A PARTICIPATORY STUDY OF PROJECT BASED LEARNING AS MEDIATED IN A TEACHING UNIT OF ELECTRICITY FOR GRADE 8 LEARNERS

BY

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DEDICATION

This study is dedicated to my loving and supportive wife, Leone, and dearest children for their patience and understanding, and my caring parents Johannes and Sophia Jafta, and doting uncle Peter Marais.

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ABSTRACT

This study, which adopts a participatory research methodology, is about creating opportunities for learners to negotiate their own meaningful learning that is linked to action. In keeping with the new vision for education in South Africa, I explore the need for creating space for learners to participate actively in learning that is meaningful to them. In this study I set out to engage the learners in sustained learning that is connected to real-life situations through 'project based learning'. This type of learning, including the desired space for such learning, is nurtured by the use of 'mediated learning experience' that provides the appropriate human management system for two-way rich communication between the learner(s) and the educator.

Participation in this study is an the level of the participant, and at the level of the multiple research instruments used. Fourteen learners participated, however, the data analysis is based on the responses of five learners who participated in all phases of the study. Learning linked to action in democratic learning spaces provide learners with the opportunity to express their own voice, and, to negotiate an identity of themselves. The findings show that learners negotiate own meaning in idiosyncratic ways. This is done by making use of own experiences, available resources (both physical and human), peer group sharing and dialogue, and, by expressing the nature of that which stands in the way of learning. The implications of allowing learners to negotiate own meaning requires extending democratic values in classrooms, and giving them opportunities to learn how knowledge and power are negotiated in learning interactions.

DECLARATION

I hereby declare that the research involved in my thesis entitled, A participatory research study of Project based Learning as mediated in a teaching unit of electricity for Grade 8 learners, is entirely my own work, that it has not been submitted for any degree or examination in any other university, and that the sources I have used or quoted have been indicated and acknowledged by complete references.

Thomas Daniel Jafta April 2006

Signed:

26/04/2006

Date:

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Chapter One

1. Introduction and Contextual framework

1.1 Introduction

This chapter presents the context of education in South Africa, and then elaborates on the changes in the education system. Furthermore, the chapter aims to state the purpose of the study, its critical questions, researcher's background, significance, clarify the terms used and then, present an outline of the study.

1.2 The context of education in South Africa

South Africa has seen a lot of changes in the last ten years. In education these changes range from national to school level. At national level, South Africa has adopted Outcomes Based Education (OBE) which was first introduced by countries such as England, Scotland and Canada (Department of Education, 1997). Educational change was eminent and was introduced to overcome the legacy of apartheid in education and other spheres of life. The previous system of education for the majority of South Africans under the previous dispensation is perceived to be of low quality (Lawton, 1992). Outcomes-based education (OBE) principles and practice are the underlying educational approaches adopted by the education department in South Africa.

The OBE approach espouses learner centeredness and activity-based approaches to teaching and learning, and promotes life-long learning (Department of Education, 1997). In OBE clear statements are made about what knowledge, skills, values and attitudes learners should acquire as a result of their learning. These statements are called outcomes because they tell us what the result or outcome of learning should be. South Africa has adopted transformational OBE as the preferred approach as it involves the integration of concepts in a cross-curricular approach which embraces the structure of the curriculum, and the methods by which instruction is delivered and meaningful assessments are made.

Closely linked to OBE is Curriculum 2005 (C2005) which is the uniting vision for transforming apartheid education in South Africa. The vehicle by which this vision will be attained is through an outcomes-based approach to education. The Department of Education has set policy that specifies the main aspects of C2005 that must be adhered to.

C2005 with eight design features and 'complicated language' (according to the Ministerial Review Committee, 2000) was first introduced in 1997, and it was soon replaced with a more streamlined Revised National Curriculum Statement (RNCS) in 2002, for Grades R-9 (Schools). The Revised National Curriculum Statement has just three design features, namely, critical and developmental outcomes, learning outcomes and assessment standards. The RNCS adopts an inclusive approach by specifying minimum requirements for all learners. The educational, social, emotional and physical needs of learners are addressed in the design and development of appropriate learning programmes (RNCS, Overview, 2002, p.10).

The RNCS is an embodiment of the nation's social values, and, its expectations of the roles, rights and responsibilities of the democratic South African citizen as expressed in the Constitution. The underpinning principles of the RNCS are social justice, a healthy environment, human rights, and inclusivity (RNCS, Grades R-9 Schools, 2003).

Noticeable change to the apartheid education system is the inclusivity principle, which is seen by the Department of Education to be dealing with:

> ... a number of social justice and human rights issues, and at the same time taps into the rich diversity of our learners and communities for effective and meaningful decision-making and functioning for a healthy environment. Schools are encouraged to create cultures and practices that ensure the full participation of all learners irrespective of their cultures, race, language, economic background and ability. All learners come with their own experiences, interests, strengths and barriers to learning which need to be accommodated.
>
> RNCS, Grades R-9 Schools, 2003, p.6

The new curriculum envisages a new kind of learner who will be "...imbued with the values, and act in the interests of a society based on respect for democracy, equality, human dignity, life and social justice" (RNCS, Overview, 2002, p.8). Furthermore, the NCS promotes life long learning, and seeks to create learners who are confident, literate, numerate and multi-skilled, compassionate, with a respect for the environment and the ability to participate in society as a critical and active citizen (RNCS, Overview, 2002, p.8). These ideals are supported by a curriculum which claims to be learner centered, as stipulated in the White paper (1995).

The kind of teacher that is envisioned is one who is qualified, competent, dedicated and caring. Of particular importance is a teacher who is able to fulfil the various roles outlined in the Norms and Standards for Educators of 2000 (RNCS, Overview, 2002, p.9). The following seven roles are described in a manner appropriate for initial teacher qualification, namely:

- learning mediator;
- interpreter and designer of learning programmes and materials;
- leader, administrator and manager;
- scholar, researcher and lifelong learner;
- community, citizenship and pastoral care;
- assessor; and
- learning area/subject/discipline/phase specialist.

The educator roles pertinent to this study, and consistent with those contained in the Norms and Standards for Educators (2000), include that of mediator of learning, interpreter and designer of learning programmes and materials, researcher and lifelong learner, assessor and community member.

Changes introduced at school level impact directly on the role played by the School Management, School Governance, Educators, learners, parents and non-Educators. The various education stakeholders have been brought together, at school level, to work together for the benefit of the learners.

Any interaction or co-operation amongst the various role-players at school level is intended to enhance learning, or should lead to improved achievement by the learners at the school. All "...education and management processes must therefore put the learners first" (DOE White Paper in Education and Training, 1995:21).

We can see from this vision of the new curriculum in South Africa that the role of the learner has shifted from passive to active involvement, and a shift from dependence to interdependence in social and collaborative settings. In this regard learners are seen as being responsible for their own, and their peers', learning. Greenburg (2000) argues that as learners progress from dependent to independent learners, they begin to see themselves as generators of their own knowledge, and facilitators of their peers' learning. A culture in which learners take responsibility both for their own and each other's learning is not a given as argued by Greenberg (2000) and Johnson & Johnson (1994). The teacher plays a key role in introducing, creating and facilitating this kind of learning. The teacher and learners work collaboratively in identifying learner's needs, and then jointly manage the teaching and learning situation (Malcolm, 2002; Harlem & Holroyd, 1997; Bodner, 1998).

Recognizing the importance of collaborative work in education, the education ministry, through the Call to Action campaign, called all role players in education, including parents and other social partners, to work together. A plan known as Tirisano, a Sotho word meaning 'working together', was launched in 2000. The introduction of OBE opened up public debate and collaboration in curriculum issues.

This is encouraging when viewed against the background of the history of curriculum in South Africa, where official knowledge was handed down to be 'implemented' rather than set in dialogue and discussion (Jansen & Christie, 1999). One such call in support for collaboration in learning is the national project for education transformation, which embraces President Mbeki's "Unity in Action for Change" call, seeks to mobilize educators, young people and communities to celebrate learning. In this regard, learning is seen "as a celebration of human nature and as a means of personal and social development, employment, and opportunities for a better quality life" (Department of Education, 2001: 8).

Arising out of the Department of Education's vision for education, and the need for collaborative working relationships, is the need for clearly defined roles for Educators. The Department of Education, in the Norms and Standards Document for Educators (1998), has defined seven roles for educators. One of these roles is pertinent to this study, namely, the educator as mediator of learning. This role, namely, learning mediator appears first on the list, and if this is intentional, one can assume that it plays a significant role in an educator's core duties, and, that the other roles flow from this one:

> The educator will mediate learning in a manner which is sensitive to the diverse needs of learners, including those with barriers to learning; construct learning environments that are appropriately contextualised and inspirational; communicate effectively showing recognition of and respect for the differences of others. In addition an educator will demonstrate sound knowledge of subject content and various principles, strategies and resources appropriate to teaching in a South African context (Norms and Standard for Educators, 1998).

