ba matche standard seo university e lebeletseng ba be ho sona.

Phehello (*o kopa diphehiso*): Bo mme le bontate ke kopa re bueng haaeba hoeba ho na le ho hong. Ntate Thabang na ho theoha hoo ho bile abrupt kapa e bile process?

Lebohang: Ebile process, e nkileng bo three years, but ene e matha bo di 80’s ya theoha 70’s for three, four years. Jwale Ntate Phehello o ile a tla a botsa hore ho etsahala eng jwale ka ha a ntse a bleima matitjhere I was in the same boat le yena. But eitse ha se a dutse le bana ho utlwa hore ke eng bothata…

Bonolo: Ntate ke nahana hore ke kobo anela. Taba ena ya performance ya Physical Science ha se Ahanang feela, throughout the country, ha ho analyse di results end of the year o fumana hore tse sebetsang hampe e nngwe ya tsona ke physical science. E kare this thing is systemic because ha sheba bana ho tloha grade 9, bana ba etsa what we call NS (Natural Science), and what constitutes NS, e constituta ka life science, geography, e na le agric, e na le physical science. So the problem ke ya hore the four subjects cannot be taught equally grade 9, so bana ba hloka basics. Ha o ba botsa ka force ha ba tsebe na ke eng… hape ha o sheba morao hape hap eke yah ore drop ena e qadile four five years ago, ha re sheba issue ya hore ke re feela at the moment e shebahala e le kobo anela at the moment number one, number two ke proble ya system that is why ho introdusiwang CAPS ***because ha ho sa tlo ruta ka tsela eo le titjhere ka bo yena a sa tlo tseba o ruta eng..!***

Tlhokomediso (*adds*): To add onto that, *physical science is a very practical subject. You need to do experiments, which is what is lacking at our schools. Our teachers don't have time for experiments, experiments need an extra mile. You need to remain behind after school; you need to be there on Saturdays doing physical science particularly the practical part. The allocated time is very very little; and another thing I think o*ur learners also lack enthusiasm themselves. If teacher lacks enthusiasm then it is worse with learners. *You have to fight with them to come on Saturday to go extra mile*; there is no basic formula that you can apply. Another thing that I have realized again, is the demographics as well. We are in Ladybrand we are talking about sophisticated things industrial issues when these learners are not even exposed to them. *Some of these things are so abstract to them. I have never actually had problems with the old syllabus, but since the introduction of NCS, it is indicated CAPS is coming NCS was a bit heavy for them,* with me as the teacher there is no problem. But the concepts behind that…NCS were really difficult as you can see Physical Science dropping started with the introduction of NCS. Even at Ikaheng I had quality I didn't have a problem with quantity. I was fighting quality, but right now I am fighting quantity now. …the quality is not there any more..**Phehello:** O bua ka industrial issues ntate Tlhokomediso, ke eng industrial issues? **Tlhokomediso**: Re bua ka bo chloro-alkali chemistry. Tse Sasolo kwana. Simple things tseo bana ba rona basome of our learners have not even an experience about escalators etc. **Ntsoteng:** Ke kopa ho botsa ha re ba mo practical, ha re bua ka air pollution. **Tlhokomediso:** I would say that air pollution is something we can talk about …air pollution on the other hand is everywhere and will not be abstract to learners as it immediately around them in the same way learners should be able to relate to. In physical science right now some of the things, to the learners are so, so abstract to the learners. **Moeletsi:** Ke batla ho tla tabeng ya Ntate Tlhokomediso ha a bua a re e se e le abstract too much**.** Ke nahana hore sometimes ha ba ithata subject ba ipotsa hore na e ba tswela molemo ho kae. Ke potso eo le nna keneng ke ipotsa yona, ha ke ne ke ruta physical science, hore na e molemo kae. Kapa ke ithuta ntho ee ho e krema hore matter is everything that occupy space and has mass, ke ithuta ntho feela or what. Ke nahana hore ke mokwa oo le rutang ka oona, o divorced haholo le real life. Ke shebile hona tjena mona periodic table tsena, ha re se na ntho tseo moo na ha ho na ntho e atametseng ntho tse moo e ka bang teng lapeng? Lets say we talk about sodium chloride ha re bua ka sodium chloride re bua ka ntho o e kang ke ntho e thata ka mokgwa o makatsang, and yet sodium chloride ngwana o kopana le yona mehla ena, kgaohana le sodium chloride bua ka table salt. Ke hore le leke hore ngwana a nke hore ntho e ke bua le leke ho relata subject le seo ngwana a leng sona, kgaohana le diexperimente tse thata. Ke ne kena le motho ya neng a nthuta ntho ha ke ne ke etsa reactivity series. Bana ba ka ha ke ne ke ba ruta yona ba ne ba kgona ho e tsa di-metals tseno kaofela ka simple thing ya ho reng ha ona le bond ha o rata ntho say nna ke ratana le Mme MaMoeletsi ho be ho tla Ntate Phehello ka lerato le fetang la ka, obviously ke tlo loose ose ke ra thatafatsa ntho, ke hore e be leveleng e… ke hore ha a tloha ka claseng a fumane ntho eo a ithutileng yona e teng mane hae. Jwale science ya rona e batla e tswile haholo ho real life ya ngwana. Bo sesepa, sesepa sena seo re hlatswang ka sona, it’s a chemical empa ha re bue ka sona, jwaleka bo hydrochloric acid otla e fumana kae hydrochloric acid lamuni ke eno e na le acid, its an acid. Ha re ka leka hore re leke hore ntho tse re di rutang ka claseng re bone ha ho na ntho tse haufi le ngwana hore a kgone ho bona molemo wa ntho ena a ithutang yona. Unlike a ithute ntho ena a fumane ha e na molemo ho yena. Re explore. Ke bile victim ya teng, ke a kgolwa ha ke qala, ke tla tabeng ena ya Ausi Palese mona hore science e batla e kenyeletsa ntho tse ngata haholo. Di-basics tsa yona di beeletswe ka thoko, kgale kgale re ne re etsa general science ha o qala form 2 o se o qala pure physical science hona jwale di qala for grade 10, from form 2 o se antse a etsa physical science, a explore. Bo hydrogen is the lightest gas. O tla e bona kae hydrogen unless a interact le yona. Nkile ka e etsa experiment ka sekolong ho bontsha hore hydrogen e ka hodimo gas tse ding di ka tlase. Nka balloon e tsele hydrogen, o kenye aterese ya hao hore motho eo ya tla e fumana ha e explode a kgutlele ho wena. Ha ba interacte le tsona. Group one elements ke ne ke di rata ka pelo ya ka bo Li, Na, K…di kotsi, di kotsi hobaneng? Di a floata ho ne ho nketsahalle ka nka…sodium ka e phuthela ka toilet paper ya sink, ka nka guze wire ka e thatela hobane ke ne ke batla ho bona na ho tla etsahala eng ha e kopana le metsi. Energy eo e entshang mono e kotsi ka mokgwa o makatsang. Ka mora nako ka bona ho se na letho le etsahalang, ka atamela ke ilo sheba ho etsahala eng, immediately ke nako eo e neng e explode…ha bana ba interact le ntho tseo…ha ke qala physical science, ke ne ke le Moroka, ke entse form 1 ho ne ho ena le Dr. Mahase o ne a ruta physical science. Mare a e ruta ka mokgwa o mong, ha o ne o mmona o ne o bona motho e mong, le wena ho tswa hore na ha o ruta ngwana o ruta jwang, o ne o bone motho ya kotsi ka mokgwa o makatsang (*phutheho e a qaboha*)… ha o ya claseng o ya tshaba, se ntse ke tshaba motho eo, ha ne a tla claseng ne a tauuwe,… ka be ke tlohela physical science … ke ile ka kgutlisetswa physical science ke Ntate Mokoena. A etsa di experiment ka claseng re se na laboratory. **Phehello:** Ntate Moeletsi ke batla ho kopanya taba eo o e buang le ena eo Ntate Tlhokomediso a e buileng. Hore titjhere o na le karolo eo a tlamehang ho e bapala. Ha titjhere a tshwana le enwa eo o wa hao a ka balehisa bana. Ka mantswe a mang ntate Thabang ha se feela ho amahanya le real life situation, le rona re le matitjhere re ho na le karolo ya bohlokwa eo re tlamemhang ho e etsa. Ntate o buile ka *nako, o sala morao o etsa preparation* (*voice interjects* – *a be devoted*). Ka mantswe a mang titjhere o ntse a na le karolo ya bohlokwa eo a tlamehang ho e bapala. Ho tswa feela na o batla ho e bapala jwang. Mme Bohlokwa ke bone e ka o batla ho bua. **Bohlokwa:** Tjhe ke tlatsetso maikutlong ana ao re nang le oona ka physical science. Motswalle wa ka tjhe se ntse re tswile sekolong, re ne re etsa discience le yena, jwale a se a tjhintjhile a se a sa etse science; o ye a re ho nna, monna wa tseba re qetile nako re ithuta ka metsi science ya metsi feela jwale feela jwale batho ban a ha ba re ruta re ka etsa tjhelete jwang ka metsi,… ke a kgolwa o ya nkutlwa, re shebane le ho ruta feela ha re shebe hore na o ka iphedisa jwang ka …ke shebile Ahanang hore na ebe bothata ke eng, ke nnete generally physical science e ntse e theoha, feela le mathematics le accounting, mme ha o cheka ntho tseo ho na le moo di Phehello teng. Di na le dipalonyana ka hare. Bana ba rona bothata boo ke bo boneng hona tjena ba nkile feel matric e le lecence e mme a ye a lo sebetsa. E ka nna ya ba re na le mathata a keneletseng, family background, haholo ekonomi ya malapa. Bana ba rona post matric ha a nahane ka sekolo o nahana feela ka hore ke ilo sebetsa.

Mme ntho ena e etsa hore a ye for di subject tseo e leng hore di mo thusa feela hore a pase matric. This is why re nang le combination ya physical science le mathematical literarcy, e leng hore ha a pasitse matric ha e tlo kgona ho montshetsa pele filding eno eo a e batlang. Ba ipatlela feela hore ok, let me pass matric ke ye ho sebetsa. Ba aware hore system na e reng ka di-conditions. So ntho eo re nang le yona e thata-thata ke thahasello ke a kgolwa ya ho tswela pele ka sekolo, e tliswang ke moruo, e tliswang ke hore bana ba bangata ha bana parents, bana ba bangata le ha ba ena le di parents sekolong sa rona mane o fumana hore they come from poor family backgrounds. O nahana feela hor le ha nka pasa ke accessa tertiary education jwang. Thahasello ke yona eo…interest ke a kgolwa ke yona e siyo, re na le lerato la ho ya sebetsa …mohlomong career guidance e ka bapala karolo e kgolo,.. mme metseng ya rona mona ke nahana hore bana ba rona distudies tse ba di etsang, ke hore ha re ba kenya di projecting tse bang di ka ba teng mona hore ba ka ithuta. Ke hore ha re etse mohlala.. o bua ka di measurements, inclination ho na le dicompany tsa bo truss company moo ba ka yang teng ba kgona ba ithute mme ba ntse ba…me ke bona e ka e ya ba ruta le yona mme leha eba after matric re ka ba le lehlohonolo la ho tseba seo o ka kgonang ho iphedisa ka sona..**Phehello:** Ke hore ka mantswe a mang ho na le kamano pakeng tsa science le ho iphedisa moruo wa lelapa kapa….**Tlhokomediso:** There is still a gap between what is done at GET and FET. There is a serious gap between. And science, ke tlo kgutlela tabeng ya Mme (*i.e. Bonolo*) hape-hape hore it's a mixture, and the normal tendency is, I don't know why, teachers tend to do the biology part as from grade 8 and 9, most 99% almost 100% they treat biology part and they don't treat the physical science part. Obviously the learners when they get to grade 12 then they struggle. I think we need to check what is happening in grade 8&9. **Bohlokwa:** E etswa ke bothata bo bong ntate Tlhokomediso, re na le matitjhere a fokolang a physical science mme ke ye bone ha ngata grade 9 & 8 …ha re qala re feila titjhere mono, otla thola hore ha ngata ke a part time mono ke ntho e nkileng ka e leka sekolong moo ken eng ke ruta teng ha ke hopole ke toucha biology, ke ne ke itulela physical science. Mme ha re na le batho ba bangata re tlo fumana…**Phehello:** Seo se bolela hore ho hlokala hore ho be le se etsuwang. Hona le ntho eo ntate Moeletsi a e reisitseng hore ho na le tlhokeho ya ho amahanya ho ithuta physical science le moo bana ba dulang. Ke batla ho utlwa ho Ausi Motshedisi from side ya environmental health, how many young people ba nang le projects or ba involved ka tsela e itseng mohlomong projecteng tsa lona tsa environmental management. **Mamello:** Ko Mohokare? **Phehello:** Eya, akere jwale ke shebile taba ya hore Mme Bohlokwa o re post matric ha ho na bana ba involved le hoja ke tseba hore ho na le a lot of potential ka environmenta whatever issues. **Ntsoteng:** Ha ho na, mo Mohokare ha ba yo…batho ha ba ise environment hlohong kapa ha ba e tsebe. Ho tshwana le ko Dinokeng ha o ka kopa hore ha re budgetele environment e tla fuwa tjhelete e nyane, ha se ntho e nkuwang serious and yet e re ama ebile e senyeha so re ka dirisa, ja ka ha ntate a bua practically so… re ka e etsa hore bana ba rona ba be involved ho ithuta. **Phehello:** Ntjwetse ke diqholotso (challenges) di feng, tseo o nahang hore, kapa tseo o di tsebang kapa tseo environment mosebetsing oo o etsang tse ka bang monyetla ho relate taba ya science, re batla ho fumana link between seo ke se etsang science, ka mantswe a mang bana ba ka ke ba ruta science may be nka sebedisa eng mohlomong ho tswa ho challenges tseo o nahanang le na le tsona..**Ntsoteng:** Like ke bua ke re ke ho hloka kitso ha rona batho, kapa setjhaba sa rona re a se ruta ha ba nke taba ya rona. Mohlala o ruta motho hore a se ka dampa ke hore o beha board (*tsebiso*) hore this is ‘illegal dumping’ mare at the very same spot moo re reng ke illegal damping ke moo batho ba rona ba dampang teng. Ba na le the mind set ya hore ba ‘create’ ditiro, what we are struggling at the moment ke ho change the negative mind set, ho re o ka se dampe mona, this is illegal dumping. Keep waste ko ntlong ho fihlela masepala a tlo e tlosa, or rather reduce waste e yang ko dumping site…So batho ba ipolella hore we are creating jobs hona le Indalo Yethu they will come pick up the waste, ho na le masepala they will come pick up waste ba e ise ko waste site. Athe bohlokwa ke hore ha re hlokomeleng ‘environment’ya rona. That is the main challenge that we are sitting with, to change the mind set of the people from negative to positive.. **Phehello:** A kere re di lahlile ha re di batle, di ama batho jwang? **Ntsoteng:** Di poluta ground water our soil. So ha re ka fokotsa, di affecta weather di afecta, re ba le global warming. So ha re ka change the mind set re etsa di campaign ho jewa ho tsamauwa, ha re a dira sepe, re ka dira di campaign yes mare community e benfitile eng moo from di campaigns that we conduct..**Phehello:** The idea here ene e le ho fumana say from this pollution ya ground water, water resource and so on, a link between the environmental health and science; hore instead of us going to Sasolburg, ke eng se etsahalang polutioneng what chemicals might be disposed tse ka reng ha di ka kena metsing ho be ho ba difficult ho di trace re re qeteletse re fumana re di consumile. Maybe because of lack of time ha re ka ra fumana ho thuswa hore ke eng especially sothat re e nke re e kenye ka chemistry re a kenye ka life science and then it makes sense to the child hore ha o etsa tjena this is what will happen, ho e hlalosa ka science and then o ka ba wa etsa campaign as part of project ya sekolo eo o e tshwayang matshwao, ngwana a fumana matshwao feela e tlisitse difference. Ke a kgolwa that is the idea, Ntate Tsotello you wanted to say something ke be ke qetella ka Tshepang. **Tsotello:** Ntho e ke neng ke e bua leha e sa tlo etsa sense hakalo. Ke ne ke le tabeng yane ya hore NS e se e kentse ntho tse ngata haholo. Ke ne mpa ke nahana at school level hore na ho thata ha kae ho ka… ke a tseba curriculum ha e sa dumelletseha; but re shebe hore na mohlomong a kere ke four subjects, ke physical science, biology, agric le life science, ho ka sheba hore na NS e na le periods tse kae, ho sebetswe in such a way hore re leke hore aspect ka nngwe e rutwe ke motho ya specializing, ke a hoopla hore nakong ya ntate Moeletsi ha re ntse re Ikaheng mmoho o ne a nka the science part e be ke sebetsana le biology, re leka ho e splita jwalo hona bo form 1 form 2. Hore these four aspects at school level ha re na mokgwa wa hore the little bit of agric e tla fumana ntho eo e deserving, the science the what, so that ha e ntse e ya hodimo ha e safare. I was just thinking aloud. Ha se ntho eo re ka e exploring at school level.

Tlhokomediso (*agreeing with Kgothatso***):** I think that is the way to go...**Moeletsi**: And re na le advantage ya ha o e dividile (divided) jwalo motho eno o na le nako e ngata, ya tla e devouta, ha ke re mohlomong o ruta 6 hours ke ya e divide ke nka 3 hours, 3hours. 3hour ena ke tlo e eketsa eo o tlo e eketsa. Ha ke etse mohlala. Ke ile ka fumana hore ha ke e entse jwalo e tjhentjhile pass rate ya bana… Haena e le 8 periods ke mo fa 4 periods 4 periods, maar se ilo etsahala ka 4 periods eo o kgona o etsa mosebetsi o mongata… hobane o na le nako e ngata. Ke sa tsebe NS hobane jwale le yona e kentse ntho tse ngata… **Tlhokomediso:** E ntse ele bo 6 hours,… because learners are really suffering. Just like mathematics as you are saying if athe teacher is inclined to algebra then le a qeta selemo le etsa yona…**Moeletsi:** Advantage ya yona ke hore ha o treata ntho eo o e ratang o ipha nako. **Bonolo:** Ke kopa ho tshwaela feela, leha ke tseba ha e kae taba ena feela ya pre-service hore nako e University ho etsuwa eng, ha ke tsebe kapa ba ba ruta NS… **Phehello:** Ke a kgolwa ke lebaka lena re nang le bo ntate Tsotello, ho se ntse ho utlwahala ho na le bokgoni ba hore management o ka kgona ho etsa intervene; management & governance, issues of time table and all that. Ausi Bubi… **Mme Bubi:** Ke a kgolwa jwaloka ha ho se ho boletswe, ke nahana GET mathata a hlile a mangata. Ba bang ha a tloha grade 9 a ya 10 ha a tsebe hantle hore ho na le physical science, hoba mathata on a mangata… **Tlhokomediso:** Re cheke ho etsahalang university. Our products now a days lack motivation, they come to school so demotivated. A young product from the university ya 23 years, … they can't even control a register, attendance register ya bana. Ha ke tsebe na ke issue ya remuneration e tla pele, o se a ntse a bala hore ke qualified ke tlo kgola bo kae banna…**Bohlokwa**: Ehlile ke nahana o buile ka yona Ntate Tlhokomediso hobane nna ke bone morao tjena re lebeletse bana ba tswa university ba tsebe ho re feta because rona e re fumana re le system but ha ba fihla o fumane e le rona re bapalang role ya ba ruta mme nna ke nenhana hore ke bona ba neng ba ka re thusa… Ha ba fihla o fumana hore ka nnete ke bothata. **Phehello:** Ke nahan Ntate Thabang a ka hlalosa, ho thwe ho ne ho etsahala eng? **(***Phutheho e ya tsheha***). Lebohang: O ya ba botsa ba le kae?** Ba tsamaile a kere. I never had an opportunity ya hore ke ba botse. Feela ke ile ka implementa leano leo feela ha le a ka la ntshebeletsa, for two successive years. **Moeletsi:** E tswa hape le mothong ya rutang, sometimes o ya mo bebofaletsa…nna e ntshebeleditse ha ke batle ho pata. Physical science le mathematics ha ho na ntho e ntle ka ho fetisisa, ho tswa ho motho hape hape…**Phehello:** Ka mantswe a mang e ntse e confirm karolo e bapalwang ke titjhere (*Tlhokomediso, Moeletsi, Lebohang in the background agree, commitment ya tichere*). **Lebohang:** Hona moo ha re tlare e stope, ha ke titjhere ya discience ha ke HOD ya disciences, ho na le moo e tlare ha o feta titjhere e mong o ntse a omanya e mong. E ile ya senda message ho nna hore e kanna ya ba matitjhere ka bo oona a na le problem haesale taba ya bana. Ho re ha o so etse ntho e itseng, nna ne ke feta ha ba mpona. E ka nna ya ba, jwaleka ha ntate Moeletsi a tjho, e mong o fumana e le comfort zone ya hae, hore ag, theme ee ke tlo ba comfort, ha ba tlo bona le ho bona. Well unfortunately ke ne ke ntse ken a le head of department ya neng a ntse a se concerned ka department ya hae, it was the most unfortunate part of the story, hance o ile a ba a resigna because …once e ba jwalo maybe re ye motho wa science… But at the end of the day ho na le dintho tseo re di ratang ka science. Le rona re le matitjhere re tlamehile re kgothaletse bana ha re bona ba ena le potential, but re emeletse thoko, and sometimes le rona re le matitjhere maybe role eo re e bapalang e fosahetse ka hore science teachers tend to belief bana ba bohlale ba loketse ho etsa di science, bay a ba hula ha ba fihla grade 10 mane …bana bao ba seng sure ka bona ba ba tlohela bay o etsa history. **Moeletsi**: ...ntho e nngwe le nngwe re kena re sa e tsebe, ho tswa ho re na wena (titjhere) o jwang…**Tlhokomediso**: Re ntse re kgutlela tabeng ya commitment as a teacher. Your commitment as a teacher is infectious baneng…**Moeletsi:** Ngwana o tla a sa tsebe ntho ena… and Tlhokomediso: (agrees). **Lebohang**: Last year ke ile ka organiza motho e mong wa Esekhomo, a tla bua ka electricity. Ke hoopla ka mokgwa oo a neng a presenta hantle ka teng, batho re ntse re kgotsa hore motlakase o monate…ka mokgwa o interesting. **Bohlokwa:** Ke bona e ka le dipolotiki di bapala karolo e kgolo haholo. Tjena: di results tsa grade 12 di bohlokwa haholo, mme ke bone di entse ke moleko kapa ke eng (*phutheho e ya keketeha*) wa hore re senye nako ya rona e ngata, di subjecteng tsohle ke a kgolwa, ho bona hore na bana bana re ba kgontsha jwang ho pasa matric, ke hore bana bana ke ba thusa jwang ho pasa physical science mme processesng eno re compromisa understanding ya physical science haholo. Hobane o shebile feela hore ha ba ka nepa that’s all I want. Ke tjho tjena ke ile ka ya workshop e nngwe…e ne e etswa ke lekgowa le leng Blomfontein, o ile a etsa ntho e nngwe ke be ke tsheha ke bona hore ngwana a ka etsa ntho ena a ba e nepa a sa utlwisisi altogether seo a ntseng a se etsa. Eile ya re ha ke tsheha a be a re ‘there is nothing we can do department wants the results’ so we must produce results, ha a fihla pele o etsang, no it’s for the university to see hore na e etsang. Department yona e batla bana ba pase matric. So nako e ngata re leka ho bona hore ngwana ha a ka pasa mare understanding yona, mme ke yona e etsang hore science …a ke be a pasa o sa qeta syllabus, a ke be a pasa o sa etsa dintho theo ho thweng di etsuwe..**Tshepang:** Ke a leboha modulasetulo. Nna ke, I am really quite impressed ke the conversation that we just have had now. Ke lekile ho note a few things, tse ding ke di siile tsa tsona. The main thing I think e ke nahang is emerging from the conversation ke hore thuto ya bana is our responsibility, at least rona ba teng mona. And irrespective of what the requirement of the department could be, ha ke tsebe mohlomong ke etsa a controversial statement, but ke nahana hore, re tlamehile jwaleka matitjhere, re nke boikarabelo over the learning of our children, hobane I mean we are comparing ourselves with other countries, there is no way we as a country ultimately can perform to the required level if re sa nke boikarabelo. Ha ne re ne re hlokomela ditaba ho na le bo TIMMS, PELS, moo e leng hore as a country we do not perform well, re hlowa le ke dinaha tse nang le small economies than ours. But I think from the conversations here, I get a sense ya hore ha re na kgetho, we don’t have an alternative, we really have to do our job as well as we can. And what that means we have to go beyond the call of duty, Mme Palesa o buile ka systemic problems, ke a di utlwa di teng diproblems tseo, but we taught ka tlasa apartheid, and inspite of the constraints tse neng di tliswa ke apartheid we wanted to go beyond what apartheid we considered that to be the basic need and we went beyond and I think this is the message we want to carry across. Ke ye ke shebe dikolo tsena tseo re ratang ho isa bana ba rona ho tsona tsa former model c schools; irrespective of the curriculum 2005 kapa curriculum 21 or ke eng, what ever CAPS; they are consistent. They consistently produce good result. Maybe re contesta that issue, but the main thing eo ke ye ke boneng e ka ba ya e etsa, dintho tse prescribuang ba di nka e le just the minimum, the main thing again ke taba ya nako. Hore dikolong tsa rona it is very rare moo o fumanang as teachers we spend at least eight hours per day at school. We spend far less than that. Leha ho fihlwa weekend Labohlano ke a kgolwa bo ten (10:00) in many schools re se re le siyo; week end teng ha ke sa bolela, over and above that re be re eba le long holidays but bottom line really is: ke hore re tlamehile re hlokomele hore if we don’t do anything about our children ha ho na moo re yang. So, ha ke ntse ke mametse, seemingly we are focusing on those things that we can do something about. And one of the things that came out of the conversations is the critical role that the teacher plays. Hore mohlomong we can do something about. Hona jwale tjena ke bona e ka re representa that collective hore maybe out of this thing we can create opportunities to support teachers hore ho be le that awareness, ho be le, ke utlwile ho buuwa le ka those effective strategies moo e leng hore teachers specialize, ha a specialize in an aspect of say NS o kgona ho ya beyond, o tla bona o tla etsa extra classes batle bo hoseng. I think what we need is a systematic way of handling those things. Creating opportunities for us to come together to talk about that and empower ourselves especially e le hore as teachers re realize hore we have the power in our hands, really ha ho na motho ya tla hlaha Gauteng kapa kae a tlo re bolella because this is our future this is the future of our children. Ok re buile hape ka pre-service ya matitjhere, ke thabile hore le a bua taba eno, but ha re buwe ka yona loudly, ho re the university,… re tlamehile re…we should be found guilty when the education system is faulted. Ha hona motho ya re kenyang in the equation all the time, re emeletse ka thoko, k erona ba supang menwana mohlomong ha ho ka tloswa principal kapa ha tejelwa mang. Nobody is saying teacher preparartion progTlhokomediso tsa rona di bodile, nobody is says that. And we continue doing this maybe some of the things should come out of our conversations…nka o etsatsa mohlala hore ha ho train matitjhere in the past you would have to go and do a BSc purely, e be hona o tla trainuwa o le teacher for a year or two; but hona jwale tjena we half cook re a ba etsa B Ed … mane re ntse ba ruta hanyane hanyane the sciences and so on, for schooling, but o wa bona hore ha se at the level eo o ka ba trainang for pure sciences, ultimately ha ba tswa mono ha ba tswe e le really scientist..ha hona nako e sufficient… I really think that is an issue that can be taken up, but at the same time I hear us saying we'll create opportunities where we can retrain these teachers and ourselves hore ultimately we are able to do what we are supposed to do. Ntate Phehello o itse ke bue ka under representation of our children in terms of the natural sciences. Ke problem e leng hore, I think all of us know about, hore batho ba etsang disciences university ha ba yo, and le ba ba teng do not perform well and the problem really, I think is at the school level. This is what I think Ntate Phehello is trying to address, hore let us come together and collectively try to address some of those issues. Ho na le CAPS jwaleka ha Me Palesa a boletse, but I think we are just going to look at that as the basics, we are really going to go beyond and try to do what is right: teach children effectively. Ke ratile contribution ya ntate Moeletsi because he confirmed what I have always suspected hore every child can learn effectively, can learn everything beyond anybody's wildest expectation only if we can create conditions that are conducive. And I think we have an opportunity really to do just that. So it's about commitment, going extra mile and making it possible for children to find meaning in what they learn. Ke a utlwisisa ke skills hore a new teacher or ya keneng kapa eo e leng hore o kene botitjhereng a se na thahasello ha kalo, may not have those skills. But haebe e le hore may be we can have that coming together, I think ke bua haholo ka Ntate Moeletsi because I think I know what is he capable of, and I am also aware that we can invite other people who have been there. There are many of our senior colleagues who are in the community there who can really buttress us. Ke hore hona tjena o fumana hore o titjhere o ruta group ya hao o mong le ikwaletse mane you don't want to open up hobane batho batla discover the limitation; but if we can open up and all of us participate and support each other, ke hore ha ke nahane hore re ka experience some of the problems we experience. We can actually make our children ...you would remember in the past ho ne ho ena le ntho e na ya public understanding of science and technology e neng e etswa ha nngwe ke batho ba NRF or something like that, people were trying to make it easy; but now if it's a systematic thing that we do on daily basis supporting maybe on weekly basis where the two schools, our retired skilled people ba tla invite expertise, eskom people whatever, it becomes so interesting, and all of us we open up we learn and we realize hore the power in the knowledge ultimately reside in us. So ke ka mokgwa oo ke bonang project ya ntate Phehello ka teng ke pula madiboho in that sense, hore in as much as we are concentrating on that there should be opportunity created hore this should broaden up hore all of us should come in and inform the process. Ha ke tsebe how to express my excitement hore we have so much skill and expertise e leng hore we are not exploiting it, if we can exploit it even as young teachers, really we are definitely going to learn greatly. And lastly I think that collective ha e le hore e ka tla mane university of the FS ya tla re bolella hore our teacher programme di bodile. I think that will cause us to think again about what we are doing , it is unlike one person explaining. Ha re tsebe le hore na what is happening in the schools empa re pretend e kare we are preparing teachers. Ha re, le melao ena e metjha ya bo eng, we don't know anything about them, I mean hona jwale tjena e ne e tshwanetse e be ke university e nkileng the lead in terms of supporting people ka CAPS and other they are supposed to be leaders in that regard, but ha re tsebe le hore na ke eng CAPS. So how do we provide that leadership? So what I am trying to say is, instead of the top down approach we need to do it differently, to say here we are we need the leadership of the university, we receive your products every year, but ha re bone na ntse le etsang. And these are the issues tseo re nang le tsona and if they are based on empirical evidence e le ng hore you sustainly work on and it's a collective of two major schools and the community and everybody else, I think our voices could be heared. So Ntate Phehello ha ke rate ho senya nako ya hao, but these are the issues; I am really hoping that today e ka ba the beginning and the start of that process ya hore its not going to happen only here but in all the place we are, but already here I am actually seeing the light, because some of the problems tseo keneng ke nahana di thata ke bona e ka re na le di solution; yona NS eo ke e utlwang, we can redefine strategies; Ntate Thabang has already started with something a re batho ba specialize but its like leha ho entswe jwalo ho ntse ho ena le di problem. Maybe ho tshwanetse ho be le further support and training and whatever that is being done to generate that commitment amongst those people, beacuse seemingly its not because ho itswe ba specialize but maybe the problem might be with themselves mohlomong ha ba na interest, or mohlomong ha ba bone the point or they might not see the need. Maybe le bana le bona ba hulanya maoto e seng hobane ba rata ho hulanya maoto but because ha ho na motho ya kileng a ba hlalosetsa hore actually the future ya hao depends on you understanding the sciences because there is no way you can make it in life o sa tsebe dintho tseo o ntse o ithuta tsona. So ke bona e ka ke responsibility ya rona e kgolo ena. I am really putting this as challenge ho ntate Phehello, I really hope that by the end of the year we should be able to say things have changed and this collective should take responsibility Ntate Tlhokomediso ha o emetse di results at the end of the year le rona should be waiting anxiously ho bona hore this collective has really worked. That's my input. **Phehello:** Ke ne ke hopotse hore ka nako ena re tla be re qetile. Re na le item tse pedi tseo ke sa nahaneng hore re tlamehile ho nka 30 minutes ha re dumellana. Ke nahana hore di item tse pedi tse hlahlamang ntate Tsotello a mpe a re lead feele ka … le hore mohlomong re fane ka implementation plan. **Kgothatso:** Ke a leboha. Ba heso dumelang hape. Ke a kgolwa mona se re batla re hlahisitse some of the things ke taba ena ya Ntate Phehello. Ntho tse re duileng mona o ne a ile a di etsa engage a le mong, tsa bo di problems and challenges this was to confirm hore ke nnete or not. As a result o tlile ka proposal ya ho etsa a model e tlo leka ho bridge gap between what is actually taught at school le practical application ya physical science in real life. Hence model wa hae o na le aspect tse five. The first one is to justify whether there is a need ya ho leka ho bridge the gap between what is actually done in schools le se etsahalang in real life. So ke nahana hore from the discussion re bontshitse hore there is a need hore re leke ho tlisa science ena haufinyana sothat now bana ba kgone ho ka e aplya le hore tsane tse ka kwana ba di tlise ka claseng hore kgone ho etse sense e kgolwanyana. But ho feta moo, ke hore na haele mona ho na le a need, ke dintho dife tse ka etsang hore model ona at the end of the day o tsebe ho ba implementable ke hore the components tsa oona hore model ona o tshwanetse ho ba le 1,2,3 etc. Ke mpa ke sumarisa, o tla leka ho expanda hanyanenyana hodima dintlha tse ding. Ho feta-feta mono say there is a need ya hore model o be teng le hore le di components moo ke hore na di conditions tse ka thusang hore model ona o be successful kapa o ska ba successful ke dife jwaloka ha re se re boletse mohlomong approach eo re rutang ka yona. Taba ena yah ore how about breaking the subject into what ever ke tse ding tsa dintlha tse re ntseng re brainstorma around; diconditions tse ka thusang mohlomong hore model o be successful. Further more ke hore na ha ntho ena e ntse e tswela pele di threats e ka ba di fe Mme Bohlokwa, hore se re bone hore mohlomong bana ba re why physical science? Nna ke se ke mpa ke e etsa feela kapa ke tla coupla le, ke ntho ee…, le maths literacy. That thing is a threat because ha ho na moo o tlo yang ka physical science ya hao why ke sa nke pure maths e be challenge ya hore as much as I master Physical Science e tlo needa maths o e leng pure maths. And ultimately ke hore na ha ho ntse ho uwa pele ke ntlha dife tseo re tshwanentseng re di shebe hore na are we on track na ntho ena eo re e nahanneng e tswela pele kapa is falling flat. Ka mantswe a mang we monitor as it goes on hore na re kgatha tema kapa re tapa-tapa nqa e le nngwe. Haeba re tapa-tapa nqa e le nngwe, what are the challenges, ke eng eo re sa e etse kapa e batlang re e shebe ka ihlo le leleng hore ntho ena ya rona e tswele pele. That is that basically.