The above role of an educator as mediator of learning is further described by the Department of Education in the Norms and Standard for Educators (1998) as follows:

- practical competence - the ability to make decisions, knowing how and being able to perform;
- foundational competence - knowing and understanding what and why one decides and does; and
- reflexive competence - the ability to learn and adapt through self-reflection and to apply knowledge appropriately and responsibly.

The role of an educator as interpreter and designer of learning programmes and materials is further described by the Department of Education below:

> The teacher will understand and interpret provided learning programmes, design original learning programmes, identify the requirements for a specific context of learning and select and prepare suitable textual and visual resources for learning. The teacher will also select, sequence and pace the learning in a manner suitable to the different needs of learners" (DOE, 1999: 69)

The new vision for education calls upon educators to take on new roles and ensure that there is effective learning (Department of Education 2001). However, the critics of outcomes-based education (OBE) in South Africa maintain that its language is too complicated for the majority of teachers who cannot speak, read and write English well enough to put OBE into practice (Vinjevolt, 1999). Some observers claim that the majority of schools are not ready for OBE due to backlogs in infrastructure and facilities, a lack of the culture of teaching and learning, and that these factors will cause learner achievement to drop even more (Taylor, 1999). The long term resolution of the problem of effective support lies in the scope and quality of pre-service training (Jansen, 1999).

Based against this backdrop, it is clear that learning-friendly roles such as facilitator, mediator, guide and/or coach are envisioned for educators. Such a role(s), if employed appropriately, will support active approaches to learning.

1.3 Researcher's background

My interest in teaching was nurtured at a very early age when I was taught how to plant trees and vegetables in a garden by my parents. The teaching and learning that took place there was incidental and fun. Shor (1992:17) asserts that "people begin life as motivated learners, not as passive beings ... they busy the older people in their lives with questions and (demands) for show me, tell me".

My teaching career began in the 1981, teaching Science and Mathematics to high school learners. I am currently teaching Science (namely Natural and Life Sciences) at school, and facilitate continuous professional development and support (CPDS) courses for educators on behalf of the Department of Education and other Higher Education Institutions, as an OBE facilitator. My travels abroad and visits to schools and other education institutions in Denmark and United States of America, have provided me with insights and a new perspective to teaching and learning.

It is evident from the above that I have chartered a course to teach other people, and, that only recently (that is, the past five years) have I chartered a new course, one that is informed by the recent changes introduced in education internationally, and in our country (South Africa).

Of interest to me, and central to this study, is learner centeredness which advocates active involvement of the learner in collaborative learning situations (Meyers & Jones, 1993). Learner centeredness links directly with project work which is the focus of this study. The critical outcomes of outcomes based education requires learners to be actively engaged with their learning. Furthermore, learners need opportunities to try things out, test ideas, and to reflect on their processes of learning.

They need an environment in which they are valued, can take risks, where they can value and respect others' points of view, engage in constructive debate, and develop communication skills. It is against this background that I contend that project work is the most appropriate method that enables the achievement of the new vision for education as espoused in the RNCS. Project work links the student's learning to his/her real world experiences, and helps them access those aspects of the real world that they have not yet encountered for themselves.

Classroom practitioners should promote social justice (Department of Education, 2003), and collaborative learning and working relations where learners are able to express ideas and opinions freely with others.

Over the years, and through my participant observation of schools in South Africa, I have noticed the decline of learner inquisitiveness as highlighted by Shor (1992) above. He further asserts that " year by year (the learner's) dynamic learning erodes in passive (school learning contexts) not organized around their cultural backgrounds, conditions and interests. Their cultural and social instincts decline, until many become non-participants. It is not the fault of the (learners) that their learning habits wither inside the passive syllabus" (p17). How can teachers rekindle inquisitiveness and the quest to gather knowledge in learners?

Against the above backdrop, I explore the creation of learning opportunities that will enable learners to engage actively in their own learning, and how such opportunities can maximized when examining the ways in which they mediate their learning. I have an interest in the creation of learning communities which would enhance mediated learning experiences (Feuerstein 2001) for learners who engage in life-long learning.

Educators need to see education as a process in which learners co-exist in a democratic fashion (Dewey, 1943), and, where they foster a collaborative learning environment in order to discourage teacher-dependent attitudes by learners (Spector, 1993).

1.4 Research purpose

The purpose of the study is to explore how a group of Grade 8 learners at a specific school negotiate their identity in a science classroom in order to gain access to meaningful learning in science through project work. The unitThe study moves from the premise that learning is meaningful if learners can negotiate an identity of themselves within the learning context. It is argued that the meaningfulness of the context of learning strongly depends on this negotiation. The argument advanced is based on the view that the learning context is failing the learners; that there is little space or opportunity for the learners to negotiate their identities within the context of science learning. In this regard, the study sets out to explore how Grade 8 learners create the space for their meaningful learning.

It is believed that learners can shape their own identities when given an opportunity to participate in a social learning situation centered around a communication rich framework.

The purpose of the study is twofold:

Firstly, to explore the ways in which learners negotiate own identity through project based learning.

Secondly, to explore project based learning, in conjunction with mediated learning experience, as a means to foster learning in a collaborative and social learning environment. In this regard, we explore the relation between mediation and identity as highlighted in the three research questions.

The above two foci will be answered through the following research questions.

1.5. Research questions

This study intends to seek answers to the following research question(s):

RQ: How do Grade 8 learners use a unit on electricity to negotiate their identities within a learning context?

CQ 1. How do they mediate their own learning of a science unit on electricity?

CQ 2. How do they approach their learning of electricity (if at all) as drawn from their own lived experience in the home, school and community?

CQ 3. What are Grade 8 learner's understanding of meaningful learning as derived from a unit on electricity?

The topic on electricity is chosen in response to a call by the local community Ward Councillor, namely, problems with electricity consumption and supply (see Chapter 3, number 3.3, and Figure 2). In essence, the problems and concerns that community members might have are centered around issues of electrification of their new Reconstruction and Development Programme (RDP) houses.

1.6 Context of the study

1.6.1. The school

The school is an ex-House of Representatives school (a legacy of the old racially segregated education system) which is centrally situated between the three previous racial residential areas of Newlands West (a former Indian area), Newlands East (a former Coloured area), and Kwa-Mashu (a former African township). The staff at the school is also representative of the three former racial groupings, and the learner population is mixed as well, that is 'Coloured' and 'African' learners. English has been the medium of instruction all along and still is. IsiZulu as a subject offering has been introduced for the first time as a second language at Grade 8 level this year (2004).

Of the five Grade 8 class groups, four have chosen to study isiZulu as an additional language, and only one class has opted to do Afrikaans as an additional language. The school's language policy has been amended this year (2004) to include isiZulu as a second additional language. English is the language of instruction for all Grades, and learners are free to choose between isiZulu and Afrikaans as an additional language. Just a few years ago the learners were prevented form speaking isiZulu in class or during intervals. This served as a control measure to exclude other race groups, and due to lack of understanding of the learner's home language by the teachers at the school.

The above information and background on the school highlights, firstly, the plight of the learners in previously segregated schools, secondly, the question of access to learning, and thirdly, the RNCS principle of inclusivity which is discussed earlier in this chapter. This study recognizes that learners come from diverse backgrounds and the school therefore has to cater for their different needs. Through this study, I aim to make links between the learners' school life experiences and his/her home life experiences through the use of project work.

1.6.2. The teacher

The teacher as researcher, has been teaching at the school, where the study is conducted, for the past twenty one years. As a product of the outdated apartheid education policies, I have chartered a course in continuous professional development in order to keep abreast with the recent changes in the educational arena. Central to role of the educator within outcomes-based education, is the provision of learning environments that promote action and participation on the part of the learners (Department of Education (1998).

As teacher researcher, I want to understand how teachers can best fulfil their role as mediator of learning in the two-way interaction between learners and teachers in (or outside) the classroom setting. Researchers commenting on this role, characterize it as a "warm human being" (Feuerstein, 2001:2), or as facilitator of learning (Department of Education, 1997). My role as community worker and civic leader, has facilitated access to local community resource persons such as the local Ward Councillor.

This role has assisted me in linking the learner's school experiences with their community needs and experiences. I am fully multilingual, and can speak and write in English, isiZulu, Afrikaans, and isiXhosa. As an Educator, I have made a commitment to be available during the intervals to support those learners who need extra guidance and or assistance with their school work.

1.6.3. The learners

The research participants were selected (see section 3.3 in Chapter 3 for details) from two of the five Grade 8 Classes, namely seven learners from Grade 8A and another seven from Grade 8B. The participants worked and sat together as a group like all the other groups in the class. The participants sometimes met on their own during intervals to complete certain activities, or worked together with the other class group on a Saturday for about 2 hours. Saturday Group sessions were negotiated first with the participants and then with prior arrangement and consent from their parents (see Annexture 9).

A short profile of the participants, obtained through the use of a questionnaire (see Annexture 8 for the questionnaire), is provided here.

> The majority of the learners live in close proximity to the school (10 learners who walk to school), while the others live further away (3 learners live approximately 1 km , and hence walk to school, while one learner lives approximately 2km's from the school, and comes to school by bus).

Most of the learners live with their parents (12 learners), while the rest live with their relatives (2 learners) in either formal homes with electricity and inside tap water (11 learners) or in an informal settlement without electricity and outside tap water (3 learners), and have privacy in the home for doing homework (7 learners).

In relation to the topic of study, namely electricity, 11 participants have electricity in their home for electrical appliances such as television, stove and a radio, while 3 participants do not have electricity and rely on paraffin for their heating or lighting requirements. Most of the learners help out with the cooking (10 learners) and a few have a part-time job (3 learners), and one learner has DSTV at home.

1.7 Significance of the study

The study is intended to empower the participants and the local community on the problems associated with the unit on electricity. It is useful to me as researcher and practitioner, as well as other educators and education policy designers. The significance of the study will highlight four (4) issues, namely:

a) the way in which educators transfer policy statements as contained in policy documents into classroom practice;
b) how learners negotiate their own meaningful learning through project based learning;
c) how educators carry out their role as mediator of learning as defined by Feuerstein (2001); and

d) to explore the ways in which learners respond to this mediator role of educators in teacher-learner mediated interactions.

The educator as mediator of learning as defined in the Norms and Standards for Educators (1998, 2000) has not yet been clearly understood by teachers. This study hopes to shed some light and valuable insights into this role and thereby serve as input to further and deepen the debate regarding this role. Insights gained through this study will impact on the way teachers help learners both inside and outside the classroom situation.

In this study I want to understand my own practice, to explore what I do and how learners respond to what I do in a mediated learning setting.

1.8 Outline of the study

The study consists of five chapters beginning with the introduction and contextual framework. The second chapter, Chapter Two, outlines the theoretical framework and elaborates the link between project work and mediation. The study employs a participatory research approach to hone in on the role of the learner as participant, and the role of the educator as mentor, mediator and co-creator of knowledge. MLE has as its central construct 'interaction', and this study sets out to explore how this interaction can be maximized through project work. Chapter Three focuses on the methodology and research instruments. This chapter elaborates on the interview methods and the selection criteria used to enroll the participants in the study.

Chapter Four looks at the data analysis. The data analysis is based on the results of the data gathered from the main research question. The results obtained from each data sources is analyzed and discussed. The last chapter, Chapter Five, has a discussion on the issues raised and puts forward some recommendations which are based on the findings of the study

1.9 Description of terms used in the study

The terms mediation, mediator and project work are, amongst others, the key terms in this study, and shall be clarified for the purpose of the study. The terms learning experience and lifelong learning are key aspects of OBE. The central construct of MLE, namely 'interaction', including the four critical attributes of MLE, namely, reciprocity, intentionality, meaning and transcendence will also be clarified.

1.9.1. Learning experience

Learning is neither cognition (inner mental action) nor behaviour (outward action) nor an interplay between the two: it is a dynamic process involving affective, subconscious, unconscious and irrational processes and influences, often captured in notions of 'practice' (Morrow, 2001). Learners come to the teaching and learning situation bringing their own pre-knowledge and a frame of reference based on experience (Spector, 1993).

In this study I extend the idea that learners learn best when educational processes incorporate people's experiences and emotions as well. Against this backdrop, the teacher's role is to create learning experiences rather than imparting content or information.

In keeping with the new vision for education in South Africa, teachers should "...put learners first, recognizing and building on their knowledge and experience, and responding to their needs' (DOE, 1996:11).

1.9.2. Lifelong learning

Learning is a process of ongoing or continuous learning throughout one's life. It is seen as a journey or a process, and not as an angst-ridden event or destination (DOE Teachers Manual for Grade 7, North Durban Region, 1999). Manganyi (1997) asserts that "...lifelong learning is a crucial strategic intervention to transform the education and training system. It will provide an increasing range of learning possibilities, offering learners greater flexibility in choosing what, where, when, how, and at what pace they will learn" (Manganyi, 1997, p.1). Lifelong learning "... becomes imperative for all citizens due to the pace of change which is dramatically changing the nature and management of work, social structures, values and cultures", and this change continues to accelerate as a result of globalization and technological innovations (Department of Education 2001, p.14). The learning which takes place in the classroom and school is just part of the process, one never really stops learning (Department of Education, 1996).

1.9.3. Mediator

A mediator is a more knowledgeable adult or peer who acts as an external agent in assisting the learner mediate his/her own learning.

Feuerstein (1988) suggests that mediated learning is present where there is a strong, clear loop between the sending and receiving ends of the communication process. This feedback loop is intended to maximize learning and to foster reciprocity between the learner and the teacher. In this study I argue that the educator should act as agent who facilitates learning, and in this context assumes a more flexible role as co-discoverer or learner instead of taking on the role of expert. When engaged in a two-way interactive dialogue the teacher can relearn the content, and acknowledge that there are a few things which he can learn from his students as well. The mediators role is to guide classroom participation in a manner that is geared towards the empowerment and affirmation of the learners.

1.9.4. Mediation

Mediation is a process by which the learner engages in learning, and the Educator as external agent helps the learner's mediation process through his/her role as the mediator. This study explores how learners respond to their educator mediated learning environment. The mediation process is also elucidated further in Chapter 2 (see 2.2.2).

The participation by each learner is in this study is essential, and opportunities are provided for each learner to mediate his/her own learning as an individual, and/or, as a small project task group.

1.9.5. Interaction

Interaction is the main construct in MLE (Feuerstein, 2001), and in this study I argue that interactive dialogue is critical to effective mediated learning experiences. Interaction is the two-way rich communication that takes place between the Educator and the learner(s). The nature of the interaction is such that it is comprised of the teacher or agent whose role is mediator with specific roles to play on the one hand, and, the learner or who engages in the process of mediation on the other.

1.9.6. Reciprocity

Reciprocity is the establishment of "a positive connection of acceptance, trust and understanding between the learner and the mediator" (Greenberg, 2000). Intentional behaviour is considered to be reciprocal when a learner in a mediated learning interaction responds in some way, verbally, non-verbally or even visually showing that he/she could attend to the teacher's mediation (Klein, 1991). In this study I argue that trust and acceptance between the role players must be earned first for learning and understanding to occur.

1.9.7. Intentionality

"Intentionality transforms any interactive situation from accidental to purposeful. By constantly focussing on the child's state of attention, problem solving strategies, mistakes and insights, the adult infuses the learning situation with a sense of purpose and intentionality" (Kozulin (1998, p.66). The educator in his or her mediator role brings to the learning situation a sense of enthusiasm, purpose and intentionality. The mediation of the purpose and intention of learning is key to learning as proposed in the study.

1.9.8. Meaning

Meaning is energized when the teacher addresses the cognitive, affective or motivational needs of the learner (Feuerstein *et al*, 1988). Mediation of meaning involves labeling of information (Tzuriel, 1999), and , it is more likely to occur when a reciprocal relationship is established between the mediator and the learner through a display of affection and mutual expression of acceptance, trust and empathy (Hundeide, 1991). This study extends the idea that learners are the main stakeholders in education, and that learning needs to be meaningful to the learner.

1.9.9. Transcendence

The educator or mediator goes beyond the concrete context or immediate experience and teaches the rules and generalizations that govern the experience (Tzuriel, 1999).

The goal of transcendence in a mediated learning experience is to help the students to apply what they learnt in a classroom setting to other appropriate settings or contexts. The main benefit of such learning is that it will help learners to become active generators of their own knowledge. In this study I extend the notions of forming links, exploring relationships, making connections and/or using 'bridging statements' (Greenberg, 2000) in order to help learners relate what they learnt in contrived classroom settings to other personally relevant learning experiences.

1.10. Project work

Project work and project based learning are used interchangeably in this study to mean sustained and co-operative investigative work (Bransford and Stein, 1993) by learners either individually and/or in small groups. Project work forms part of classroom science learning, and focuses on problem-solving in order to encourage ongoing and purposeful learner participation. This study adopts a participative approach to teaching and learning where the participants engage in ongoing and co-operative investigative work. Project work is one of the methods that can be used to meet the requirements of the vision for a new curriculum in South Africa. It forms part of a 'progressive approach' (Vithal, 2004) to teaching and learning in which learners have greater control and independence in their learning. Learning in this way, has the potential to get learners to participate actively in a manner that links the learner's school life experiences to their home or real-life experiences.

Project work is a long-term investigative study from which students produce a culminating presentation, and a way for students to apply what they are learning (Kellough and Kellough, 2003).

1.11. Preview of Subsequent Chapters

Chapter two is a literature review. The literature review sets out to:

- Build a theoretical framework for the study; and
- Identify past studies that have informed the research, looking at both local and international literature.

Chapter three focuses on the research methodology, while Chapter four presents the data obtained from the performance task in which five participants took part, including the data analysis (Stage One). Chapter 5 deals with the analysis of data (Stage Two), and the discussion and recommendations.