So the model oo a nang le ona ke the need: e bontsha ho justify hore ka nnete hohlokala hore ho be le mokgwa o mong oo physical science e rutwe ka wona akere. Di components ho re ho be hantle re tshwanetse re focase (focus) on which things, conditions, threats as well as hore ha re ntse re tswela pele mohlomong re kgone ho bona hore na are we still on track re modifaya kae re lokisa what else adopt but now ntho tse di tla tswela pele. But now ntho tseno he di tla tswela pele ka hore eee ha re ntse re tswela pele ho na le tse ding tsa di constructs tseo re tla tlameha hore at the end of the day hore model ona o be successful because re ile ra ela hloko hona le hona… so ke ne ke kopa hore ke eme moo. **Phehello:** Thanks Ntate Tsotello. E e ne e le framework eo re sebetsang ka yona. Framework ena e se e bile e entse hore re be le a document, ha di ngata ha kalo eo ke e bitsang transformational service learning implementation plan. Framework simply outlines the document eo e tla reng ha re qetile re team re tla beng re e produce and submit to Tshepang and the university to say this is what we intend doing. Framework ya rona etlaba le contents, let me say e tla ba le forword, forword is basically something like an abstract ya the study, I am sorry for the spelling, ee but it generally gives, e karetsa hore na study se kenyeletsa eng. Ha o phetla ka hare di contents tsa teng ho na le introduction, e introdusa (introduces) the reader to the study generally, and then outcome ke aim ya study. Basically this comes from an approved…ke a kgolwa Tshepang ha ne a bua o ile a hlakissa hore ho na le proposal e ananetsweng. So aim ya proposal eo becomes the outcome – to design a high schools service learning model. Ntate Moeletsi service and learning should be related to one another ke thabile ha o metionile taba eo, hobane re re there is a service that we must get from…, lebaka leo ausi a le teng ka lona ke hore ke potential service donor. Ke ho re re batla di servce tseo a di etsang, what is it that we can take from those services, and develop a programme e kentseng science e tla reng ha ke ntse ke ruta ka claseng e be ke ntse ke addressa issues tsa service; ka mantswe a mang ho relata to the real life situation. So ke aim eo. Ha o sheba 2 e tla hlahisa outputs and activities. Outputs re lekile ho di etsa ka…e le di objectives of the study, tsena tseo ntate Tsotello a ntseng a bua ka tsona. Hore there is a need so re hlahisa output ka mokwa wa objective then the second output would be the components, the third output e tla ba the conditions, fourth risks & threats and fifth the implementation of the project.Tjhe ntho tsena tse mona di tlo tlameha tse ding tsa tsona di tsamaye paralellel, together. Ka mantswe a mang, like today discussion e na e ka mona e re file more than just one thing; ke there is a need e ddresitsweng mona, re buile haholo ka the role of the teacher e etsa an important component, ho buuwe ka nako, it becomes a component ya bohlokwa. Ke hore ke dumela hore ha re dula fatshe re mamela recording ee, re tla kgona ho fumana all those things. Ka mantswe a mang di output tsena ha din a ho folowa one after the other they will run simultaneously concurrently. And in the event ha re fumana hore ho na le gap, on monthly basis di meeting tsa rona re tla dula re refina the same document hore ho na le ntho ena let us put it in. Ho na le dintho tseo re sa buwang ka tsona, tseo document e sa buweng ka tsona tse re tla di fumana mona, then we relate like the challenge that Tshepang is mentioning ena eo a re qholotsang ka yona. We will see if, haeba e le relevant…haeba e se relevant re tla mo jwetsa hore ae (*phutheho e ya tsheha/qaboha*). But after the outputs and the activities, qetellong mane ke a kgolwa last page, we still have to identify thoese enabling conditions for the implementation of the study, such that the framework, the plan eo re tla beng re tla ka yona e kgone hore re e implemente. So number four ke map, map e detaila those activities, re e fa di-timeframes, re etsa resource allocation, e leng this document. So documente ena le yona ka tsela e tshwanang, o tla bona we have actually actioned taba ya the framework. Ho na le output and then…, except for output number one, output number one is basically ke the establishement of the team. But two, three, four up to six ke five objectives of the study. Ha o sheba for instance output two o tla bona hore it talks about the need, the need for a transformational learning of Physical Science through service learning; and then ke activity ya ne eo re e hlahisitseng ka hara framework, ke description of that activity; person who lead that; and then what are the key tasks; what a re the funds required for if there are funds required and then funding mechanisms.

Some of these ha di tlo hloka tjhelete di hloka feela hore re aligne…, the key principle mona ke ho re re aligna the study to the study programme and/or to normal day to day programmes. For instance moo, ausi Motshedisi, the municipality e bang le campaign teng, to what extent can we align our teaching…where we have identified a project, to what extent what can we link to that programme sothat ha o ntse o etsa mosebetsi ono le rona re ya ithuta. The other thing is to say maybe once we shall have completed this we have this in form of a document, e tla ba yona e guiding our discussions. Everyday when we meet we report against it. O tla hlokomela hore ha re ntse re reporta against yona se ntse re araba di objectives, re sentse re araba aim. It is also in lign with the charter that we talked about. Because the charter simply took the aim converted into a vision, e ntse e bua…ha o sheba vision ya teng e ntse e le transformational service learning as the aim. So I think that is basically that. Now I am giving this to Tshepang to have a look at them, but by the time a re fang feedback we shall have ironed out some of the things and moved on.

We talk on regular basis with Mme Bohlokwa as the head of the department, I have already given him a research project for the grard 10’s hobane re tlamehile re ba fe research project. Ntate Tlhokomediso ke research project on…ha o sheba grade 10 ba ba botsa ka project ya energy, electricity. O ile ho batla power plant tsa Eskom, e nngwe e Cape Town e nngwe e Trakensburg e nngwe e kae. So I am saying but I can still achieve the same scientific principles using a project locally. Because it’s about weight, it’s about gravity, to gravitate metsi from one reservoir to another and pump it back. Masepaleng mona re a flasha ya letamong, ha a le sekono re a hlatswitse re ya a pumpa a ya thabeng, ha atloha thabeng a theohe ka (gravitate) motseng hape (*phutheho e hasana ke ditsheho, ho tsota*). So I said, I am afraid taba tsa eskom di tla ntlhola, ha ke re di mpe, but ha re sebediseng tsena tse haufi. I have already developed something and submitted it for monitoring and evaluation ho ya ka di pehelo tsa sekolo. I think the challenge eo Mme Bohlokwa a ileng a e bontsha ke hore bothata ke hore examiner yena o tla nne a o ise Sasolo. Maybe it is another thing that we need to highlight, don’t take us where we don’t have access, tloo … ask the principle and not the industry; because jwale e kare o ya maketa (marketing): because scientific principle is about gravity and not about Eskom… **Tshepang** (*interjects*, *seeks clarity*): So motho ya botsang dipotso o di botsa ka Sasol? **Phehello (***responds circumspectly***):** Ja…**Tshepang:** So, is not a principle? **Phehello** (*responds with hesitantly/care*): Not necessarily. Taba ke hore ke industry, but what about industry; its about clhorine…**Tshepang** (*follows up*): Ha hona opportunity ya hore children can make an example ka situation eo ba leng familiar ka yona? **Phehello** (*responds*): Yes **Tlhokomediso:** Ntle leha ba iketsetsa model tsa bona… **Phehello:** We can but most of the times its things that are not here …**Tshepang:** Motho eo ha a botsa o botsa ka ntho tse siyo, ho re bana ha ba kgone ho utlwisisa the question…**Phehello:** Ke kopa ho o fa mohlala o mong. Last year ka grade 10, there was a question e nngwe e botsa ka electrostatics, e bua ka mme enwa wa mo coloured kapa ke mokula, o ne a le congestioneng kae, kae stationing sa trene. Ke a bona ha ba ntse ba hohlana mono ba pushana a be a eba charged. Moriri wa hae o be a ema. Jwale ba mo toroile (draw) mono moriri o na o eme tjena. Then I was asking is this possible, ke nna ke ipotsa ka ngwana. Is that the right way of asking that principle. This is a simple example. Maybe we need to re-think.Because ngwana o tlo tla pele a contesta. **Tshepang:** But my question would be haeba ngwana a tseba principle tseno a ke ke a kgona ho araba potso e jwalo na? **Phehello:** Contestation ya hae ke hore ha se nnete ntho eno; leha e ba a tseba principle eo. O tlo araba the scenario o tlohella the science principle. And it makes it even more difficult. The principle is there a kere o e tseba ha o rub pene hlohong o etsa dipampiri, kapa o ka kena kapa wa tswa ka koloing things like that. But the point e ne e le feela ya hore already for this term, by the end of this term kena le practical investigation ke tlo e design around this and that research project. Mme the responses e se ntse e le to respond to some of the things tse leng identified as constructs in the plan. Basically e bua e re dintho di tla nne di etsahale together concurrently. And those results e tla kgutlela morao e re fe evidence ya hore works or not. **Kutlwano (***asks a question***):** ***Not audible***

Phehello *(**responds to Kutlwano***):** Yes, a kere team every month re ya kopana. This was our first meeting and based on what we have discussed today we willl agree on the date of the next meeting. Basically to consolidate and address those things that re ka di pick up from this discussion and then say yes to the plan, that simply means according to this and having built in the team building aspects. And also in the plan o tla bona ho na le visitations of science, re tla ya purification plant with the support ya environmental health because part ya brief ba environmental health ke water, o bua ka pollution of water. So for us to to be able to access… ho bobebe ho rona ho ya mona ho feta ho ya Koeberg kapa Drakensburg hore re tlo etsa ntho ena, but out of that the practical investigations would lead to a point moo bana ba tlang ka something ka solution to the problem. I was saying to the principal during the course of the week that I am excited about what I had discovered about what I found as a potential practical investigation e ka etsang hore bana ba qholotsehe hore ba qalelle ho sebetsa mmoho le environmental health and the municipality on a campaign of some sought not because e le campaign but because they…Mme Bohlokwa o buile ka something like economic impact ya science …ka baka la ntho eno, if they want to address the problem eo re nang le yona. So, all these will be part of this programme, etlo end up with a worksheet for learners plus related practical investigation and research tse ka re thusang re fihlele ntho eno. The process e kenyeletsa the identification of further other projects tse ka re thusang hore as we teach science we can immediately relate bana to the real life situation.

Tshepang (*interjects*)**:** Ntate Phehello I think, one of the reasons why batho bano ba ethice le ba CTR ba ile approva proposal ya hao, ke hore they are sure hore it is going to work.That’s one point. And now I know I am digressing a bit, but I am really very jealous at the same time of the collective that we have here, hore I hear o batla ho emphasize your team ya batho ba five bane. But I am trying to say what are the possibilities of as you embark on the process of the project hore ho be le di spin offs moo e leng hore ha se wena feela other teachers participate but maybe guided by other colleagues who are not in the team of five; hore the sharing of whatever the processes, may the opportunities for teachers to share, to hear what you are doing, maybe doing what you are doing or sharing and …I don’t know. But I am 100% sure hore your project definitely is working or is going to work but I am trying to say what is the possibility of taking teachers together? Because I think from the conversation here ke hlokomela hore really there is a need for that to create spaces for teachers to talk about themselves, and you are coming up with this, this is how I have done it, may be other people can try it , may be people can raise issues. Ha ke tsebe hore na such an opportunity do exist, moo e leng hore maybe at the level ya sekolo sa hao, maybe on fortnightly or weekly bases you are sharing what you are doing. It will serve much better purpose ha ele hore you have a critical mass of people who move in the same direction. Because I think this is what learners… Ha ke tsebe haeba ke hlalosa point ya ka hantle [*Meeting seem to be in agreement*]…hore ke bona e ka we have solutions to many of the problems tseo wena le Ntate Thabang le neng le bua ka tsona le re mohlomong matitjhere a etsa jwang. But I am saying may be in stead of trying to find where the fault is may be lets start to move in the direction of saying lets find the solution because Ntate Moeletsi says he has seen it work, actually I have evidence of that, that he has actually done it and seen it work. But there still some teachers who may have some question marks, ho ka creat opportunity moo e leng hore you are sharing ... ho ne ho ena le ntho tsena tsa bo di subject committee, because I know hore sekolong mona ho na le an hour, moo e leng hore ha bana ba qeta ho tsamaya teachers remain, maybe you can use that hour to share with colleagues, and people taking turns to open up, because I really think its possible hore by the end of the year that it will not only be you but there are 5 or 6 other teachers who are moving in the same direction, moo e leng hore tla bona some significant incremental across schools e ba a collective thing moo e leng hore the experience and expertise that we have beyond the schools we can tap on that e ba a local thing….**Phehello:** Tshepang, there is that opportunity. I think one of the reasons eo Ntate Tlhokomediso a sa tsebeng hobaneng ke mo memme (*meeting laughs*), it was because le yena on one-on-one re buile ntho tse ngata hore ke ikemiseditse eng. By the look of things ke ile ka bona le yena a ba jealous jwaleka wena. Ke ka lebaka lena ke lebohileng ha a bile teng le ha re sa ka ra kopana kamora hoba ke siye invitation. But coming to the issue of meetings yeas we have, re na le coordinator ka sekolong sa ntate Tlhokomediso, The only thing ke hore re hlokomele jwaleka committee hore it does operate. At school level, feela ha ken a bolela hore ha re ya e etsa… (*All laugh*) that one we… I think principal will attest to it, re department e hantle re mpa re ikgaella ka staff se mmalwa. We are supposed to, re tlamehile re fanne ka di report tsa learning area two weeks ago, ho…head of department. Basically what we have agreed upon ke hore on mothly basis there is at least learning area meeting and there is a departmental meeting. So each learning area e ya report to amongst its members sothat report e yang ho Head of department e ba report ya learning area, and then the head of department a kgone ho report ho principal. Those are the things that can easily be incorporated. **Tshepang:** I am happy ntate you have addressed my jealousy … I still have a question…ka Ntate Moeletsi. **Phehello** (cracks a joke): ntate Moeletsi o mpa a le ke hore ke le pirates jwale ntate Tlhokomediso ke le chiefs, jwale o ya ka leeme, but he e ne e le enngwe ya dintho ya dintho tseo re neng re hopotse hore …o tla hopola re ile ra bua ka community based service learning center, mme re ne re hopotse hore Ntate Moeletsi o tla re thusa haholo ka yona. Ekare ho ka ba le mokgwa oo e kareng e ka seke ya ba feela Ikaheng …(*jokingly*) **Tshepang:** Ntate Phehello but you do not respond to my question. Question ya ka ke hore we have to systematize but not arrangement ya ntate Moeletsi a nang le yona. I think we can derive maximum benefit, young teachers can derive benefit …lesson design It must not be out of own arrangement it must be our arrangement so that we no longer talk about Chiefs and Pirates but about Bafana Bafana (*jokingly*)

Phehello: …Ekare ho ka ba le ka mokgwa oo re ka I think that is something that we need to consider. I think this covers the point on transformational implementation plan. Maybe to say yes, may be Ntate Tlhokomediso, Ntate Moeletsi we need to thinking about how best we can start working towards that aspect for the good of us all…**Lebohang:** Ntate Phehello what about that one eo ke ileng ka bua ka yona le wena ya ho hula Eskom hore le yona e tlo ba part ya rona. Seemingly manager e ka re ke motho ya ka re thusang, like haeba ho ka uwa Koeberg batswadi ba ke ke ba kgona. Simple re na le power station mona ha ban a monyetla o no wa ho re ba ke ba kene ka hare ho power station. I also raised that issue to say how about inviting Eskom ho ba part ya this maybe e ka fana ka transport for free ha re e ya kae. Maybe le yena next time a ka attend ya eba part ya kopano eo. **Phehello:** E ntse e le teng, Its just that ha re a ya to the detail tsa ntho ena, this activity plan. But I am happy you mentioned it so that e be part of this record that it forms part of this whole discussion. The idea was to form a team that might meet with ease sothat consolidation e ba bobebe ha re ba a bigger team we might not even be all of us come together and meet but ha o sheba structure sa rona for each and every department re ntse re emphasize taba ya ho expand, key a kgolwa ntate Tsotello o ile a bua issues of management & governance ka mantswe a mang e tla ba our arm, now Mme Bohlokwa and myself as educators in the teaching fraternity hoba bobebe ho nna ho kopana le ntate Tlhokomediso le matitjhere a hae, ha o ya di planting tsa masepala ausi Motshedisi is aware hore o tlo re thusa ka hore a liaise le operators le who ever a tla beng a le on duty on a said date. Ka mantswe a mang much as re tla ba few whenever we have meetings there will all of us I will try to sensitize them. If there are issues they can send them for consideration and possible incorporation. Our meetings e tlo ba meetings tsa tsa kgwedi le kgwedi they will not be as long as this one. Re fanana ka opportunity ya ho interact one on one. **Tshepang** (*interjects*): they are still meeting any way…**Phehello** (*confirms emphatically*): Yes, yes, re a kopana ke hore we still interact. May be before ke kopa Mme Bohlokwa ho re kwalla ka mantswe a teboho, ke bontshe hore re na le permission from the Mayor, o re ngoletse permission ya hore re ka sebetsa ke hore study se ka sebetsa, but ke ntse ke tlameha ho etsa arrangements le acting Municipal Manager, I talked to the acting municipal manager who promised hore o tla kgutlela ho nna kapa o tla romela motho. O ne a itse o tla re Acting Technical Manager a attende. But I also talked to the Councilor services, le yena o ne a bontshitse a na le thahasello, o excited about this. Ntate Ntsepe I also notified him. O mphoqa feela ha a sa bue le nna a bua le Tshepangessor (*meeting laughs*). Ke a mo invite hore ho na le session, o araba Tshepangessor, founo ya ka ke ena…but anyway le yena o ile a ba invited. I wanted as many people to be part of this meeting, sothat everybody is aware so that re bone ho re re ka thusana jwang ho ya pele. I also have permission ya FS Education they also wrote to the district office, the consent letters to parents di tsamaile, re di rometse le bana re di rometse Mantaha ho ya ho bana le batswadi individual learners hore re ba mema ho participate. Ke fumane di responses tsa batswadi le bana ba fifty seven out of seventy eo ke e lebeletseng. So I already have conse nts tsa batwadi le bana. Principal is here yena every time ha ke ile ka etsa eng ke mo etsa aware le Mme Bohlokwa mmoho le SGB chairperson. The only thing eo Principal a neng a e sajestile e ne e le hore meibi juring the khos of dis coming weeks this month during meetings tsa di grade ho tla ba le opportunity yah ore re bue le batswadi as a collective. Ka mantswe ano nna ho tswa hlakoreng la ka ke a leboha, haholo le hona. Mme Bohlokwa o ka re lebohela.