Chapter Two:

2. Theoretical Framework and Literature Review

2.1 Introduction

In this chapter I discuss the theoretical framework and the literature review. The theoretical framework revolves around the complementary features and links between project work and mediation. The literature review focuses on past work done on project work both locally and internationally.

2.2 Theoretical Framework

The theoretical framework sets out to :

2.2.1 Introduce the reader briefly to the purpose and argument being advanced;

2.2.2 Discuss project based learning and mediation;

2.2.3 Provide a discussion and highlight project based learning and the challenges for assessment, and.

2.2.4 Illuminate the link between project based learning and mediation.

2.2.1. Purpose and argument being advanced

As discussed earlier in Chapter One, the new education system in our country has introduced new approaches to teaching and learning. The focus has shifted in favour of the learner as reflected in the principles of learner centeredness and life-long learning (DOE., 1997). Schools are also encouraged to create cultures and practices that ensure the full participation of all learners (RNCS, Grades R-9 Schools, 2003), and enable them to have respect for the environment and the ability to participate in society as critical and active citizens (RNCS, Overview, 2002).

From the above it is clear that the education system advocates for, on the part of the learners, active learning, greater participation, collaboration with others, and that their experiences, needs and interests are taken into account. In this study I use the practice of project work (or project based learning) to afford learners the opportunity and a context to engage in meaningful learning as envisioned by the new education system mentioned above.

The study moves from the premise that learning is meaningful if learners can negotiate an identity of themselves within the learning context, and that the meaningfulness of the context of learning depends on this negotiation. The argument advanced is based on the view that the learning context is failing the learners (Taylor, 1998) and, that there is no space or opportunity for the learners to negotiate their identities or their meaningful learning (Ausubel, 1963).

The learner is mostly "sheltered" from other educational influences within his or her community (Hawes, 1979:1). In this study we create the space for a hands-on, minds-on and hearts-on approach for meaningful learning. This learning is based on the standpoint that learners can effectively mediate this learning and shape their own identities when given an opportunity to participate in project based learning that uses, or is supported by, mediated learning experience (MLE) (Feuerstein, 2001). In this study I make the link between project work and mediation. Mediation and project work both have features that have the potential to advance meaningful learning that is action orientated. Through this study I explore the link between the two, drawing on those characteristics that will enhance meaningful learning.

2.2.2. Project based learning and Mediation

2.2.2.1. Mediation

In this study, mediation is approached from:

- The process of mediation where the learner is mediating learning that gives meaning directly, either through self (individual learning), group (co-operative learning), language (oral, written, gestures and graphically) or other appropriate way; and
- The role of an agent or mediator, a role that can be taken up by an educator or more capable adult or peer who mediates the learning experience, that is, a coach or unobtrusive guide on the side (Blumenfeld *et al.*, 1991; Polman and Pea, 1997; Sage, 1996).

Mediated learning experience (MLE) as proposed by Feuerstein (2001) was developed for children's learning. This theory has as its central construct, interaction, and this interaction is one that is guided by an adult peer or more capable other to deepen the learner's understanding and experience in a two-way rich communication setting. The role of the mediator within the MLE perspective is clearly defined. Among other functions, the mediator must understand and look out for ways in which the learner approaches problem solving in order to promote learning. This mediator role of educators is clearly defined in the Norms and Standards for Educators (2000) document, see Chapter 1, (Section 1.2). Feuerstein (2001:2) characterizes the mediator in the mediated learning experience as that of a "warm human being". The mediator's are there to support the learner during mediated learning experiences by responding with praise, criticism, and encouragement throughout the development of responses. MLE emphasizes the two-way nature of responses during the interactive dialogue that leads to learning.

The characteristics of MLE are listed below in point form, as they have already been introduced in Chapter 1.

- Intentionality

  The teacher, acting on the way in which the learner approaches problem solving, begins by understanding and assisting him or her to understand how to process information. Contributions by other researchers on intentionality as a characteristic of MLE, assert that "intentionality transforms any interactive situation from accidental to purposeful by constantly focussing on the child's state of attention, problem solving strategies, mistakes and insights (Kozulin, 1998, p.66).

Flexibility on the part of the teacher is critical because "intent often needs to change during the activity" depending on the needs of the learners (Greenberg, 2000).

- Reciprocity

  This characteristic is based on the need for the learner and the teacher to see each other on the same level, that is, the teacher "... does not pretend to know the answer as to how the learner should be thinking", but takes on the role of co-discoverer or fellow explorer in the teaching and learning process (Feuerstein, 2001:2). Other researchers commenting on this characteristic of MLE, assert that reciprocity is the establishment of "a positive connection of acceptance, trust and understanding between the learner and the mediator" (Greenberg, 2000), and, mediational comments such as "... I can see where you are coming from, but I need a little more information to understand fully", or " ...that is interesting, I had not thought about it in that way before, tell me more about what you are thinking", will foster reciprocity and demonstrate to the learner that what they are thinking and sharing is really important to the teacher (Presseisen and Kozulin, 1992). A power sharing classroom structure uses the "we" language and distribute power in learning interactions (Landou, 2004).

- Meaning is made explicit

  In this characteristic the teachers role is to interpret for the learner the significance of what he or she has accomplished in the mediational situation, and helps the learner to reflect on the solution, how it was obtained, and in making generalizations which flow from the solution and process of learning.

Commenting on this characteristic of MLE, other researchers assert that mediation of meaning involves labeling of information (Tzuriel, 1999), and, that the mediator's role in guiding learners to find meaning may be achieved through (a) comparing and contrasting present learning experiences with those of the past and those anticipated in the future, (b) discussing learning goals with the student, (c) helping the student to identify and to use new learning in different applications, and (d) by asking "why" and "how" questions rather that "what" questions (Ben-Hur, 1998). Mediation of meaning involves labeling of information (Tzuriel, 1999), and , it is more likely to occur when a reciprocal relationship is established between the mediator and the learner through a display of affection and mutual expression of acceptance, trust and empathy (Hundeide, 1991).

- Transcendence is made transparent

  Here the teacher helps the learner in linking new experiences or lessons learnt, to new situations. Sharing findings on this characteristic of MLE, researchers assert that the teacher or mediator goes beyond the concrete context or immediate experience and teaches the rules and generalisations that govern the experience (Tzuriel, 1999), and on the role of the mediator on bridging, Haywood (1988) asserts that "...(the mediator) to have students draw examples from their own experiences or situations in which the same process work. In this way the students see the broader application of the process in their own terms and in relation to their own experiences, rather being limited to teacher-contrived situations with which they may be unfamiliar (Haywood, 1988:4).

- Development of affective attributes

  This characteristic deals with feelings, emotions and attitudes which have an impact on learning. The teacher models the following aspects of this characteristic to the learners in his day-to-day interactions with them:

  Feelings of competence; goal seeking and achieving; awareness for potential for change; feelings of belonging; sharing behaviour; self regulation and control of behaviour; self challenge; and a search for alternatives.

  According to Ross Albon, MLE does not just focus on the cognitive side, but looks at emotions too. (Available online).

The above characteristics are imperative to how the two-way rich communication takes place. Mediation involves participation, which is key to the processes of negotiating meaning (Lave and Wenger, 1991). The collaborative aspect which is also present in project work, provides the learner with the opportunity to work with others including the teacher as participant. In this way, added opportunities for the student to learn how knowledge is negotiated are created. Mediation, as defined by Feuerstein (2001), can build a learning community between the main role players who include the educator, learner, peers, parents, and others. There are limitations for the application of MLE in the South African classrooms that are under resourced, with large numbers, and with many teachers who still use teacher centered approaches. The essential elements of MLE largely employ "2-way rich interactions" that need one-to-one interaction between the learner and a more knowledgeable other (peer or adult). Such learning interactions are time consuming and work well in small class sizes.

The approach to mediation, as defined above, and, as defined by Feuerstein (2001), provides the collaborative context for managing the human interaction, while project based learning as defined by Bransford and Stein (1993) and the Multimedia Project (see section 2.2.3 below), creates opportunities for learning that is long-term, interdisciplinary, student-centered, and integrated.

2.2.2.2. Project Based learning

The "project" method has been considered as "one of the best and most appropriate methods of teaching" (Knoll, 1997:2). Other education researchers use the term, among various other conceptions, project-based learning (PBL). "PBL can be defined as an inquiry process that resolves questions, curiosities, doubts, uncertainties about complex phenomena in life" (Barell, 1998:7). Project based learning (PBL) is a comprehensive instructional approach to engage students in sustained, co-operative investigation (Bransford and Stein, 1993). Project work is a long-term investigative study from which students produce a culminating presentation, and a way for students to apply what they are learning (Kellough and Kellough, 2003). Project based learning is:

> ... a model for classroom activity that shifts away from the classroom practices of short, isolated, teacher-centered lessons and instead emphasizes learning activities that are long-term, interdisciplinary, student-centered and integrated with real world issues and practices. (The Multimedia Project, Available online).

According to Barell (1998), project based learning (PBL)is different from other more traditional teaching and learning strategies. He asserts that:

> PBL crosses a broad spectrum of instructional patterns ... it is a shift away from a teacher-directed curriculum to a more student-directed curriculum ... is inquiry driven, the first element is designed to engage students in thinking about their prior knowledge. What do we KNOW? What do we WANT/NEED to find out about? HOW will we go about finding out? What do we expect to LEARN? How will we APPLY what we have learnt - to ourselves, other subjects, (other people, and, in the community)? What new QUESTIONS do we have following our inquiry? The second element asks students to: OBSERVE objectively, THINK reflectively, and QUESTION frequently (Barell, 1998: 9).

Project work is not entirely new. The idea that projects encourage learning by doing is not entirely a new one (Dewey, 1933; Kilpatrick, 1918). According to Knoll (1997), quoting Kilpatrick (1918), projects in the 1970's gained worldwide recognition. In the United states it was made out to be one of the best methods of teaching. The conceptual distinction between the project and other teaching methods remained unclear, and the historical basis of project work was confused through the work of researchers such as Stimson, (1908), Richards (1900) and Dewey (1899), (Knoll, 1997). The origins of project work according to Knoll (1997:2) are not American but originated "out of the architectural and engineering education movement that began in Italy".

Subsequently, the rigorous use of project work as a teaching device, has its origins in France as early as 1671, where the French architects, through a monthly competition, the "Prix d'Emulation", focussed the students' training by using learning by projects after which they would gain medals or recognition (Knoll, 1997). Woodward, (1887) took the training in the handicrafts that occurred in college to the secondary school level, so that learners could apply what they learnt in a context (Knoll, 1997). For Woodward (1887), instruction progressed systematically from elementary principles to practical applications, that is, 'instruction' first, followed by 'construction' of the project.

Dewey (1899) and Richards (1900) were critical of the manual training approach espoused by Woodward (1887), and assert that 'construction' and then project work, should not be the final goal of the educational process, but that it be part thereof (Knoll, 1997). Richards maintained that 'instruction' did not precede the project, but was central to the 'construction' of the project itself, that is, instruction is integrated into project work. Kilpatrick (1918) attempted to redefine the term 'project' and based his project concept on Dewey's (1899) work , namely, the theory of experience, where children acquire experience and knowledge through problem solving in social situations. Kilpatrick (1918) was more influenced by Thorndike's psychology of learning which espouses the notion of a sense of purpose and procured satisfaction in learning (Knoll, 1997).

Hence, for Kilpatrick (1925), student motivation is a key feature of the project method, that is, it is a 'hearty purposeful act'. In his view there are 4 phases in project work, namely, purposing, planning, executing and judging, and that the initiation and completion of projects by learners is the ideal. His agenda is the development of democracy, an agenda which is consistent with the new education philosophy of South Africa as envisaged in the RNCS (DOE, 2001).

Kilpatrick's (1925) views on project work did not go unchallenged. To Dewey (1938) the project was not to be an 'enterprise of the child', but that it was a 'common enterprise' of the learner and the teacher. Dewey's (1938) objection at this juncture begs the question: How do we gain new knowledge about the world?

For Dewey (1938) the role of the teacher or mentor is important in the provision of guidance and assistance during the 'common enterprise' mentioned earlier. Criticism of project work by Dewey (1931) was that project work was just one of the methods of teaching, and, that the role of the teacher was key when learners engage co-operatively with peers and the teacher (Dewey, 1938). His criticism, including that of other educators, had a dampening effect on the wide use and acceptance of project work. Dewey was not opposed to project work, but raised questions about the way it was delimited by other researchers.

Notwithstanding the constructive criticism leveled at project work, in its continuous development up to the present, it has survived and is still practiced to-day (Barell, 1998; Bransford and Stein, 1993; Blumenfeld *et al.*, 1991; Kellough and Kellough, 2003; The Multimedia Project). Currently there exists a variety of models described as project based learning in which learners engage in 'hands-on' or 'active learning' activities. Research indicates that there is a shift of instruction in schools from teacher-directed to mostly learner-directed and initiated learning that is goal-driven, independent and having an emphasis on knowledge building (Scardamalia and Bereiter, 1991). Issues raised by some researchers are highlighted below. No adequate attention was given to support teachers and learners in such innovative educational approaches to teaching and learning, and would therefore not be widely accepted or implemented. The developers of project based learning did not give sufficient attention to learners' point of view. Sustained investigative learning and ongoing assessment of such learning requires special skills and knowledge.

The lack of widespread use of PBL in the past is attributed to the fact that the complex nature of learner motivation, and, the knowledge and skills required by learners to engage in sustained investigative and reflective work (Blumenfeld, *et al.*, 1991).

Project based learning, as defined by The Multimedia Project mentioned above, identified 7 features as key components of PBL for use in describing, assessing, and planing for multimedia projects. These 7 features are listed below:

- **Curricular content** - learners and teachers are responsible for the integration of content to be learnt, and that this be supported and demonstrated in process and product.
- **Multimedia** - this component gives students opportunities to use various technologies effectively as tools in the planning, development, or presentation of their projects.
- **Student direction** - this component is designed to maximize student decision-making and initiative from topic selection to design, production and presentation decisions. Projects should include adequate structure and feedback to help students to make thoughtful decisions and revisions.
- **Collaboration** - this is accommodated and promoted among and between students and the teacher, and between students and other community members. It is intended to give students opportunities to learn collaborative skills and to work co-operatively.
- **Real world connection** - PBL may connect to the real world through addresses real world issues that are relevant to students' lives or communities.
- An **extended time frame** - this builds in opportunities for students to plan, revise and reflect on their learning. Though the time frame and scope of the projects may vary widely, they should all include adequate time and materials to support meaningful doing and learning.
- **Assessment** - due to the ongoing process of PBL, assessment is an ongoing process of documenting that learning. PBL requires varied and frequent assessment including, teacher assessment, peer assessment, self-assessment, and reflection. Assessment practices should also be inclusive and well understood by students, allowing them opportunities to participate in the assessment process (Adapted form The Multimedia Project, Available online).

The above features of PBL emphasize the importance of both the learning process and content in ways that allow for the co-construction of knowledge by learners with the teacher. This co-construction is based on, or usually done with, a "driving question" (Blumenfeld *et al.*, 1991). The seven features espouse a sustained learning centered approach which makes links to the learner's real life experiences.

The student directed component provides learners with the opportunity to participate in their learning in ways that give meaning to them, in a supportive learning environment.

Against this backdrop of project based learning (PBL), learning takes centre stage, the learner participates actively in the learning process, and is supported by an environment that is conducive for meaningful learning. Learning is organized around projects that make use of authentic content, student autonomy and responsibility, explicit learning goals, co-operative and sustained learning that culminates in the application of learning using real products and presentations. Such learning must incorporate the transformation and construction of knowledge by the student (Bereiter and Scardamalia, 1999). The teacher's role is to guide and support this learning through mediation, coaching and/or mentoring. Depending on the complexity of the situation or learning context, the mentor provides "scaffolding" or supportive activities that help students learn (Young, 1993).

The challenge for the teacher using PBL and a constructivist teaching and learning approach, involves the preparation of learning experiences that include appropriate forms of scaffolded instruction. This kind of instruction, as envisaged in this study, brings to the fore the mentor and mediator role of the teacher, whilst preserving students' ownership of the learning process. Brooks and Brooks (1999) assert that "(a)s educators, we develop classroom practices and negotiate the curriculum to enhance the likelihood of student learning"(p.21). PBL espouses student engagement through participation in active mental and physical processes that are real and relevant and student centered, all of which are akin to the mediation process which drives meaningful student learning.

Doing projects in the way envisaged above would provide learners with the opportunity to make choices, and for then to take ownership over the learning process in a supportive learning environment. Researchers argue that 'methods matter' (Daniels and Bizar, 1998), and with regard to PBL there is no guessing about who holds information, and how learning takes place.

2.2.3. Project based learning and the challenges for assessment

In the light of the sustained, long-term, and ongoing nature of project based learning, and the concomitant ongoing process of learning, it follows that assessment is an ongoing process of documenting such learning. Learning of this kind, namely, project based learning, promotes the notion of multiple abilities in the participants. Multiple abilities, talents and skills, according to Gardner (1987), are the different ways of knowing or multiple intelligence's that enrich our lives, and help us respond effectively to our learning environment. Gardner's (1987) concept of multiple intelligence's enables us to broaden our concept of learning. His ideas on the different ways of knowing are key to what we set out to explore in this study, namely, the way in which learners negotiate their own meaningful learning. With initial teacher mentoring, project based learning provides opportunities for learners to exercise their multiple abilities and talents, and in so doing builds upon the strengths and weaknesses they each bring to the learning situation.

Flowing out of the above expanded concept of learning, is a broader concept of assessment which moves beyond traditional paper and pencil testing method.