Bohlokwa: Ke a leboha Ntate Phehello. Bomme le bo Ntate re leboha haholo re le team ena ka bo teng ba lona kwano. Re a tseba le tlohetse mabaka a lona haholoholo la ho shebella Chiefs (*kopano e ya qaboha*). Tlokomediso**:** e se e bile e korile…Re kopa tshwarelo ha re le inconvinensitse feela he re nahana hona hobane ho ama ngwana wa rona se bohlokwa ho feta tsohle. Le ka moso ha re le mema le mpe le re phallele, maikutlo a lona ho rona a bohlokwa haholo. Mme Ntate Phehello le wena re a o leboha ha o ile wa re kopanya ka tsela ena. Re bile re re tla supota study sena…Ka mantswe a ana ke a leboha re kgutleng mahae ha monate.

ANNEXURE T 2: 'REFLECTION'

TEACHERS, PARENTS AND LEARNERS MEETING

DATE: 16 FEBRUARY 2012 **DURATION:** 1:48:28 **VENUE:** AHANANG SECONDARY SCHOOL

Par 1: O bula ka thapelo. **Bohlokwa (Facilitator)**: Over to you Ntate Phehello

Phehello: Ke se ke lebohile. Dumelang Bomme le Bontate le bana. Ke a kgolwa ntho eo ke tlo e hlalosa key a hore hobaneng re kopane. Re kopane le bana bao e leng di coordinator tsa di team tsa bona. Akere team ka nngwe e na le bana (ditho) ba ka bang bane ha ba fete bohlano. Mme re na le batswadi bao re ileng ra ba kopa, ba ikutlwela hore batla re thusa hore re tlo sebetsa mmoho ho bona hore ha le tlile sekolong ka nako ya afternoon le etsa ntho ena eo le e tletseng ya ho tlo bala. Mme jwale sepheo-pheo ho na jwale ke hore re tlo utlwisisanang hore na re tlo sebetsa jwang, e le hore ha re tlo qala, re be re tseba hantle hore re ya pele jwang. Ke a kgolwa ke karolwana eo ke neng ke batla ho e hlakisa. Mme ke ile ka founela bomme le bontate ba ileng ba ingodisa. Re ile ra ba le kopano ya pele ya batswadi le bana ba grade 11 le 12 le bana mme mono ha tswa batswadi bana bao re nang le bona ke a kgolwa ba bang ba ntse ba le tseleng…ba tla re fumana re se re ntse re tswela pele. Mme lenane re le entse ke lebaka lena kajeno ke reng re kopana re le bana, re le matitjhere re le batswadi. Bao re reng re tlo shebisana taba ya ho ya pele hore na jwaleka ha re buisane hore na re ya pele jwang. Ke a kgolwa ho ba leng siyo ke batho ba babedi feela bao ke sa kang ka ba fumana…E tlare ha rentse re bua, re tla tsamaisa attendance register hore batho ba teng ban ne ba ingole hore ba teng. Ntate Kutlo ke a kgolwa ke qetile karolo eo ke tlamehileng hore ke e etse. Ke lebeletse ntate Mokoko e kare o moraonyana. **Bohlokwa:** Ka pele ho rona mona he batswadi le lona bana, re tshwere taba e buang ka reflections. Ha re bua ka reflections ke ho sheba, re bile re itjheba re sheba morao e le hore re tle re tsebe re ya pele jwang. Ya pele ke learning and teaching strategies. Ke a kgolwa ntlheng ena batho ba ka re thusang haholo holo ke bana bao re ba rutang. Mme le rona ke a kgolwa ba ka sheba ho rona haholo hore na e be mekgwa eo re e sebedisang ho ba ruta, ba e bona ka leihlo lefeng. Hore na mekgwa eo le e bonang re e sebedisa na le bona e ka e na le bokowa kapa bofokodi hokae mme re ka e ntlafatsa jwang. Jwale ka ha le rona re hlola re bolella mehla ena hore e ka re ha le ithute hantle mathata le maima ke ana. Re le tjena re le bontate le bo mme le bontate titjhere le botswadi re hlokometse hore maikutlo a lona ke afe a ka ba matle kapa a ka ba mabe ha feela ho se na tlhapa. Mme ke ema mona hore le ntshe maiklutlo ka dithuto tseo re le fang tsona. **Parent 1:** Buang, haeba le sa rutwe le bue… **Bohlokwa**: Le se ke la re tshaba, ke session e bulehileng. **Learner 1**: Ke bona ho ntse ho rutwa hantle, di jesa ditheohelang…**Bohlokwa:** Le bona eka re le fa tests tse lekaneng, le etsa di practicals, mathata haeba a teng e ka ba afe…**Bamo:** Sir, tjhehe ho ya ka nna ehlile ha di a lekana … re rutwa ntho ho na jwale re a e tshwarella feela ha re botswa … ke kopa feela hore ho be le kekeletso ya diteko. **Bohlokwa:** Wena o bona e ka ho hlokahala diteko tse mmalwa. Ha o sheba tse kae ka nako e kae? **Bamo:** Ka beke re etse tse pedi … **Kgutso:** Nna Ntate tse ding tsa dithuto di a lebaleha, ha ho ntse ho uwa pele. Matitjhere a rona ha a ne a ka bona hore re dula re hopotswa ha re ntse re ya pele. **Bohlokwa:** Haeba ke o utlwa hantle, mosebetsi o fetileng o ke o be le di assignment tse ngata… **Kgutso:** ..tse ngata. E be assignment e be test, e le hore re kgone ho bona bofokodi ba rona before re ka ya di chaptareng tse ding. **Bohlokwa:** Na ho na le maikutlo a mang hape? Ke fumane a di test, ke fumane a di assignment hore di increase akere? **Nthabiseng**: …ke tlatseletsa maikutlo a ntshitsweng. **Par 2**: Ha ba bua ka di homework, di homework tsona? …**Bohlokwa:** …di wela di assignments tsona le classworks. **Teacher 1:** Sorry Ntate Kutlo, batswadi ba tlo bua neng tabeng ee… BOHLOKWA: Ee batswadi le bona ba ka kenya lentswe hona jwale. **Mathabang:** Nna ke ne ke buella temaneng ya ha ba bua ka hore ntho tse ding ba na le ho di lebala ha ba se ba fetela termeng tse ding, hore na ebe ba ka se keng ba sebedisa mokgwa wa ho etsa ntho ba e shebile hore ba tsebe ho e utlwisisa. Hoba ntho ha o e etsa ha o e lebale kapele. Ke hore wa di practical ka mantswe a mang…**Bohlokwa** …moo ho kgonehang **Moletsane:** Nna ke ne nka thabela haholoholo maths mona ho na le ntho tsena hore o ka batla le ntho tseo o sa boneng di amana kae le bophelo…**Bohlokwa**…a ko etse mohlala. **Moletsane:** … jwale ka bo ntho tsena tseo o ntseng o ntse o di etsa tsa bo reflections…**Bam:** Ke ne ke kopa ho mo araba….**Moletsane:** …e sebetsa kae bophelong.. **Bohlokwa**: E hlakile o batla maths o bontshe practical demonstrations tsa oona…**Moletsane:** Eee **Makgothatso**: Nna ke ne ke kgothaletsa weekly test…hore sehloho se itseng ho be le test. Le hore titjhere a shebe hore na mosebetsi ba feela ba o utlwisisa na. **Matlholo:** Ke ne ke re batho ba etsang Maths… group di hlodisane ka hore group e sebetsang hantle ka test tseno tsa beke le beke, ba fuwe ntho e itseng e le hore ba tsebe ho hlodisane. Eee e ya utlwahala Mme, e ya utlwahala…? **Bohlokwa:** E ya utlwahala mme, o re re ya tjheka hore group ba sebetsang hantle ba tswa group efeng. Jwale ho be le competitions e be ho ba le dimpho tse bang teng…mohlomong re kgutlele ho ena ya Moletsane, ya hore maths ona o batla o le thoko le bophelo. Ke hore seo re se etsang ka claseng, ekare ha se ntho eo re e phelang ka ntle ka mane. Mme ke a kgolwa se pheo-pheo sa rona ke hore seo re se etsang ka claseng se bonahale baneng ba rona kantle ka mane. Hobane tshwenyeho ya rona e kgolo ke hore bana ba rona ba entseng maths and science ha a qeta ho pasa kapa a feila matric e ba o fella seterateng mane, ha a kgone hore a iphedise. Ke ne ke tlwaetse ho bua ke a kgolwa ho ntate Phehello, ke re ha ke le ngwana sekolo ke ne ke rutwa all chemistry ya metsi ke tseba ho etsahaling ka metsi, feela unfortunately, ha nka ba ka rutwa hore na nka iphedisa jwang ka metsi, and ke bona ke ntse ke reka metsi bo Spar mane, eno ha e ka ba thuto e ke e rutwang. So, rona re batla hore ka science le maths le ha a ka feila matric a kgone hore a ilo ntshetsa bophelo pele ka ntle. Mme ke a kgolwa seo a se buileng se bohlokwa sa hore se etsahalang ka claseng se bonahale hore na se ama bophelo ka ntle jwang…Ntate Phehello, o na le maikutlo? **Phehello:** ..ke mametse ntate…**Mme Sheba** …maikutlo? o ruta geography

Manthabiseng: Ho tlatseletsa taba tse qetang ho buuwa ke abuti mane, ho na le mokgwa oo re o sebedisang ka tlung o mpa o sa kgone ho elellwa hore ke dipalo. Mme ha a pheha papa o etsa di measurement tsa letswai leo a le tshelang o etsa measurement phofo eo a e tshelang…abuti ha a ka atisa hore a be haufi le ntho tse kang tseo o tla kgona ho utlwisisa hore dipalo di monate. Hobane leha ho etsuwa dikuku ka lapeng, dikuku ha di etsuwe feela, di etsuwa ka di measurement, hore na ke …mme ha a tlo kopanya hore ha a batla ho etsa biscuit…so ntho eon ka kgothatsang bo abuti le bo ausi haholo ba etsang dipalo le science, atamelang haholo ka tlung hore o tsebe ho enjoya ntho eo o e etsang…ke nahana ke moo dikarabo le motivation o leng teng…**Bohlokwa:** Ke a leboha Mme. O se o ntse o utlwa Sejojo…ba bang bar eng maikutlo…ke bona e ka taba ena re e buile **Phehello**: Ntate Kutlo, ntho eo ke utlwang e ka mme o ya e bua ke ya hore ntho tse re di rutuwang sekolong hantle-ntle di tla sekolong ho hlalosuwa hobane di teng bophelong…**Bohlokwa:** di etsahala ka ntle pele…**Phehello:...**ha se ka kitjheneg feela. Le tshimong ha a ntse a hlaola o apply force (‘*bana ba tsheha’*, *ka mokgwa oo e kang ba tsota*)…le lebelo leo kgarefu e tsamayang ka lona ke acceleration, bothata feela ke hore ke nahana hore seo mme a re hlokomedisang sona ke hore ntho enngwe le e nngwe eo le e rutwang potso ya hao ha e be ena eo re utlwang Sejojo a e botsa, ke batla ho mo leboha ka potso ena. Potso e reng ntho ee e ntswela molemo kae kapa nka e sebedisa jwang. E seng na ntho ena e ntshebedisa jwang. Kajena nna ke bona e ka re se re le makgoba a dintho tse tlamehileng di re sebeletse, jwale ke bona eka ke rona re sebeletsang tsona. Hobaneng? Ke mokgwa oo re ithutang ka oona. Ha re battle ho sheba hore na ntho ee e amana jwang…ke hore ha o ka nka bophelo ba hao ho tloha hosing ha o tsoha ho fihlela ha le dikela, o tlo fumana dipalo tse ngata, o tlo fumana physical science, o tlo fumana chemistry…potso ke hore na o ya e bona na? Mme ha o ka e bona, ke leboha mohla oo mme, ha o ka e bona ke kopa o re fe yona re tsebe ho tla e tlisa ka claseng. Ka mantswe a mang ho bo mme haholo ba phehang, ha o na o na le resepe re fe resepe; jwale re tsebe ho tla etsa chemistry ka yona, ke tlohele ho nka matswai ana a ka mona ke ke ka nke resepe ena. Ke utlwile mme a bua ka competition, e ka nnang ya eba e nngwe ya dintho, ho na jwale ha re ne re ka ba le letsatsi feela ho tlo bakuwa dikuku…jwale e be re determine hore na ka tswekere e kae le motswako o mokae re kgona ho baka kuku tse kae. Ke a kgolwa e se e le business studies…ho ntse ho tla ba le bana bas a tlo kgona ho ya pele empa ba pasitse maths le science taba ya ho hlokeha ha mesebetsi ha ena ba excuse hore ha re na ja .

Bohlokwa: Ke a leboha ntate Phehello. Tse ka ntle di hlalosuwa sekolong. Ke hore e hlile ho jwalo, mme mathematics it’s a tool ya ho sebetsana le bophelo bona. Hobane jwale ka ha mme a buile, o buile ntate Phehello, ha o qala o tswaka, ha o sena dipalo tse hantle o kanna wa etsa diphoso. Empa ha o na le di tools tse hantle e leng dipalo o kgona ho tswella pele. Ntate Mokoko o teng Ntate Phehello, ke mo lahlella yona..Ntate Mokoko re ntlheng ena ya bo bebedi, learning and teaching strategies. Mme ka hore re ya tseba Ntate Mokoko kgale a ruta, mme a ka nna a re thusa. Re leka ho sheba hore na mekgwa ya ho ruta e ka thusang bana bana ke efeng. Ho pasa le hore ba utlwisise di subject tsena hantle, e le hore ba kgone ho ntshetsa bophela hantle ka ntle. Jwale ba ne ba ntse ba re fa maikutlo jwale le a hao re ka a thabela**. Moeletsi:** Ke a leboha. Ke tla mamela pele ke tsebe ho lokisa kelello ya ka, **k**e se etsise motho eo e reng ha a qala a kena kopanong a kene a se a ntse a phahamisitse letsoho (*phutheho e ya tsheha*)...**Bohlokwa:** Jwale ntlha eo re neng re le ho yona haholo ke ya hore thuto ya ka sekolong…Moeletsi (*o ya qetela*)..e se ke ya arohana le bophelo ka ntle…Bohlokwa(*o ya dumela*)..e se ke ya arohana le bophelo ka ntle. Jwale ho ne ho shebala hore maikutlo ke hore, a ko e hlalose ntate Phehello, hore thuto re loketse ho e sebedisa e seng e re sebedise. Ntho tsena di ya etsahala ka ntle bophelong re mpa re tlo di hlalosa ka hare ho mabota ana. Mohlankana enwa o ne a ile a botsa ka hore maths, hona tjena re ntse re etsa di functions, di reflections; jwale o re ha a bone hore na e amana le bophelo jwang…empa he kgang-kgang ke hore dintho tsena di ya etsahala ka ntle re mpa re tlo di hlalosa ka hare ka mona. Jwale mekgwa eo re hlileng re e batlang, ke ya ho link sena se etsahalang exactly le se etsahalang kantle, jwale ka ha mme a entse mehlala ka ho pheha le hore di ama maths le science…tsa ba tsa kena accounting ha re ya thekisong.

Phehello: E re ke hlakise taba ena ya hore e se key a re sebedisa…ka nako e nngwe di ka sebediswa ho fihlela dipheo tse ding tseo di se nang …**Bohlokwa:** Dr. Basson akere e ya tsebahala…**Phehello:** ha re battle ha ntho tse jwalo di eba teng

Bohlokwa: So, bana ba re ho rona ho be le regular testing, more assignments and practicals, practical examples. Ke a kgolwa e se e ntse e ama subject tse ding. Jwale hape e nngwe key a competitions. Jwale each team compete amongst themselves

Moeletsi: Ntate Kutlo ke ne ke tla tlatseletsa. Ke lebohile …se ka ruta bana nako e telelele mo rute nako e kgutshwane mme o be o mo testa…nna ke ne ke fana ka tse …

ANNEXURE DM 1: DEPARTMENTAL MEETING

NATURAL SCIENCES, PHYSICAL SCIENCE; AGRICULTURAL SCIENCES

DATE: 08 SEPTEMBER 2011 **DURATION: 1:11:26** **VENUE:** AHANANG SECONDARY SCHOOL

Phehello: Good afternoon colleagues. You have before yourselves minutes of the previous meeting. I want us to look at them quickly, and if there is anything that you want us to add or query or subtract you will indicate. Point one (*interruption phone rings*), ke kopa re di etse off hobane jwale di tlo etsa meeting o kene nako e telele. Taba ya item number one under policy matters a ke re we are still saying we did not do as much as we intended ka taba ya implementation; hore we had said our meetings di tlameha ho dula on monthly basis that we will rectify that that is why we are here today. Number two we said that our work schedules are not…ha di a structuruwa ka tsela e tshwanang, despite the fact that re departmenteng re learning areang e le nngwe, akere. That is what we said, and we said we will bring copies to this meeting sothat re be le informed engagements. But we also agreed that we will work together in planning particularly in grades eight, nine and ten, which will be the focus today. The same with lesson plans, hore notwithstanding that re grade tse fapaneng…yaba re etsa announcement ka research study hore there is a transformational service learning study that is underway and we need to exploit possibilities of maximizing our benefits there from. Is there anything *Rethuseng and* (Mohau) (life sciences & natural sciences) that you think we omitted from the minuets? ***Rethuseng***: Ke tsona taba tsa di workschedule le lesson plans le hore re planner jwang mosebetsi wa grade 8 and 9 hore ho be le that link. **Phehello:** So this is a record ya meeting o fetileng? **Rethuseng & Mohau**: Yes. Ke yona. **Phehello:** I have requested Ntate Kutlo le Mme **Mosupatsela** to be here. The reason being that Mme Masupha has been doing science for how many years?. **Mosupatsela** (*trying to recall*): Ha ke hopole dikolong tse ding feela ke ho tloha ha ke fihla ka 1998. Ke bile grade 8, ha ke so be grade 9, ka ba grade 10, ka ba grade 11 ka ba grade 12. Ha ke kgone ho arrange hore na neng ke neng but grade 12 haesale ke le hona teng ho tloha ke fihla mona ka 2000...

Phehello: Ok, but the whole idea e ne e le hore, because re tlo bua ka scope ka scope jwaleka ha RETHUSENG a se a boletse hore grade 8 and 9 especially, we had agreed hore re hloka ho sebetsa mmoho; sothat ho be le the link, synergy pakeng tsa seo re se etsang pakeng tsa FET science le grade 10 le grade 9. Haholo hobane ho na le maikutlo a reng part of the problem eo re nang le yona science ke hobane bana bana GET ha e monitharuwe (monitor)hantle in the sense ya hore ho na le possibility ya ho ba inclined to one (aspect/section of the work) at the expense of the other and so on and so forth. So, maybe as the school we need to look at it even if it not at detail today, but we need to say how then do we …but is it your finding as well?

Mohau: Yes. A kere the other thing is ho na le this 'corolinary' concepts for 8 and 9 o ka fumana hore mohlomong 8 o ntsa etsa ntho e ke ntseng ke etsa 9; like mohlomong electricity grade 8 and 9 so re tshwanetse re tjho ho re na grade 8 ha a etsa electricity concepts core content re tshwanela ho kgetha, together, hore ha o le 8 wena o nka dife moo. **Phehello:** Ntjwetse lona grade 8 and 9 ha le na ntho e tjee, work schedule? **Kutlo**: Grade 8 and 9 ha ho na work schedule ha ngata ke core content. Let me say e hlile matitjhere a grade 8 and 9 they come together ba dule fatshe hore topic e itseng jk electricity hore grade 8 re tla treat electricity from this part to this part and grade 9 re tswella pele from this part, ho se ke ha fumanwa ho etswa the same thing. MOHAU(*confirms*, *repeats with KUTLO*): …the same thing. **Phehello**: But le bona e ka ntho ee e ya sebetsa hantle? **Kutlo**: Moo re neng re sebetsa teng, … mane, we used to sit down together. Ha e sebetse hantle because of the problem ya hore NS e kentse ntho tse ngata haholo. E kentse life sciences, e kentse eng e kentse eng…so le ha re ne re di arotse ka nako, motho wa life sciences o tla ya deeper ha a fihla life sciences mme wa physical science a ye deeper ha a fihla physical science.

Mosupatsela: Like ha ke ne ke ntse ke sebetsa le Rethuseng; o ne a ntjwetsa mehla ena hore ae wena o ituletse physics. O etsa physics ho feta biology jwale ha re tlo botsa re a sokola. Say ke ruta ka claseng jwale re argue ha re tlo seta jwale ke se ke entse ntho e ngata ya science.

Kutlo: Ho na le problem yona e no ya hore ha hona work schedule se uniform from tswa ho department. Sekolo ka sekolo se a iketsetsa. Ke ntho ena ho bang very difficult hore o re setele NS e common. Na e ile ya ngolwa NS common exam? Ha e ka ba ya ngolwa. Ke ka baka la bothata bona. Ho ne ho thwe di-LF di sete ba ile ba hana. Ke hobane ha re na work schedule. Jwale taba ya ho e etsa e engwa pele ke hore why empa re qala ka CAPS. CAPS yona hopefully ho tla ba le common works schedule.

Rethuseng: CAPS ke grade 10 akere, grade 8 and 9 di ntse di so kene. **Kutlo:** So next year haeba CAPS e ntse e so be teng, re tla tlameha ho iketsetsa our own work schedule. Ka tsela yona ena ya grade 10 e be re nka this core content e be re a choosa. **Phehello:** But the extent, botebo? Rethuseng & Mohau & Kutlo: core content ha e tjho. **Mohau:** Wa bona this thing ke e entse ke sebedisa core content. Ha ke qeta ho chosa from concepts, ke hore ntho tsena ha o ka sheba ke di nkile core contenting. Re tlameha re be re dutse le motho wa grade 8 hore ke chusistse this one mme o nke yane. **Phehello:** But does the core content indicate how much time must you spent on which one? Because ke yona ntho eo ke nahanang hore we must start working on. CAPS e le teng kapa e le siyo, because ha re tsebe hore na CAPS e tla re tlela le eng e tla tla ele jwang. Jwale ka ha eka e tla be e le siyo di grade tse itseng. But fortunately we have agreed hore lets work as a team and see how best we address the problem. Le hopla re e etse jwang now? Akere.. are we grade 9 ke titjher 1 le grade 8 o mong, mare le ntse le latela but…**Mohau:** Ke hore rona re se re avoida hore bana ha ba fihla honna ke treat ntho eo yena a sa e etsang. O thola hangata ho na le ma grade 9 ba sa tsweng sekolong sena, ba tswa dikolong tse ding. Ha ke etsa mohlomong electricity concept tse itseng bona ba di entse grade 8 moo ba tswang, hobane re kgethile ntho tseo ba neng ba sa di kgetha sekolong seo ba tswang ho sona.

<u>**Rethuseng**: Hape o fumana hore ha re kgethe hakalo, nna le Mohau, ke hore ha re kopane. So hoo o tla fumana hore this year ho na le ntho tseo a dietsang tse ke ntseng ke di etsa kapa seng ke di entse. Ke hore ha ho wa ba le planning e hantle, re dule fatshe re bolele o tlo etsa tsena ke etse tsena. Le hona jwale ha re plana because selemo se batla se fela, ke nahana re etsa planning for next year, ha re dula re etsa</u>

schedule eo, re re first term o etsa ntho tsena, second term eng eng…**Phehello:** Don't you think ho re ho tlo ba bohlokwa hore re cheke (check) hore na what is it that you have done already le hore na ke eng e setseng le extent ya yona in the same way le ho grade 9 sothat for the fourth term, Mohau (*interjects in agreement*): ho ka tjhentjwa, **Phehello** *(continues from that*) yes if need be. Hobane haeba e na le di field tse four kgonahalo ya hore re tla ba le mathat a tshwanang e tla nne e be teng. **Kutlo:** One of the things ke hore matitjhere a rona a ruta grade 9 le 8 ka bobedi ba bona, ha ke tsebe na biase ba kgona ho e avoid na. Because ka mona ka high school, ba ruta life science. So ha re tsebe hore na ha ba ruta eo ba e rutang haholo ho feta e nngwe ke efeng.

Mohau: Nna ke ntse ke di balance, key a di balance. Since ho tloha kgale, ke na le lesedi la physical science le biology. **Phehello:** Biase ke hore o ka nna wa ba le lesedi leo feela o be o rata karolo e nngwe haholo ho feta tse ding, and then therefore o be o spend nako e ngata ho yona. **Mosupatsela**: Nna streaming, ntho e nngwe e etsang hore bana ba be le tshekamelo e itseng ho tswa hore stream se tshetseng. Hoba se seng se tla be se kentse di subject tseo ho thweng di thata kaofela. Se tla be se kentse maths, se kentse science, se kentse geography… So ka nqane ka life science a ka nna a etsa life science a sa tlameletseha ho etsa maths e le math literacy. Ntho ena re hlokomele hore maths lit e entse di stream di be moferefere, bana ba batla feela ho tshabela maths, bay a ka maths lit. So, as a result moo math o leng teng, science e teng. O tla fumana hore bana ba bangata ke ba etsang maths lit, e seng ha kalo ba ne ba baleha science. Say ba ne ba baleha maths so maths o tsamaya le science

Phehello: Ntho ya bohlokwa ke batla re kgutlele hore ha ngwana ha a fihla grade 10 o ya streaming seo ha a tla ho sona, dintho tseo a di entseng grade 9 di mo kgontsha hore a cope with the.., le ntho ya ne eo KUTLO a e botsang ya biase. Because if grade 9 ho ka ba le biasness on some topics, e etsa bothata, hobane grade 10 ho tswelwa pele jwale ka ha ekare basics ba di entse. **Rethuseng:** Nna ke ne ke re ho bua nnete ke a kgolwa hore le ha ke e tsa grade 8, ha ke clear hantle ka physics, but ke ya e etsa part eo, so nka se kene deep ho yona like ke kena parting ya life science, ya biology. Ke ntse ke e etsa feela o ya utlwa ke e etsa tjena …ka hodimo, moo ke tla kenang haholo ke moo…ke titjhere ya biology le geography, ho batla yona ntho ya hore re kopana re bone hore part e le re etsa jwang. E le hore le bana ba se fe Phehello headache ya hlooho…(*laughing headache ya hlooho*). **Mosupatsela:** Ke ne ke batla hore haholo ka content ya grade 8 le 9, re e hlahloba hore na physical science e etsa karolo e kae ya yona, technology, e na le geography, life sciences e kae. Ke ne ke nahana ha re ka re sheba ra leka ho e arola ho latela hore na e kae, ra tseba ho di allocatela nako e lekaneng. Then ra be re tlo leka ho sheba hore na how best can we help each other nthong tseno. Rethuseng ntho eo a e hlahisitseng e bohlokwa haholo ha a na tsebo e ntle le hoja ke dumela hore ho motho ya keneg sekolo a ka ithuta yona, empa he hore na re ka thusanang jwang. **Phehello:** Ebe e ba mang ya etsang ntho eo? **Kutlo**: Ho hlakile hore ho ho rona re le tjena ha o kena topic e nngwe emong le emong a ka assita. **Phehello:** Ya ho thusa re dumellane re tla sebetsa mmoho. Ka mantswe a mang anyone ya ka approachuwang hore a thuse o tla tlameha ho ya thusa. Ke tjho analysis eo; pakeng tsa Kutlo, Phehello, Le Rethuseng & Mohau but outside this meeting hoba re ka se e etsa mona. Hore maybe before nakong e itseng re tla be re ile ra sheba ntho ena hore general sciences, life science geography those four streams di fuwe nako e kae, kapa di na le topic tse kae ke hore mokgwa feela oo re ka kgonang ho di analyse, so that re kgone ho ka package nako tsa tsona jwang…

Rethuseng: Ke nahana ha o tjho jwalo lets say next term ke etsa life and living mma Mohau o etsa ntho enngwe e le hore moo ke nang le ntho teng grade 8 and 9 nna le yena ha re ka shebisana ha a nka life and living and the next term ke be ke e etsa because e ntse e le class tse thatro le yena, mohlomong yena a ba etsa part ya…ha ke tsebe jwang, a batlo nketsetse this…**Phehello:** O ya tharollong, ke nahana o se o le step ahead. Stepe sa pele ke hore re etse analysis, how much of which le hore na ha re ya planning therefore ke term e fe moo re ka etsang theme efe. Jwale ha o bua o bua e ka o re re di staggare (stagger) ha dib a staggered it would mean that term ya pele re etsa lif and living ha e mong a etsa part ya physical science a ba lo thusa ka physical science ha wena o tla be o mo thusa ka life and living. It is part of the solution. Because alternative e ka bah ore ha o lo etsa life and living o ka e etsa but ha o lo etsa scienc o ka kopa mme Mosupatsela, Kutlo, Phehello a lo thusa mare re shebile taba ya ntate

MML 1 a e builleng a re ha se taba ya lerato hobane o ka nna wa e etsa. Di tla tlameha e be a team effort ha di etsahala ka tsela ena ya bobedi. **Rethuseng**: Ee ke nahana ha ke kopile motho e mong mare ke be teng, ha le teng ke se ntse ke ruteha. O ya utlwa ha ke iketsetsa yona ke le mong ho se na motho ya ntharollang, ke dula selemo le selemo ke ntse ke le hona mono. Ha ho na ntho e ntjha eo ke ithutang yona ha ke tsebe niks. **Mohau:** Kapa the other thing if time table e dumela nka nka grade 8 di theme tsa physics, grade 9 theme tsa physics yena a be 8 biology le 9 biology. **Phehello:** Kutlo o teng o tla tshwaetsa management hore na ho ka etsahalang ke hofe. Lehlohonolo ke hore re na le di alternatives. But ke kopa re kgutlele morao he re na le tharollo, haeba ho ka ba le ya boraro re tla e fumana ha mmela o ntse o puta. Re fumana analysis eo neng? **Mosupatsela**: …

Phehello: ke kopa re dumellane hore ho tloha hona jwale ho fihlela labobedi, e mong le emong especially ba tshwereng ntho ena re etse analysis he re leke ho di classify so that kopano ya rona e se ke ya tlo nka nako e telele. Then re be re dumellana hore tsena ke science tsena ke tsa eng tsena ke tsa eng, therefore based on this nako ke ena and what next. Ke ne ke batla ho tla tabeng ya hore it would not necessarily be for next year e ka nna ya e ba for next term. Because if re ka ra fumana hore the extent, depth ha re ya e etsa ka bo tebo, we need to have some way of addressing it in the next term. Because bothat ba rona ke hore re identify the right learners re ba fe first the right skill and identify for their right potential ya bona. Ok ke nka hore… Mosupatsela ha ke tsebe e seng ke o fe sebaka o bue, what do you think, how best, what is it additional I am aware re ntse re le mmoho, but is there any other way, your knowledge hobane wena o tswa kwana o tswa kwana o batla o…

Mosupatsela: Nna ke hlile ke batla ke pharaletse but ke nahana hore tsela eo re ntseng re e nkile, le batla le e qetile hobane ha ke a ba nako e telele grade 8. Mme boholo ba ka ke hlile ke pota bo teneng (grade 10) mona. So e ne e kaba hantle ha re ka ra bonnyane re be se ba hlwaile ka tsela eno yah ore re bone ba nang le potential ha re ba imetse, hobane ba bang o fumana hore ba kene ka mono feela ke ho imetsa ngwana ha a na light, ha a na letho. Le bao a ntseng a ena le bona le ha ba ka ba fana ka dintlha tse itseng, ba le tracking o fumane hore yena ekare o lahlehile. **So, ka nako e nngwe o sulafallwa a sa le grade 10. So ke a kgolwa ha e ka ralwa ka tsela ena e ntseng e ralwa ka yona hoba re ne re ntse re sa etse jwalo all together.** Like I am saying nna ke ne ke ruta 8 ke ne ke ithutela yona taba ya hore, a kere ha ke a ngollwa hore ke etseng haholo, jwalo ka fumana hore ha ke tlameha hore ke kenye biology part, e batla e fokola haholo; ke e imeditse ka physics and geography, geography yona ne ntse ke kena ho yona. Jwale ke sheba sheba mono ke re aaaaa e nyane taba ena ya biology, batla nne ba e etse pele kwana batho ba etsang biology. So nna e hlile focus ya ka e ne e le most on science. So ntse ke tjho ke re grade 10 bothata ke bona bono ba hore bana ba mixed feela ha re tsebe na re etsa eng…grade 10, ke hore bana ba pasa grade 9 ba ya grade 10. Ha ho na order ka nnete. Le rona re le ba science re sitwa hore ngwana enwa a ka e etsa science, ho tjena feela ha ba kena ka moo. So mohlomong e tlare thusa hore re tsebe ho fa bana ntho e nepahetseng. Ho ba fa future e nepahetseng…