Project based learning as a progressive method of teaching and learning poses its own challenges for assessment. Assessment within PBL is viewed as follows:

> ...the ongoing nature of PBL must make learning visible to assist in documenting evidence of learning ... students, teachers, peers and others can discuss achievement (or non-achievement) of learning based on concrete evidence ... frequent and clear feedback loops can foster self assessment practices that engage learners in the evaluation of their own work ... assessment can help make the content connections clearer through the use of journals or idea books ... assessment helps teachers to plan their next steps by gaining insights into what the students are learning and what needs to be addressed ... assessment, through class presentations, design reviews, conversations with teachers and group members helps give students valuable feedback to help them plan their next step for their projects (The Multimedia Project, Available online).

The above innovative approach to assessment supports learning and does not stand in the way of good teaching and learning. It also helps the teacher and learners to develop more complex relationships that foster meaningful learning.

According to Malcolm (1992:86), "our assessment techniques and the things we choose to assess make telling statements about what we think is worth learning, what learning is, and what teaching is", and that when it applies to assessing for learning, "(t)he principles of assessing for learning differ from the principles of assessing for grading". When we assess for learning, according to Malcolm (1992), it differed from assessing for grading. Malcolm (1992) asserts that, when we assess for learning, "...we do not have to set all students the same task under the same conditions ...wrong answers tell as much as right answers about student's thinking ... open questions apply and give insights to students' thinking ...tasks do not have to yield the same ranking ... assessment for learning is integral to teaching (Malcolm, 1992, p.86).

The position articulated above by Malcolm (1992) is consistent with the earlier discussion on assessment that supports learning. The challenges for assessment within the project based learning requires that assessment be ongoing documentation of evidence of learning that is tangible, that is, something that can be seen or heard. Assessment must be made public, and the learner should be involved in the design of the assessment instruments (The Multimedia Project, 1997-2001). I chose project work in order to assess for learning, that is, to find out if learning has occurred (Malcolm, 1992).

In PBL we are looking for evidence of learning, and when one takes on the role of assessor, one needs to know what to look for:

> When we look, we do not see everything - we select according to our purpose in looking, and our knowledge. It helps to know what children are likely to say or do, and to be clear about what science says (Malcolm, 1992, p.81).

When looking for evidence for learning or development, educators must plan for assessment, and publicize the reasons for assessing students' learning. Whiles there are differences between assessment for grading and assessment for learning, PBL links up with assessment for learning, as it publicizing and establishing reasons for assessment. Assessment for grading can best be used to provide to interested parties a clear and useful summary or account of how well learners have met the school's set learning objectives, and, evidence of learning requires formal testing conditions, and involves norm referencing. Assessment for learning, on the other hand, is used to monitor the learners' progress in learning, diagnose problems, and to motivate further learning.

When planning for assessment for PBL, in order to find out if learning has occurred (Malcolm, 1992), educators must bear in mind the following:

> ... assessment techniques are linked to curriculum planning through aims, stages of development, and performance indicators (Malcolm, 1992, p.78)

Assessment that takes the above into account will provide more information or feedback with respect to depth of learner's knowledge and/or skills and attributes, and how learners use their knowledge or skills to work through problems, tasks and investigations. To give effect to the above assertion related to the planning of assessment, appropriate assessment instruments with clear criteria for performance are required. Authentic assessment (Moursund, 1999) is espoused for project based learning. Learning is maximized if the context for learning resembles real-life situations in which the newly learnt material can be applied to (Brown, Collins & Duguid, 1989). For example, when learners are required to connect a plug to an electric appliance, problem solving is addressed in the context of electric currents or electricity in the home or school.

As discussed earlier on projects and learner performance, tasks do not have to yield the same ranking (Malcolm, 1992). A learner may be good problem solver when it comes to connecting a plug, but not so in quizzes. The focus in the above example is on the learners' progressive development, which is justifiable through monitoring the learners' stages of development with respect to each assessment technique. For this to happen it requires problems of varying difficulty, or problems that are open enough to enable all learners to solve them at their own level (ibid).

In the example where learners connect a plug to an electric appliance, all assessments focus on connecting as a performance by the learners. Such performance, according to the seven features of PBL mentioned earlier (see page 36), feedback loops must be included to help learners make thoughtful decisions. In addition, the integration of content requires that performance in projects, (1) be based on standards, and, (2) support and demonstrate content learning both in process and product. At the GETC level of the NQF, and at the level of the classroom, standards lead to achievement when learners are engaged in teaching and learning experiences through observation, simulations, questions, and products. According to Malcolm, Long and Chamberlain (1999:57), "Standards define levels of achievement ... Standards define the quality of the learner's work ... Standards help teaching as well as reporting".

On levels of competence, Malcolm, Long and Chamberlain (1999:58), assert that "the shift is to level of competence. An alternative way of defining standards - a descriptive writing through the use of 'scales' or 'levels of competence' in the (learning) outcomes". In order to successfully integrate content learning with performance of tasks in project work, and, to ensure that learners get support for this learning both in process and product, 'scales' or 'levels of competence' assessment instruments can be designed by educators. PBL requires that these designs should involve learner input so that the learners could use such assessment tools to either guide their learning, or to provide thoughtful feedback to their own or peer's learning.

Below is a discussion of scoring or performance assessment guides made up of specific pre-established performance criteria used when assessing learner performance or products that may result from a performance task. There are two types of scoring guides also referred to as rubrics, namely holistic and analytic. A holistic rubric requires the educator to score the overall process or product as a whole, without judging the component parts separately (Nitko, 2001). In an analytic rubric, the educator scores separate, individual parts of the product or performance first, then sums the individual scores to obtain a total score (Moskal, 2001; Nitko, 2001). In the case of holistic rubrics, the focus of the score is on the overall quality, proficiency or understanding of the specific content and skills (Mertler, 2001).

The use of holistic rubrics allow for a quicker scoring process, because the educator needs to read through the learner's product or performance to get an overall sense of what the learner has presented as evidence of learning. In this case most of the assessments are summative in nature, and require limited feedback. Analytic rubrics, on the other hand, are suitable when a fairly focussed type of response is required (Nitko, 2001). In this case several scores are obtained first, and thereafter a summed up total score can be arrived at, that is, assessment on a multidimensional level (Mertler, 2001). The assessment process is therefore slower, as the educator needs to assess a number of different skills or characteristics individually. The individual scoring criteria make it possible for more feedback to be available to the learner. This study makes more use of analytic rubrics (see Annexture 14 for an example).

Against the above backdrop of an expanded concept of learning, and assessing for learning, standards are prerequisites for attaining quality in education. If standards are to be applied fairly, we need to separate learner's personalities and past experiences from their achievements in the current one, making assessment judgements on one learning outcome independent of another, and making an effort to know all the learners equally. Assessment for learning provides us with opportunities to draw on, and then to build upon, the learner's diverse needs during teaching and learning situations. This kind of assessment is developmental providing appropriate supportive space for learners to negotiate own meaning. It also broadens the scope of for the kinds of information that is collected as evidence of learning, or lack thereof. It provides effective feedback loops between the members of the learning community. Assessment for learning as envisaged in this study, and for project based learning, requires new assessment strategies such as, among others, exhibitions, portfolios, presentations, performances, creation of real-life projects, showcasing, and demonstrations.

2.2.4. Link between project based learning and mediation

Based on the foregoing discussion on mediation and project based learning, below we consolidate the complementary features and links between project based learning and mediation, as discussed in this study. Mediation involves participation. Without participation there can be no learning (O'Donoghue, 2001), and, participation is key to the process of negotiating meaning (Lave & Wenger, 1991) in collaborative social settings in which students learn.

The collaborative aspect, which is also present in project based learning, provides the learner with the opportunity to work with others, including the teacher or other adults as participants. In this way, added opportunities for the student to learn how knowledge is negotiated are created, and hence the idea of a learning community.

Below is a schematic representation of meaningful learning through mediate learning experience combined with project based learning.