Phehello: Ntho e nngwe, ho na le taba ya hore, bana ba bang ba tswa di feeder schools, ha re tsebe hore na di feeder schools di rutile eng. Re tseba di feeder schools tsa rona akere. Haholo bana bao re ba amohelang grade 8 ke ya pele, jwale re ba le bothata ba bana bao re ba nkang grade 9. **Mosupatsela**: And ke bona ba kenang ka bongata. Jwale le yona re a e sheba hore na ke bo mang ba re fang grade 9 ya bana ke bo mang ba re fang grade 8 ke bo mang ba re fang grade 11. O tsebe re na le bana ba ho tswa le bana bana grade 10, but ha o fihla grade 11 ho na le ba bang bao re ba nkang grade 11. Jwale ha o tsebe le bona hore na how far have they gone. Mohlomong ntate KUTLO maybe ha le ntse le dula management especially now that re bile re atametse ho ya selemong se tlang…ha ke tsebe hore na maikutlo a lona ke afe. Di admissions tsena tse staggered, maybe proposal ke hore diprimary tse re fang grades 8 in one way or the other, either now or in the future re be re ile ra kopana le matitjhere a bona ho fumana ho re na what is it eo ba e entseng le bana bao akere. Sothat ha o sebetsa le bana ha selemo se qala o ya tseba o sebetsa jwang. Ha jwale re ba sebetssa ka pampiri tseo ba tlamehang hore ba be ba di entse primary le ha ba sa di etsa ke molato wa bona. The same with grade 9, ke bo mang ba re fang ma grade 9 boholo, na re ka kopana ka date e itseng, e le hore re batla ho establish hore how far have you gone with your science. E tla re thusa hore ha o planner you must take into cognizance this issues. **Mosupatsela:** Ntate Phehello, ha nkeke botse hore na ntho ee eo o e buang ha se eo ntate (SMGD) a kileng atla ka yona ha a re kopanya ka mola. But ha e sebetse. **Phehello**: Ha e ya sebetsa hobane coordinator. Akere o ya hopola hore re dumellane ka hore re tla ba le di meeting. Ke mang coordinator ya rona? **Mosupatsela:** Ke lebetse feela le rona ha re so etse letho. Kutlo: Ke ka makgetlo ke bua le yena..**Phehello**: Nna ke ne ke ena le Ikaheng SS feela…**Kutlo:** Ntho ena eo o buang ka yona ntate Phehello ke ya kgolwa o tla hopola last year … we were trying to establish hore na ntho tseo ba di tsebang ke dife. Mme o ne o fumana hore basically ntho tseno ha ba di tsebe. Ka BODMAS, ba ne bas a di tsebe. Ke hore e ne e le bothata haholo. Ka di primary ke bona e ka re ka bua. Ke bona e ka ho ntse ho hlokahala hore bana bana ha ba fihla haeba ho ne ho ka etsahala re ne re ka seta dipotso pre-test e seng psychometric tests…hore re tsebe hore na bana ba tseba ha kae. Tlotlanang, ha ba ne ba fihla grade 10 ke ne ke ba fa dipotso hore score sa rona se ne se re thusa hore bana ba…. Otla thola e mong a na le level 7 feela a sa tsebe ntho tse basic.

Phehello: I think ntho ya pre-assessment re ka e leka, but le ena ya ho kopana re le matitjhere e hloka re e leke. Re battle mokgwa wa hore re kopane. **Opportunity eo re nang le yona kehore lefapha la thuto le batla re kopane. The only thing ke hore re qobellanang jwang hore e etsahale**. Because unless hore e etsahale, re tla nne re be le bothata bona ba hore o tla nne o re o rutile athe ditaba tsa hao ha di kgone ho fihlela mobung o tsitsitseng hantle, le wena o se o feta feela syllabus e tlameha ho fela.

Kutlo (*o ya tsheha***): Ke kgothaletsa hore re kopane feela at the same time ke a tshaba**. Akere wa bona re high school re bua ka matitjhere a primary. Wena he ha o ka hopola Motsomi le Hlaba Poraemari ya rona. O ye o utlwe ha ke tjho ke re sekolo seo sa rona e ne e le sekolo. Bana ha ba ne ba ba hlaha primary, e ne e le feeder school ya rona ba ne ba fihla ba sa tsebe ho ngola. Re re bile re batla ho kopana le matitjhere e se hampe re bile ra kopa sepeketere ka nako eo. Re ile ra etsa jwalo. Jwale ba be ba re re nahana re tseba haholo bona ba rutile bana bano, bana bao ba pasitse. Yaba spektere se re se tswa ho principal, principal o re bana ba pasitse, so wena ha o mo fumana a sa tsebe ho ngola feela a pasitse, ke bothata ba hao bono, solve it. So, ntho e etsahalang ke hore, **my fear is ba bang ba tla utlwisisa ba bang o ba bontsha bothata ba bona. O ka tloha wa fumana hore e baka bothata bo keneletseng**.

Phehello: Ntate Kutlo ke a leboha. **Feela re na le meyetla e fetang ka nako eo ho na jwale**. Akere ke lona le ngodisitseng bana ANA. ANA o ne a le siyo ka nako eo. **Ka mantswe a mang e mong le emong ho tloha ho ministara kajeno o bua hore bana ha ba tsebe ho ngola le ho bala ba le grade tseo ba tshwanetseng hore e be ba tseba ho bala**. So, ha esale taba ya patuwe, **ke taba ya hore rona we are extending a word of friendship, le hore re kopaneng re bontshaneng hore re tswarisanang taba jwang**. **Hobane bao ditaba le mantswe a bohloko a tlang ho bona ke matitjhere**. Hona jwale tjena ha bana ba Ahanang SS ba feitse kereiti 12 di tlo tswa, poraemari ha ho na moo e fitjharang, ba lebala yona ntho eno eo o e buwang ya hore ba ntse ba ba fetisa jwalo ba sa ntse ba sa tsebe ho ngola le ho bala.

Kutlo: Ntate Phehello, **one other thing one common problem** ne ke e fumane ha re ne re kopane re le matitjhere a Botjhabatsatsi bona ba poraemari ba re the main problem ke hore a kere **wa bona syllabus e ya tjhentjhwa…ntho tsena tseo batho bana ba tlang ka tsona** primary, boholo ba matitjhere a primary ha **ba di tsebe**. So ba bua … ha ke tsebe letho. **Mme ke enngwe ya bothata bo teng** poraemari

Phehello: **E bile ke monyetla wa rona wa ho re re thusehe, because jwale re tla be re na le factual information.** **Kutlo:** Mosupatsela, A kere o ile wa nna wa tjho hore titjhere enngwe ya ….school mohlang wane tsona ntho tsena tsa BODMAS ha a di tsebe …**Mosupatsela**: O ne a tjho jwalo a re nna the mona o ya nthuta… ke hore a ipuela feela hantle…**Phehello: Ke ka hona ke reng ha re hlolwe re lekile. Feela re e etsa ka maikutlo a matle hore re batla ho etsa ntho e tjena.e leng yona ntho ena e ntseng e sa etsahale. Maybe the approach was wrong kapa the manner in which re neng re batla etsahale ka oona o ne o fosahetse. Akere ke ho fumana feela batho ba nepahetseng dibakeng tse nepahetseng hore dintho tse ding di etsahale**. **Mosupatsela:** Ee ke hore re e leke ntate hobane bo nnete ntho eo

Rethuseng a e buang ke nnete ya hore batho bana ba na le ho ba le ‘attitude’ ke hore bana ba primary somehow, haholo mona Mohokareng ke hore re sa pate. Ha ho uwa ho lebuwe sekolo sa Ahanang SS, le matitjhere a di primary ha bana ba qette grade 7 ba bua ka melomo ya bona ba re tsamaya wena o ilo applaela ka Ikaheng SS, o se ke wa ya ka Ahanang SS. Ke hore attitude e ngata ka hara Mohokareng, attitude e ngata ho dikolo tse re fepelang hore ha di re thabele hakalo…**Phehello:** So, it is up to us hore re ba prove wrong, so that next time ba re e yang Ahanang SS…

Mosupatsela: Ke yona ntho eo ke neng ke rapela tshebedisano mmoho ya location (community) jwalo. It is either ba nyatsa batho ba sebetsang moo. Ho thwe matichere a mona a manyane and a tletse papadi, ka mane e batla e se e le batho ba baholo ba serious ka bophelo…**Phehello:** and we are going to prove them wrong.

Phehello: Ke kopa re qetele ka item number four. Ke leboha le mokgwa oo re ntseng re bua ka oona re batle re le interactive; ke taba ya Laboratory ena eo re leng ka ho yona. Re ne re na le moeti ho tswa Protec mme o ne a thabile a bona laboratory ya rona e hlwekile e bonahala le hore e ya sebediswa. He was very impressed. But a ba etsa recommendation ya hore re identify old stock re se tsetele some where. A kere o ya bona ha re na labels re leke ho arrange ka tsela eo rona re ka bonang e le thuso ho rona, le hore re boloke inventory. Lebaka la hae leleholo ke lena as private sector, ha o lo batla thuso, tjhelete, bat la o botsa hore na o na le eng e kae. O ile a etsa mohlala ka van de graff generator, ke eno re na le yona. Ha ke fihla mona le yona e ne e le dismantled yaba ke a e kopanya so that ke display ka yona…jwale ha a fihla o ile a mpotsa hore na e ya sebetsa. A re ba ka re thusa le ka di technician kapa ba ka e nka ba re fa e ntjha. Feela a re ntho e jwalo ba ka e etsa only if o kgona ho account for what you have, ke ntho e o ke e nkileng ha ke se ke bala between the lines. So re na le project e re tlamehang ho e etsa ka laboratory to make it functional. Ke ne ken a le meeting le batswadi ka di 1 September: ntho eo ken eng ke bua ka yona ke hore re tshaba ho sebedisa laboratory hoba e kentse ntho tse kotsi, bana ba bona ba ill disciplined and son on and so forth. Hape ho na le hore ba qabane kgefe-kgafetsa, jwale ba tloha ban ka ntho tsena e be ba lwantshana ka tsona ntle le kaparo…jwale the main reason why re na le item ena. Ke kopa ke utlwe maikutlo a lona hore how best can we do this but we don’t know how much of what. Rethuseng o ile a etsa suggestion ya hore some of these charts re di behe maboteng …jwale di claseng ka baka la ho dula ho butswe bana ba di tlosa. Should we propose hore ntate Kutlo a kope management for control ho be le tse itseng tse bulwang…

Mohau: Ho lokiswe di fenstere le mamati, di clase di notlelwe. **Phehello:** Bitsong la thepa re ka kgetha class tse itseng mme class teacher a nke karolo tabeng ena. **Rethuseng**: Le bana ba rutwe ho boikarabelo, ho hlokomela ntho tsa bona hoba ke tsa bona. **Kutlo:** Ke tla kopa jwalo management. Feela ha o ka sheba psychology ya bana tsona tseo tse tlo kwalwa ke tsona tse tlo tjhwatluwa. **Phehello:** Mohlomong re kope le RCL e etse time table ho supervise. **Kutlo:** For a start re ka nna ra di isa with time batla tseba.. **Rethuseng**: Ha re ka laminate di chart mme re di bee difenstereng tsa laboratory. **Phehello:** Re e hlokomela jwang? Ke mang ya fielang neng?

Mosupatsela: Bana ba kenang class mona kapa ho kgethwe bat la ikarabellang ho yona..**Kutlo**: Laboratory e ntse e hloka e fielwe on daily basis, e seng feela ka matsatsi a ikgethileng. **Phehello:** Bakeng sa stock re sebetsa jwang? **Rethuseng**: Ke sisinya hore re e etse ka di holiday. **Mohau:** Ha ho na template ya ho etsa stock? **Phehello:** Ha re e lekeng ka di holidays mme re fumane le bana bano ba disciplined. Re tla etsa combination ya tse buuweng viz. e le rona, e le rona le bana ka di holiday re tla sheba feela ke eng e sebetsang. **Phehello:** Ke kopa ho tsebisa hore with regard to my study, Ekere ke ile ka bua ka hore ke batla re tlo etsa community based service learning center. Hantle-ntle one of the services tseo center e ka di etsang, ke ntho ena eo Ntate SMGDS a neng a re e etsahale - study group. So e ka re thusa ka yona e re boelanye. But also tlameha e kenyeletse batho bohle, batswadi, bana, batjha and all that. Ke buiswa tjena maobane ke kopane le Mokebe, ha a sebetse ha a ya sekolong. She is one child eo ke tsebang o ne a le disciplined le science o ne a le motle. Jwale community based service learning center ha e sele functional hantle e tlameha ho ba le management center, e tlameha ho ba well managed. So, ho tla ba le management committee. So ho e manage ke ne ke nahanne out of school youth like many others ba ka kopana. Mme re ka ba fumanela hore e be karolo ya business planning, ho etsa business plan ho kopa di funds for this, because akere ka nako eo re lo sebedisa center, ba tlameha ho ba ready like any other space se lokisetswang ha ho tlo ba le di event tse itseng. Secondly, part ya karolo e nngwe eo ba ka e bapalang ke ho ba di laboratory assistants dikolong tsona tsena tsa rona…ke leka ho reng o ka prepara hantle wa tsamaya feela ha o kgutla claseng e se e le rush-rush jwale e kare ho ka ba le batho ba ka tlang ba o kgutliseletsa ntho tsena mane moo di tlamehang ho bat eng; ha o di batla a ka o atameletsa tsona. Like o ilo sebedisa box ho etsa ceilinder…it is one way nna ken eng ke nahanne ho ka ba thusa ka mesebetsi provided re fumana di funds. At least malapa a mang o ntse o fumana o robala a sa ja but ha re tsebe ke mokgwa o fe oo re ka thusang ka teng. But also le yona ntho ena eo re ntseng re e bua ya ho labola laboratory, re ka kopa university while re sal e part of the study UFS hore what do I need to be laboratory assistant. Na ka nnete ke hloka hore ke be le BSc? I don’t think so. Ba ka re thusa ka ntho ena for these learners. If le lona le na lethahasello please show interest. Di teaching aids teng, di project tseo re di etsang will ultimately be done at the community based learning center. So with that I must just thank you for attending the meeting. Ke **lebohile** haholo

ANNEXURE ST 1-7

AHANANG SECONDARY SCHOOL

SUSTAINABLE LEARNING ENVIRONMENTS

Transformational Learning of Physical Science

23 November 2011

Dear Leaner Participant

We thank you for having shown the commitment and willingness to learn Physical Science through the use of service learning. We are confident that your continued positive attitude towards your work will get you to succeed in all you do at school and in life.

Remember we (you)

1. visited the waste water treatment plant during the September 2011 (Spring) vacations;
2. worked with other learners from different classes and grades to respond to the questions asked in the study worksheets and
3. furthermore participated in the study teams for purposes of preparing for the November 2011 examinations etc.

We would like to improve our learning and teaching approaches in the year 2012. Please share your experiences of the study *e.g*. of the above encounters with us. (*e.g*. what you liked and disliked about them; what you personally learned from them; how they influenced you attitude towards learning and life in general, what can be done to help you to learn better *etc.*).

Thank You

__________________ _____________________

Phehello R **Thabang M (Principal)**

The Learners' suggestions, views and comments on areas of improvement of learning of Physical Science:

No data given in this section because of ethical reasons

TEAM PERFORMANCE CHARTER

Surname	First Name	e-mail	Cell
Letolo	Phehello	Phellumt@webmail.co.za	082 790 2610
Thabeng	Makgabane	makgabsa@live.com	084 739 8561
Lekitla	Tsotello	stsots@vodamail.co.za	073 789 3966
Dikomo	Ntsoteng	ntsoteng_dikomo@yahoo.com	083 663 9869
Mphatsengi	Bohlokwa	bohlokwai@gmail.com	081 699 5586

TABLE OF CONTENTS

1. Introduction

This document outlines the responsibility, conduct and the terms of reference according to which the research study coordinating team will operate for the duration of the research project. The contents hereof were agreed upon by all members during the coordinating team's strategic planning session of the 07th August 2011.

2. Purpose

The purpose is to enable members to complete the research study timely as per the agreed upon programme ***viz***. the transformational service learning implementation plan (TSLIP).

3. Vision

There is a tendency to teach Physical Science through teaching methods that lead to rote learning. These abstract learning in classrooms and do not relate it to real life situations. The learners ultimately do not find meaning in what they learn, because there is no direct linkage between school learning and practical real life situation. It is in this **context** that this research study project affords us the opportunity to respond positively towards the RSA transformation agenda. Thus the research study team adopts the aim of the study as its vision viz.

A transformational learning of Physical Science through service learning for sustainability

4. Mission

To design a high school service learning strategy towards the transformation of learning of physical science in high schools, in order to create sustainable learning environments and

To establish a community service learning center for the sustenance of Physical Science's transformational service learning and of learning in general beyond the study project

5. Values

The research coordinating team's engagements will be guided by a set of values especially ***trust, care and respect*** for each other and the research study participants**.**

6. Communication & Team Structure

A flatter structure seeks to encourage members to communicate more effectively also emphasizes members participation as equals.