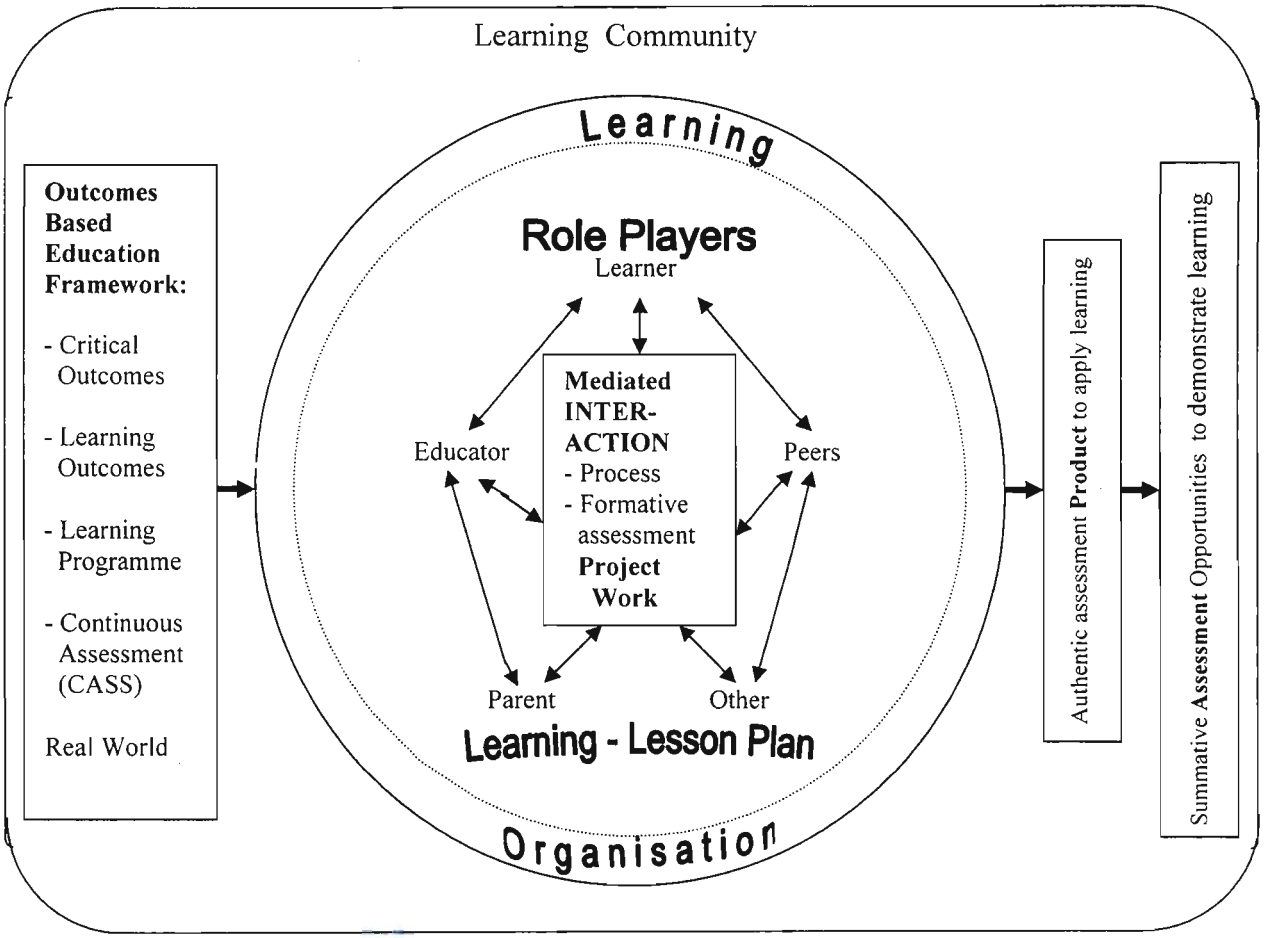


Figure 1: The Mediated Learning Experience (MLE) through Project Based Learning in a Learning Community.

Flowing out of this model, is one of the ways that describes both the methods and the thinking used by the learner (that is, the processes), as well as the learner's final level of achievement (that is, the products). The model also indicates the inextricable link that exists between mediation and project based learning. It is through this type of link that I assert that project based learning provides the 'optimal conditions' for mediation (Bennett & Dunne, 1994).

I chose project based learning because it allows educators and learners to assemble purposeful evidence of learner's abilities and skills over an extended period of time, which is a shift from the more traditional methods of teaching and learning. Projects, like portfolios, serve as tangible evidence for showing teachers, parents, administrators - as well as the students themselves - what students know and can actually do (Tombari and Borich, 1999). They allow for multiple ways of expressing the answer (Nitko, 2001), and allow direct observation of student skills and capabilities (Oosterhof, 2001). In the light of the foregoing, I use project work as a way that learners come to know and what they take out of their learning. It serves as an artifact in the mediation of learning (Blumenfeld *et al.*,1991). Projects are consequential tasks in which learner's thinking is made both visible and public (Brown and Campione, 1994; Glaser, 1994).

In moving forward, I contend that project based learning and mediation are inextricably linked in a manner that the one complements the other through a two-way interaction. Project based learning sets mediation into action for the learner, and initiates the necessary and appropriate support and guidance that the learner needs from the "warm human being" described by Feuerstein (2001: p.2). Because of the interrelatedness of project work and mediation, I contend that project based learning optimizes mediation (as discussed above, in 2.2.2.1).

2.3. Literature Review

This section focuses on studies or work done on project work both locally and internationally. On the local front, the awareness and subsequent introduction of project work can be attributed to the introduction of continuous assessment in the middle and late 1990's by the Department of Education. According to Vithal (2004 :225), in the South African Journal of Education, Vol. 24(3),

> ... project work (as conceptualized by the Department of Education) typically involved a small self study on a topic usually chosen by the teacher, and done outside class time for assessment purposes. Even in this rather limited notion of project work and despite it appearing to be a relatively widely implemented assessment practice, virtually no research exists to examine its use and effects (Vithal, 2004 : 225).

In a study conducted by Vithal (2004) on project work in a Mathematics classroom, research was undertaken involving an educator doing project work with a group of learners.

In this study, a student teacher chose to do project work, and she - Vithal (2004) - presented data and an analysis of work done by the student teacher with special reference to one learner. The data presented was intended to point to the tensions and potentials of project work and its associated concepts. I use the example of this study based on a Mathematics lesson, because the insights gained from it can be applied in other subjects as well. The findings from the above study conclude that:

- project work provides the means for meeting some of the expectations on the new curriculum reforms in South Africa;
- the problem oriented feature of project work may make it possible to produce "learners who are able to identify and solve problems and make decisions using critical and creative thinking";
- the concept of participant direction suggests that learners are able to "organize and manage themselves and their activities responsibly and effectively and working effectively with others as members of a team or group";
- exemplarity may be inferred from learners being able to "demonstrate an understanding of the world as a set of related systems";
- inter-disciplinarity is expected in requiring learners to be able "to transfer Mathematical knowledge and skills between learning areas and within Mathematics";
- project work as a pedagogy provides a means for realizing some of the important features to teaching and learning Mathematics (such as problem solving and investigations) expected by the new South African curriculum reforms;
- such "progressive pedagogies" need to be made available to those involved in teacher education programmes; and

- these "progressive pedagogies" need to be interrogated through research.

The above findings, as stated earlier, apply to other subjects such as Science and this is attributed to, (1) the legacy of the recent past education policies of Apartheid education, and (2) the recent introduction of continuous assessment as part of the changes that were made for the vision of the new education system discussed in Chapter 1. This legacy of the Apartheid education is best captured in the words of Gardner (1991):

> rote, ritualistic or conventional performances ... (that) occur when students simply respond ... by spewing back the particular facts, concepts, or problem sets which they have been taught (Gardner,1991: 9).

Reflecting on my past experiences, both as a student and as a teacher, traditional school projects have been summaries of information read from reference books or text books, that is restated in one's own words in the creation of some form of product. An authoritarian climate prevailed in schools where control and docility were prized and freedom and spontaneity extinguished (Holt, 1964). This approach to teaching and learning have long been the subject of severe criticism by educational theorists. Sparks-Langer *et al.* (2004) assert that:

> When students are exploring ideas in ways that seem meaningful and important, they worked hard and felt proud of their efforts. When assignments were perceived as busywork, or unrelated to the real worlds, students were resentful and uninterested (Sparks-Langer *et al.*, (2004:41).

It is against the above backdrop that this study sets out to use project based learning to create the space for learners to negotiate their own meaningful learning of a science unit on electricity. The legacy of past educational practices linger on despite the recent educational changes in South Africa.

Critics of the slow pace of educational change in South Africa cite the lack of resources as a limiting factor in the strife for quality education. Through project based learning using the available resources, both physical and human, and, using innovation and improvisation, I create an opportunity for meaningful learning in a Science classroom. A classroom that supports democratic values and processes that will lead to developing competent citizens better prepared to deal with the new challenges facing our modern society, (RNCS, Overview, 2002, p.8).

Internationally project work is a well established educational practice. It is interpreted and practiced in different ways with regard to pedagogical and assessment practices.
In the discussions that follow, I will shed some light on the different, or similar, ways that project based learning (PBL) is interpreted and theorized, and then present and examine some of the studies conducted using PBL. The interpretations and theories will focus on the alternative ways of looking at PBL, then I look at what constitutes a PBL task, followed by ways of minimizing frustration for first time educators and learners when doing PBL. The literature reviewed shows many ways of looking at PBL, and I use five categories to distinguish between them, namely, student directedness, sustainability, real-world connection, interdisciplinarity , and problem orientation.

Student directedness

This category deals with learning that is learner centered (Dewey, 1993).