TRANSFORMATIONAL LEARNING OF PHYSICAL SCIENCE THROUGH SERVICE LEARNING STRATEGY FOR SUSTAINABILITY **A response to the creation of sustainable Physical Science learning environments** --------------------------------- **TSLM Research Coordinating Team**

Research Team Convener	Education / School Coordinator s	Service Provision Partner	Technical / Academic Support	Sustainability through Community Service Learning Center
…….. *Physical Science Teacher: Researcher; team leader, research project manager & convener* 1. Convenes research team 2 Coordinate 2.1 Research Strategic Plan Session 2.2 Focus group sessions 2.3 FAI with team members and learners 3 Teach 4 Monitoring implementation of TSLIP 5 Implement model	…….. *Head of department mathematics & Physical Sciences & School Management Governance and Development* 1 Organize information and resources: 1.1 Physical Science Curriculum implementation monitoring 1.2 Management & Governance 2. Participant & Observation 3. Liaison	…… *Environmental Health Practitioner: environmental health management coordinator* 1. Organize information & resources 1.2 Water Treatment works 1.3 Waste Water Treatment 1.4 Service Opportunities for learning 2. Liaison with Plant operators and relevant water services staff 3. Participation & 4. Observation	…… *Sector Department AGR & UFS – SL* 1 Organize information & resources: 1.1 Service Learning 1.2 Water Care 2 Liaison 3 Provide guidance 4. Monitoring	…… *School Governing Body Chairperson & Community Development Worker: Coordination of community members / organizations / parents* 1. Organize People 1.1 CBDO's 1.2 CSO's 2. Participant observer 3 Liaison

7. Agreement

The research coordinating team members enter into this agreement being fully aware that their participation in the study is voluntary; that they may withdraw at any given moment if they feel that conditions for participation have changed; that the information obtained for this study through the participants will be treated confidentially and will be used for the purposes of the study only; that the study will comply with the rules and regulations of conducting a research, UFS ethics board provisions and those of the FS Education Department. The research team thus agrees to:

1. support each other and the team efforts in a caring, trusting and respectable manner
2. contribute their skills, knowledge and experiences freely to the study where such is needed;
3. communicate openly with each other to pursue the enhancement of team performance
4. execute their respective coordination responsibilities as agreed upon in the TSLIP;
5. participate actively, fully in the study programme / activities and give feedback on assignments allocated as well as those matters that may be found to be relevant to the study;
6. keep records of their observations and submit same to the study convener / coordinator for the purposes of record of the study;
7. hold monthly meetings during the weekdays at Kwetlisong Teachers center or Ahanang Secondary School or a similar convenient venue as shall be agreed upon by members from time to time;
8. hold structured meetings and keep to time for a period not exceeding two hours per meeting
9. Align their individual work schedules with the study programme from time to time to enhance performance of both the team and their respective work situations
10. remain in the team for the duration of the research project as far as it is practicable,

7. Schedule of events and meetings of Coordinating Team

This schedule addresses issues pertaining to the frequency and duration of meetings. Team members are afforded an opportunity to guide the team in at least one of the site visits and safety inspections in line with the research team coordinating structure. All meetings will be conducted in observance of the agreements made herein above.

Venue: Sekgalabateng Teachers' Center		Time: 13:00 – 15:00
Date	**Champion**	**Purpose**
07/08/11	Phehello	Strategic Planning Session
04/09/11	All	Site safety inspection 1 and organization of mitigation strategies Meeting of Team Members with Learner Participants
05/09/11		Site Visit 1: Water purification plant – transportation of water: mechanics
12/09/11		Feedback from the first site visit – Learner Participants
/09/11	Phehello & Bohlokwa	Site safety inspection 2 and organization of mitigation strategies
/09/11		Meeting of Team Members with Learner Participants in preparation for site visit: Water cycle
/09/11		Site Visit 2: Water Resources: mechanics – Weight / Gravity
/09/11		Feedback from the 2nd site visit – Learner Participants
/02/12	Ntsoteng & Tsotello	Site safety inspection 3 and organization of mitigation strategies
/02/12		Meeting of Team Members with Learner Participants in preparation for site visit: Matter and Material
/02/12		Site Visit 3: Water Resources: Chemistry – Separation of matter
/02/12		Feedback from the 3rd site visit – Learner Participants
/03/12/	Makgabane & Phehello	Site safety inspection 4 and organization of mitigation strategies
/03/12/		Meeting of Team Members with Learner Participants in preparation for site visit: Electricity & Electromagnetism
/03/12/		Site Visit 4: Water Resources: Electricity & Electromagnetism
/03/12/		Feedback from the 4th site visit – Learner Participants
/04/12/	Phehello & Ntsoteng	Site safety inspection 5th and organization of mitigation strategies
/04/12/		Meeting of Team Members with Learner Participants in preparation for site visit: Electricity & Electromagnetism
/04/12/		Site Visit 5: Water Resources: Electricity & Electromagnetism

/04/12/		Feedback from the 5^{th} site visit – Learner Participants

8.1 Responsibilities

8.1.1 The champion will facilitate meeting or ensure that the purpose of the **event** is achieved;

8.1.2 The champion and the captain will ensure that records of the event are available and kept according to the manner agreed upon;

8.1.3 Members will interact and engage with the feedback / information given critically;

8.1.4 The research study coordinator will be responsible for all logistical arrangements e.g. learners' transport to sites, invoking of mitigation strategies, keeping of records etc.

8.1.5 Members will keep record of their observation in respect of each of the five study objectives and will submit it to the research study coordinator when asked to do so;

8.1.6 Members will help with the supervision of learner participants during the site visits;

8.1.7 The study research coordinator will prepare worksheets and formal assessments for the learner participants;

8.1.8 The coordinating team will discuss assessments during the feedback sessions / meetings.

9. Conclusion

This charter has been designed in such a way that the members and learner participants are not disadvantaged in anyway. The spread and allocation of responsibility affords all to play active role and ensure full participation in this study.

Thus signed on this 07th day of August 2011 at Sekgalabateng Teachers' Center

Surname	First Name	Signature
Letolo	Phehello	
Thabeng	Makgabane	
Lekitla	Tsotello	
Dikomo	Ntsoteng	
Mphatsengi	Bohlokwa	

ANNEXURE CT 2: IMPLEMENTATION PLAN

Output 2.1: An implementation plan for the transformational learning of physical science through service learning model is developed, implemented and reviewed frequently to enhance achievement of the research study outcome/aim

Activity number	Activity description	Responsibility & Delivery Partners	Key tasks	Funds Required for	Funding source / Mechanisms	Time frame
2.1.1	Close communicative gap between team members	Phehello	Identify prospective research project coordinating team member participants. Engage and recruit them to participate in the project.	Communication Travelling	NRF	July 11
2.1.2	Establish/set up a research project coordinating team to execute the function		Formalize the involvement of team members – through written free consent	Written correspondence	NRF	Aug 11
			Together agree about roles, responsibilities through a performance charter / agreement			
2.1.3	To develop a plan for the implementation of the evolving TSL model	Phehello &Tsotello	Prepare and organize resources for the planning session	Venue Documents Computer & printer Voice recorder	CT / Sponsors	Aug 11
		TEAM & Phehello	Implement and monitor the plan			

2.1.3	To conceptualize, articulate and actualize the respective sustainability aspect of the transformational learning model	TEAM & Phehello	Clearly define the concept of community service learning center (CSLC) regarding what it is, its purpose, where to operate from, management, potential financiers / sponsors, its products and services, educational value, role players etc.	Meeting & appropriate resources *vs.* Venue Documents Computer & printer; Voice recorder)	Phehello / Sponsors	Sep 11
		CT & NT / CDW	Popularized and discuss CSLC with community leaders for purposes of mobilizing participation and buy-in of relevant sectors / sections for sustainability		Alignment of programmes / campagnes	Ongoing

Output 2.2: The need for a transformational learning of physical science through service learning model is fully demonstrated and justified

Activity number	Activity description	Responsible person & Delivery Partners	Key tasks	Funds Required for	Funding source / Mechanisms	Time frame
2.2.1	Conduct a situational analysis of the teaching and learning of physical science at school (locally), regionally, continentally and internationally	Phehello & Supervisors	Establish the extent of use of service learning in Physical Science at high school/s i.r.o. learner centeredness; extent of activity base; social context & cultural wealth and impact community		Study programme	Aug 11

			Establish the reasons for the extent of use of preferred teaching strategies at a high school			
			Establish the extent to which learners' real life science related services and projects are used for the enhancement of learning and teaching of physical science at school.			
			Establish the opportunities, strengths, weaknesses and threats for the use of projects and services in the teaching of Physical Science			

Output 2.3: The components and the structure of the *transformational learning of Physical Science through service learning for sustainability model* are clearly identified

Activity number	Activity description	Responsible person & Delivery Partners	Key tasks	Funds Required for	Funding source / Mechanisms	Time frame
2.3.1	Clearly identify the <u>components</u> of the transformational learning model	Phehello	Investigate the extent of integration of SL components in the teaching & learning of Physical Science for their possible integration in lesson planning / work programme i.t.o: *Organized Experience; Structured Time; Developing caring sense; Teacher's role; Integration; Community Cultural Wealth & Personal Insight*	To develop documents	Alignment of programmes Support from schools & UFS	
			Develop worksheets and work schedules / program in line with the		Support from schools & UFS	

			components for data collection			
		Phehello & Bohlokwa	Implement programmes / worksheets and monitor the implementation		Support from schools & UFS Alignment of programmes	
			Evaluate achievement of outcomes keep record for evidence for both the research project and learner study purposes.			
2.3.2	Identify appropriate services or projects for the transformational learning model	Phehello & Bohlokwa	Develop practical investigation programmes / activities based on learners' daily life situations (prior experiences and/or knowledge)	To develop documents	Support from schools & UFS	
		CT & Phehello	Identify themes to be learned and activities through which the learning of science can be realized from the respective services i.e. process and site	Transport of learners and team	Phehello Sponsors	
			To establish /identify the essential conditions under which the identified services are rendered			
			Link /relate the essential service rendering conditions with the ones that are essential for learning and teaching of physical science			
			Arrange structured site visits for learners' practical observation, and learning.			

Output 2.4: The conducive conditions for the implementation of the model are identified

Activity number	Activity description	Responsible person & Delivery Partners	Key tasks	Funds Required for	Funding source / Mechanisms	Time frame
2.4.1	Determination of the conditions under which the model can function optimally	TEAM & TMF	Establish conditions for the model to function optimally taking into account *High failure rate* *Pedagogical disparities and preferred rote learning promoting teaching strategies* *Poverty / unemployment rate / lack of resources* *Completion of syllabus*	Intervention strategies e.g. KJS' project Community service learning center	Sponsors Free Services in respect of awareness campaigns Support and alignment of programmes	Ongoing
2.4.2	Establish strategic partnerships and networks for the sustenance of the TSLM	TEAM	Develop interventions in corporation with other relevant partners	Negotiations	Sponsors Support Networks eg. UFS – Municipality-Education or school	Ongoing
			Service level agreements with Strategic Partners for enhancement of achievement of CSLC objectives			

Output 2.5: Threats for the implementation of the model are identified and risk assessment plan is developed and implemented with the plan

Activity number	Activity description	Responsible person & Delivery Partners	Key tasks	Funds Required for	Funding source / Mechanisms	Time frame
2.5.1	Develop a detailed risk assessment framework / plan	**TEAM & Phehello**	Conduct a specific service – and – learning gap analysis to determine the extent of impact of the identified threats in terms of :	Gap-analysis meetings / interactions / engagements	Alignment of programmes	Dec 11
			identification of partners; partners' contributions and roles; study purpose blurring; diversity; lack of buy-in and resources			
			Develop / identify respective strategies to combat the identified gaps			
2.5.2	Implementation of the risk plan	TEAM & Phehello	Identify, prioritize and allocate resource and timeframes to address risks and threats	Implementation activities	Alignment of programmes	Ongoing
			Implement and monitor progress together with the TSLIP			

Output 2.6: The transformational service learning model of physical science is put into practice and its functionality is Monitored

Activity number	Activity description	Responsible person & Delivery Partners	Key tasks	Funds Required for	Funding source / Mechanisms	Time frame
2.6.1	Consolidate the transformational service learning model of physical science	Phehello & TEAM	Compile all records for consolidation into TSLM for evaluation in respect of meeting the study aim in terms of addressing needs; components; threats and conditions, i.e. records such as:	Compilation of TSLM schedule / programme	Alignment of programmes	May 2012
			Learners assessments and evidence (ROA & E)			
			Learner centered projects and activity based work schedules, worksheets for daily assessments and practical investigations			
			Submit all records for evaluation and control purposes			
2.6.2	Consolidate the transformational service learning model of physical science's sustainability	TEAM & Strategic Partners	Goods and services of the CSLC are well documented	Establishment of the CSLC management structure	Sponsors	June 2012
			Structure to manage the center is established and is active			
			Space for operations has been acquired			

ANNEXURE CT 3: PROGRESS REPORT:

TRANSFORMATIONAL LEARNING OF PHYSICAL SCIENCE THROUGH SERVICE LEARNING IMPLEMENTATION PLAN (AUGUST 2011 – JUNE 2012)

Output 2.1: An implementation plan for the transformational learning of physical science through service learning model is developed, implemented and periodically reviewed for achieving outcome/aim

Activity number	Activity description	Champion & Delivery Partners	Key tasks	Time frame	Progress Report
2.1.1	Establish/set up a research project coordinating team to execute/champion the function	**Phehello**	Negotiate timely but informally with persons in strategic positions (of influence) in relation to the study on a one-to-one basis for their possible involvement	**July 11**	Completed. TSLMCC is in place. CDW yet to be visible. **Agreed to participate.** Messrs. Makalo & Moeletsi are on board.
			Formalize the involvement of those influenced positively – through written free consent		Consent forms / letters for Mesdames Ntsotiseng & Makgabane & Bohlokwa Messrs. Tsotello, Moeletsi; Makalo;
			Together agree with roles, responsibilities through a performance charter / agreement		Performance charter is in place and it is signed

2.1.2	To develop a plan for the implementation of the evolving TL model	**Phehello**	Prepare and organize resources for the planning session	**August 11**	Completed. Session was held on 7 August 2011 at Kwetlisong
			Implement and monitor the plan	**Ongoing**	**Ongoing**
2.1.3	To conceptualize, articulate and actualize the respective sustainability aspect of the transformational learning model	**CT**	Clearly define the concept of community service learning center (CSLC) regarding what it is, its purpose, where to operate from, management, potential financiers / sponsors, its products and services, educational value, role players etc.	**August 11**	**Work in progress**. Refer to presentation of the 02 September 2011 made to UFS. Inputs from the session: • Consider involving SACE • Motivation for teachers – e.g. accreditation **Activity plan for 2012 as at 23/11/11** • **Programmes 1-5** • **Alignments with School and Service Sponsor plans for possible resourcing** **Model for Strategic management framework for resources sharing opportunity**
			Popularized and discuss CSLC with community leaders for purposes of mobilizing participation and buy-in of relevant sectors / sections for sustainability	**Ongoing**	Work in progress. See presentations made to • Ahanang Staff on • Parents of grade 10 learners on Phehello addressed AFM on the

					04/09/11 **Grade 11's (parents & learners) involvement and participation** Constant update of the school through - last on 22/11/11 **Active participation of other educators during the visit to wwtw and during the study teams establishment workshop / meeting** **Colloguium on 26/11/11: TSLM & The Strategic Management Framework for resources sharing for sustainability**

Output 2.2: **The need for a transformational learning of physical science through service learning model is fully demonstrated and justified**

Activity number	Activity description	Champion & Delivery Partners	Key tasks	Time frame	Progress Report
2.2.1	Conduct a situational analysis of the teaching and learning of physical science at school	**Pheello & Supervisors**	Establish the extend of use of service learning in Physical Science at different educational levels (viz. Basic	**Sept 11**	See **situational analysis of strategic session:** • Rams transcribed from strategic session

	(locally), regionally, continentally and internationally		FET and Higher Education) and the reasons thereof		• Moeletsi
			Establish the reasons for the extend of use of preferred teaching strategies at different educational levels		***SWOT strategic session: lack of commitment no extra mile*** ***Teacher convenience*** **(informal discussion with educators by Curriculum Coordinator)** **Time (more work less time) – Political: mandates & imposed targets Curriculum Coordinator**
			Establish the extent to which learners' real life science related services and projects are used for the enhancement of learning and teaching of physical science at school.		**Visit to wwtw** **Presentations by municipal workers** **Discussions of worksheets in multi-grade teams** **Multi-grade study teams supervision by parents**
			Establish the opportunities, strengths, weaknesses and threats for the use of projects and services in the teaching of Physical Science		**Feedback from learner participants – 23/11/11** **Learners non participation from Lesotho** **Positive for study teams and multigrade group** **Attracted learners from Ikaheng – contest for attention by own teacher**

Output 2.3: The components and the structure of the *transformational learning of Physical Science through service learning for Sustainability model* are clearly identified

Activity number	Activity description	Champion & Delivery Partners	Key tasks	Time frame	Progress Report
2.3.1	Clearly identify and / or categorize the implementable components of the transformational learning model	**Phehello Bohlokwa (SMG)**	Identify the constructs for each component	**July 11**	See presentation on constructs
			Determine methods for collection of data for each construct and component	**July 11**	See presentation on constructs
			Develop worksheets and work schedules / program in line with the constructs / components	**Ongoing**	See presentation on constructs & and site visits and practical investigation folder
			Implement programmes / worksheets and monitor the implementation	**Ongoing**	Being done.
			Evaluate achievement of outcomes keep record for evidence for both the research project and learner study purposes.	**Ongoing**	
2.3.2	Identify appropriate services or projects for the transformational learning model		Develop practical investigation programmes / exercises based on learners' daily life situations (prior experiences and/or knowledge)	**Ongoing**	See presentation on constructs & and site visits and practical investigation folder

			Arrange structured site visits for learners' practical observation, learning.		

Output 2.4: The conducive conditions for the implementation of the model are identified

Activity number	Activity description	Champion & Delivery Partners	Key tasks	Time frame	Progress Report
2.4.1	Determination of the conditions under which the model can function optimally		Identify themes to be learned and activities through which the learning of science can be realized from the respective service i.e. process and site	**July 11**	See presentation on constructs & and site visits and practical investigation folder
			To establish /identify the essential conditions under which the identified services are rendered	**Ongoing**	**Parents meeting**
			Compare / relate the essential service rendering conditions with the ones that are essential for learning and teaching of physical science		

Output 2.5: Threats for the implementation of the model are identified and risk assessment plan is developed and implemented with the plan

Activity number	Activity description	Champion & Delivery Partners	Key tasks	Time frame	Progress Report

2.5.1	Develop a detailed risk assessment framework / plan	**CT**	Conduct a specific service – and – learning gap analysis	**October 11**	See presentation on constructs & and site visits and practical investigation folder
			Develop / identify respective strategies to combat the identified gaps		Parents meeting • Dangerous chemicals • Ill discipline - Fighting • Delinquencies Situational analysis – f/up interviews: • Enthusiasm • Teachers' role •
2.5.2	Implementation of the risk plan		Identify, prioritize and allocate resource and timeframes for the possible address of risks and threats	**Ongoing**	**Template for risk plan – see planning guidelines folder** **Training needs addressed: CT on FAI, CER , CDA**
			Implement and monitor progress together with the TLIP		

Output 2.6: The transformational service learning model of physical science is put into practice and its functionality is Monitored

Activity number	Activity description	Champion & Delivery Partners	Key tasks	Time frame	Progress Report
2.6.1	Consolidate the transformational service learning model of physical science		Bring together record of assessment and evidence (ROA & E)of learners for evaluation purposes	**June 11**	Worksheets developed, inputs sought from other teachers,
			Bring together programmes, assessment and worksheets developed and implemented during the study period		and used on 4/10/11 during site visit wwtw
			Submit all records for evaluation and control purposes		
2.6.2	Consolidate the transformational service learning model of physical science's sustainability		Goods and services of the CSLC are well documented		See presentation of the 2/9/11 at UFS
			Structure to manage the center is established and is active		
			Space for operations has been acquired		

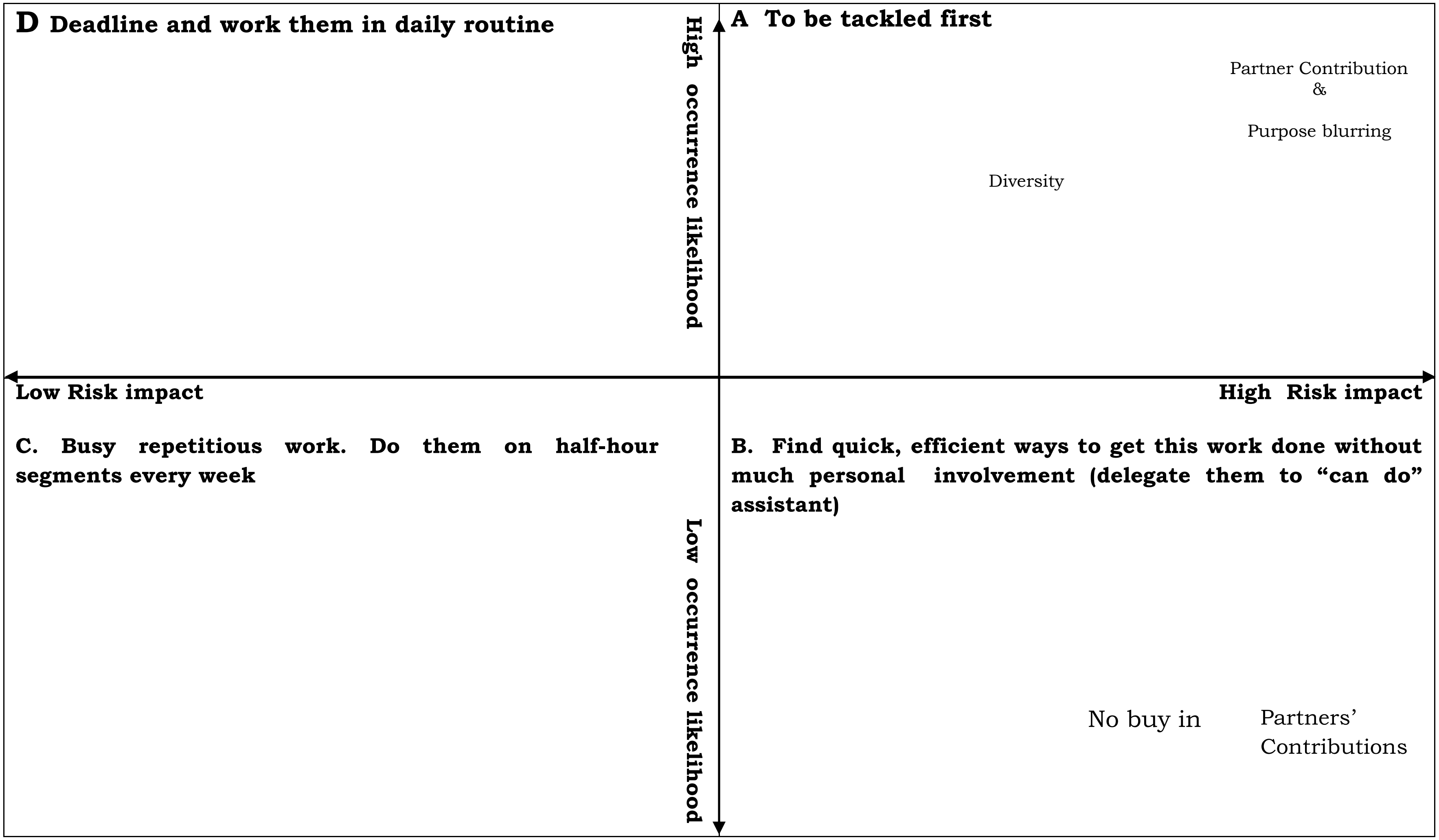
RISK PLAN

TRANSFORMATIONAL LEARNING OF PHYSICAL SCIENCE THROUGH SERVICE LEARNING FOR SUSTAINABILITY (AUGUST 2011 – JUNE 2012)

Risk No	Risk description	Responsibility	Risk impact			Risk occurrence Likelihood			Mitigation	Risk Priority
			High	Medium	Low	Low	Medium	High		
1.3.1	**Identification of partners and stakeholders:** 1.3.1.1 Sponsors 1.3.1.2 Teachers 1.3.1.3 Professionals 1.3.1.4…….	**Phehello**	*			*			Own-plan	**A_1**
1.3.2	**Participants' Contributions and Roles** 1.3.2.1 Learners 1.3.2.2 Teachers & Parents		*				*		Own-plan	**A_3**
1.3.3	**Purpose blurring** 1.3.3.1 SL 1.3.3.2 CBCLC		*					*	Own-plan	**A_5**

1.3.4	**Diversity** 1.3.4.1 Race 1.3.4.2 Other schools 1.3.4.3 Age groups 1.3.4.4 Gender				*	*			Own-plan	**C**$_{-5}$
1.3.5	**No buy-in** 1.3.5.1 Local community 1.3.5.2 School 1.3.5.3 Business 1.3.5.4 Professional bodies (SACE)				*	*			Own-plan	**C**$_{-5}$
1.3.6	**Resources** 1.3.6.1 Teachers 1.3.6.2 Security sensitive equipment 1.3.6.3 Thought provoking introductory experiments								Own-plan Transfer	

PRIORITIZATION CRITERIA (Maxwell J and Covey R)



PARTICIPANT'S PLEDGE

To be completed prior to site visit at a meeting that should discuss site safety related issues

I, ……………………………………………………………………………………………………… do hereby confirm that I am a grade ………….. learner at ……………………………………….. secondary school. I further confirm that: I was not forced to undertake the site visit trips to this research project; I gave my consent to participate freely and voluntarily and I was advised about the *do's and don'ts* of the visit before the trip. I therefore pledge to be disciplined, to abide by the instructions and directives given to me by my supervisors and teachers, to observe all site rules and precautionary measures that are put in place, to cooperate and work with other learners in team(s) and to complete worksheets and give my responses as may be required from time to time

.

Signed at ………………………………………… on this ……… day of ……………………… 2011

____

Signature of Learner Participant

____

Signature of Parent / Guardian

WORKSHEET: INFORMATION

Surname & Initials: …………………………………………………………… **Grade: ………**

This section requires that the learner participants should give information about their knowledge and awareness of the socio economic and scientific implications of water treatment processes.

1 Study the direction of rain water flow in Manyatseng give a scientific explanation why the rain water flows in this direction?

………

2 When last did you visit the waste water treatment plant in your area?

…………………………………………

3. Suggest/give a reason why the waste water treatment plant is situated where it is now.

……

4. If its location was to be changed where do you think it could be moved to? Motivate your answer

………

5 What would be the single most critical problem with moving the waste water treatment plant further away from its current location? ……………………………………

5.1 What could be the reason for its relocation?

……

5.2 How can the possible relocation be delayed and ultimately avoided?

……

5.3 What contribution would you be making towards achieving the activities you mentioned in 5.2 above.

……

6 What are the major causes of sewerage pipe blockages in your area of residence according to the respective municipal workers?

……

WORKSHEET: MECHANICS

Surname & Initials: …………………………………………………………… **Grade: ………**

1.	Explain, using the below given concepts, how used water (e.g. in toilet) gets transported to the waste water treatment plant?	
	1.1 Weight of water: …………………………………………………………………………………………………	
	1.2 Pressure: ………………………………………………………………………………………………	
	1.3 Energy: ………………………………………………………………………………………………	
	1.4 Physical and chemical properties of water …………………………………………………………………………………………………	
5.	How do people (i.e. residents) in your area pollute/contaminate the environment and water? …………………………………………………………………………………………………	
6.	Illustrate these pollution activities mentioned in 5. above with the aid of chemical equations:	
	6.1	6.1.1 Environment (air pollution): ………………………………………………………………………………………
		6.1.2 Environment (Water pollution): ……………………………………………………………………………………
		6.1.3 Environment (surroundings/vegetation): …………………………………………………………………………
	6.2	Which substances in 6.1.1; 6.1.2 and 6.1.3 are pollutants or contaminants? ……………………………………………………………………………………
7	Indicate how you can help address the problem of contamination in your area: …………………………………………………………………………………………………	

WORKSHEET: MATTER & MATERIAL

Surname & Initials: ……………………………………………………………… **Grade: ………**

Content/Concept	Pre Screen	Screens	Anaerobic ponds	Aeration	Tertiary
Give a brief description of items/things you identified/observed and/or chemical formulae describing what happens at each of the above waste water treatment stages in line with the below given concepts and content. Also indicate both their respective macroscopic and microscopic properties where possible.					
1.1 Heterogeneous mixtures					
1.2 Coagulants /Colloids					
1.3 Homogeneous mixture / Solution					

1.4. The most likely challenge(s) experienced in the waste water treatment process based on my observations of the above are

1.4.1 ………

1.5 How can you help address the challenge(s) you identified in 1.4.1 above?

1.5.1 ………

1.6. List the elements and compounds that you think are found in treated sewerage ………………………………………………………

1.7. Write down a chemical reaction for aerobic respiration: ………………………………………………………………………………

1.8. Suggest a reason for the choice and use of different materials used in the construction of the different parts/components of the treatment plant: ……………………………………………………………………………………………………

ANNEXURE CT 5

WORKSHEET: MECHANICS

Surname & Initials: ....   Grade: ....

Take readings from the different flow rate meters and determine the velocity of sewerage/water using the readings you obtained from flow rate meters at different points in the treatment plant.

Content/Concept	Pre Screen	Secondary	Tertiary
1.1 Flow Rate meter reading			
1.2 Explain or interpret each reading			
1.3 Determine the velocity of water from the flow rates			
1.4 What is the average change in velocity or flow rates			
1.5 The capacity (volume) of the reservoirs /ponds is			
1.6 The surface area of the reservoirs / ponds is			
1.7 The Potential energy at the bottom of the pond is			
1.8 The pressure at the bottom of the pond is			
1.8 A worker of mass 79 kg accidentally falls from the top of the pond that is 5m high.			
1.8.1 What was the worker's mechanical energy before Falling			
1.8.2 What is the worker's velocity at the time he hit the Ground			
1.8.3 The speed of sewerage water of the same mass as the worker does not leave at the same speed as the worker. Explain why?			

WORKSHEET: ELECTRICITY

Surname & Initials: ....   Grade: ....

Take readings from the different flow rate meters and determine the velocity of sewerage/water using the readings you obtained from flow rate meters at different points in the treatment plant.

1.1 Identify electrical appliances and components used in the sewerage treatment process

....

1.2 Draw circuit diagrams to illustrate how the above identified components are connected

1.3 Take readings from the electrical meters available on site to determine the extent of use of :

1.3.1 Potential Difference:..

1.3.2 Current:...

1.3.3 Electric power:...

2 The unit cost for electricity consumption is ....

3 The total cost of electricity for the waste water treatment based on the reading obtained in 1.3. above is

....

4 Other than electricity, the following are the cost drivers of the waste water treatment plant

....

5 Identify possible financiers for the running costs of the waste water treatment plant

....

6 Suggest strategies that can be followed to help reduce the above stated costs

....

7. What can be your contribution towards the cost reduction strategies suggested in 6

Above

....

GUIDELINES FOR LEARNERS' STUDY TEAMS FOR 2012

Introduction

Learners are divided into teams of 4 to 5 members. Each team has a coordinator elected from amongst the team members by the team itself. The main responsibility is to coordinate the activities of the team and liaises with the educators and/or parents for support, intervention and feedback.

Each team is allocated a parent supervisor as far as would be practical for purposes of monitoring and maintenance of discipline and ensuring that teams do not waste time unnecessarily.

Each team is directed and obliged to observe the principles and values of **respect, humility, care, timeliness and responsiveness**. These were discussed and agreed upon with learners during the establishment of teams processes. It is therefore imperative that the team coordinators and parents supervisors should also ensure their observance, as they execute their responsibilities in this respect.

Ensuring effective team work

The following are envisaged:

<u>Individual learner's attempt</u>

Each learner should come to a team session thoroughly prepared. He/she should endeavor to answer the questions they agreed to treat during the following / next session the topic (questions per theme) individually and where necessary research/read or ask for support. NB the learner must do the work himself or herself. S/he must write down the answer; check the answer against model / memorandum where same is available/ refer to textbooks/ask for explanations from someone else and attend team sessions

Team sessions

All members should contribute meaningfully. All should share their responses to the questions with fellow team members; compare responses and identify gaps between the responses (team coordinator); discuss towards finding the team's correct response to the question and confirm and verify the correctness of the response with the teacher

Educators & Parents (Supervisors)

Supervise the teams during team sessions (for orderliness / discipline and professional support) and complete the monitoring tool during each of the sessions supervised. Avail his / her services within the agreed upon time frames: e.g. **Monday to Friday: 07:30 – 14:00 & 16:00 – 18:00; Saturdays and Sundays 14:00 – 16:00** and give general remarks on his / her observations about the team performance as well as his/her feedback about the whole exercise for future enhancements.

Teams Files

Each team has a team file in order to help organize its work and ensure effective engagements between the team and the respective parent, teacher as well as among its members. The below given table gives information on the number of teams we have in 2012 per subject per grade. It also indicates the documents records that are provided for the upkeep of the team.

Grade	Subject	Number of teams	Number of learners per		Records / Information distributed
			Team	Grade	
12 C	Mathematics	4	4	16	Scope of work for 2012;
11 D	&	5	5	20	Personal file index page;
11 E	Physical Science	6	5	29	this guideline;
10 D		7	5	33	team work control form;
10 E		7	5	37	information sheet
Totals		**29**		**135**	

Allocation of parent team supervisors

Team of parents team supervisors from the meeting of the 02nd February 2012

Name of parent		Address	Contact number	Teams allocated to		
				1	2	Educator
1	Makgabane		083 738 8431	1 * Grade 12 Team 1	1 * Grade 11D Team 1	Phehello
2	Manthabiseng	C 298 Mohokare	078 1554 583	1* Grade 12 Team 2	1* Grade 11D Team 2	Bokang
3	Mathabang	T 4186 Mohokare	071 979 1853	1* Grade 12 Team 3	1.* Grade 11D Team 3	Bohlokwa
4						
5						
6						
7						
8						
9						

2012 LRARNERS' TEAM WORK MONITORING & CONTROL

TEAM MEMBERS (A team of learner participants elect from among themselves a team coordinator)			DATE (on which the team will meet)	TIME (For the meeting of the team)	TOPIC (Theme: Questions for revision from previous examination papers)	T-T ENGAGEMENT SESSIONS	MONITORING INDICATORS				
							No. ATT	N IWD	N TC	N TES	N TF
	SURNAME	INITIALS	07/11	14:00-15:00	Electricity: Q5 2010 June; Q 7 2011 Sept	07 at 15:30					
1											
2											
3											
4											
5											

General Remarks / Comments

________________________________ --

TEAM COORDINATOR (LEARNER) **STUDY TEAM SUPERVISOR (PARENT)**

ATT: number of team members in attendance; IWD N: No Individual Work Done; N TC: Team Cooperation; N TES: No team effort submitted; N TF: No Teacher Feedback