It incorporates the involvement of the role players as depicted in the model discussed in Chapter 2 (Figure 1), and highlights the dynamic interaction through PBL, and , where the starting point, is learning. The classroom presents itself as a microcosm of community life, and learners to learn about democratic values in the science classroom through the opportunities created by PBL. The interactive nature of PBL brings differing view points together, decisions are made among small group members. A "balance of shared power is likely to invite development, feelings of involvement, participation and responsibility. This use of power and responsibility should be learned gradually and naturally (Hopson & Scally, 1990: 57)". PBL creates opportunities to learn how knowledge and power are negotiated as the project is done (Vithal, 2004). This is particularly relevant in social learning interactions during small group tasks. Mertler (2003, p.110) asserts that "performance assessments present to students a hands-on task or some other performance-based activity that students must complete either individually or in small groups".

Project work , in which learners perform project tasks based on a "driving question" (Blummenfeld *et al.*, 1991), is the actual prompt or activity supplied to students as part of a performance assessment. It specifies to the students exactly what they are to do as indicated in an accompanying educator prepared scoring rubric which guides students with pre-established performance criteria that are used in evaluating student performance (Mertler, 2003). Educators must plan a variety of activities to accommodate learner's different styles, needs, and interests, because variety holds learner's attention throughout the lesson (Wolfe, 2001).

The concept of 'performance assessment', also referred to as assessment performances or authentic assessments, is directly linked up with project based learning. Researchers Kulieke, *et al.*, (1990) from the North Central Regional Educational Laboratory (NCREL) make notable assertions on 'performance assessment' (see page 55, NCREL 1990). Reference made in this study to the concept of 'performances' by learners, is based on what is defined above by NCREL (1990). In PBL student directed learning eventually leads to culminating performances by learners.

Sustainability

Engaged learning creates opportunities for learners to perform challenging tasks such as problem base learning or projects which require a sustained amount of time (Jones *et al.*, 1994). Such sustained activities require planning by the main role-players. Projects are more open-ended activities where learners have the opportunity to interact with peers, materials, educators and/or community members. The management of the task is a shared responsibility of the team members which includes the educator in a mediator role as defined by Feurstein (2001) in Chapter 2 (See 2.2.2).

Real-world connection

Theorists emphasize the importance of knowledge that is related to contexts that learners understand and can use in meaningful ways. In addition, they espouse the view that understanding, and the active use of knowledge in real-life context, contribute to increased student performance (Whitelegg and Parry, 1999; Howie, 2001; Hewson *et al.*, 2001) and that performance in complex science tasks is higher (Cobb and Bowers, 1999).

Perkins' (1992:5) idea of "generative knowledge" aptly speaks of knowledge "that does not just sit there but functions richly in people's lives to help them and understand and deal with the world". As discussed earlier (see Project based learning and the challenges for assessment, page 38), learning is maximized if the context for learning resemble real-life contexts. Project based learning incorporates authentic learning activities or authentic achievement which is defined as "(the) process in which teaching is organized around meaningful use of content" (Sparks-Langer *et al.*, 2004:40). Other proponents of real-life context use the terms authentic activities and performance assessments (Darling-Hammond, Ancess and Ort (2002), and, authentic achievement (Newman 1991, 1996). PBL places the learner in the centre, it is about participation in the solution of real life and challenging problems. In this way, learning is authentic, "students learn best when they are actively (hands-on) and mentally (minds-on) engaged in doing" (Kellough and Kellough, 2003 : 178).

Multidisciplinarity

Multidisciplinarity or collaboration across fields including reflexivity or working together in partnerships with stakeholders (Guile and Young, 1997; Fornäs, 1994; Jones *et al.*, 1994) is encouraged in the new out-comes based education system in South Africa (DOE, 1997). This integration is to be done across disciplines into Learning Areas, and across all eight Learning Areas and in all educational activities. The outcome of such integration "... will be a profound transferability of knowledge in the real world" (DoE, 1997:30).

Problem orientation

Researchers emphasize the need for learning that leads to action on the part of the learners. Problem posing initiates dialogue, strives for the emergence of consciousness and attempts to achieve a critical intervention in reality (Freire, 1970). Key to this category is that some real or authentic subject related problem must exist, and be deemed important by the project team or individual learners.

Learner interest in the problem is a central feature, as this interest drives motivation to see the project through to its finalization as a learner or team artifact or product of learning. Such multidisciplinary artifacts serve multiple purposes, such as a presentation to a real audience, for example, a performance assessment, or used as a persuasive tool to present the teams findings on some societal issue.

In addition to the five categories discussed above, recent studies on project based learning reveal that there are certain features that distinguish practices that may be considered as project based learning. Below are some of the key features gleaned from the field.

- Projects have a "driving" or challenging question (Krajcik, *et al.*, 1994; Blumenfeld *et al.*, 1991).
- The project is a central focus of learning, where the end product with its embedded learning is the organizing center (Challege 2000 Multimedia Project, 1998). 'Instruction' is central to the 'construction' of the project itself, that is, instruction is integrated into project work (Richards, 1900).
- They engage learners in real-life issues (Whitelegg and Parry, 1999).

- The project is a 'common enterprise' of the learner and the teacher (Dewey, 1938), and, learners are given opportunities to work independently in sustained learning activities (Scardamalia and Bereiter, 1991; Jones *et al.*, 1994).
- The challenging nature of project based learning must involve the learners in the creation of new knowledge (Bereiter and Scardamalia, 1999; Scardamalia and Bereiter, 1991).
- Project based learning culminate in real learner products or presentations (NCREL (1990) that allow for multiple ways of expressing the answer (Nitko, 2001).

The above distinguishing features of practice that may be considered as project based learning are offered to broadly define project based learning, and, to contain the scope of this study. These features are not definitive or exclusive, but are offered to describe and capture the uniqueness of project based learning as a method of teaching and learning.

As mentioned earlier (see page 51), the concept of 'performances', by learners, is closely associated with project work. In making this association or link clear, researchers Kulieke, *et al.*, (1990) from the North Central Regional Educational Laboratory (NCREL) in their study "Assessment Based on a Vision of Learning", assert that:

> Assessment performances are day-to-day activities that can also be authentic and engaging demonstrations of student's abilities to grapple with the central challenges of a discipline in real-life contexts...these performances become an integral part of the instructional cycle, and feedback provided by the teacher and peers is meant to be formative...to help the student assess his/her strengths and weaknesses, identify areas of needed growth and mobilizing current capacity. Performances are provocations for what needs to be learned and extensions of what is learned and can help push the student to the next level of skill in performance. Performances become tools for reflection on learning accomplished and learning deferred" (NCREL, 1990. p.2).

In expanding on the concept of performances by learners described above, Kulieke, *et al.*, (NCREL, 1990:2) provide examples of such performances in which learners are engaged in sustained learning that consists of 3 phases, namely,

- Phase 1: Learners choose a topic of interest, then conduct research and write a paper;
- Phase 2: Learners use information in the papers to create real-life projects; and
- Phase 3: Formal presentation of the groups findings before a panel, some of whom are experts on the topic.

The above study shows how teachers use projects as culminating measures to determine how much learning has occurred. Relatedly, Gardner's (1999) concept of 'an understanding performance' is another variation of project based learning. Gardner's (1999) concept of 'an understanding performance' is summarized below. This summary captures in essence the views held by other theorists mentioned above on project based learning. An understanding performance:

- relates directly to important learning goals;
- allows students to develop and apply understanding through practice;
- engage students' multiple learning styles and encourages diverse forms of expressions;
- promotes reflective engagement in challenging, applicable tasks; and
- requires students to perform in ways that others - peers, parents, or community members - can view and to which they can respond.

What these criteria look like when practiced in a classroom context, is captured in the scenario where co-operative learning groups are engaged in 'understanding performances' presented by Sparks-Langer *et al.* (2004):

> In one area, huddled around a computer, four students use a search engine to find information on a research topic. In another area students sit in clusters designing maps, using an atlas as a reference. The teacher is meeting with another group to assist them with the organization of their report. Out of the class is the library another group has pulled some books from the shelves and sits at a table reading in pairs.
> By posing questions, asking for clarification, and offering suggestions, the teacher guides the group from the sidelines. Charts, graphs, and reference materials signal a room where students have opportunities to learn according to their needs and interests.
> In this learning environment teachers view mistakes as opportunities for growth in understanding. The environment is analogous to a laboratory, where students explore, analyze, draw conclusions, and present their ideas in creative and meaningful ways
> (Sparks-Langer *et al.*, (2004:100).

The above scenario by Sparks-Langer *et al.*, (2004) is consistent with what is explored in this study using mediation and project based learning. Additionally, Sparks-Langer *et al.* (2004) point out that:

> In the above scenario, the teacher recognizes the rich possibilities for learning inherent in research (or project type) activities ... the main instructional objectives include ... access(ing) multiple resources; to effectively and efficiently gather, organize, and present information; and to analyze and evaluate a body of content in order to draw important conclusions. In this classroom the conflict over the use of instructional objectives has been resolved. Clear instructional objectives guide the open ended and generative activities and lead to diverse and complex learning outcomes. In unit planning teachers must consider which aspects of the unit are important enough to merit demonstration in (project work)
> (Sparks-Langer *et al.*, (2004:100).

Reflecting on the recent changes in the South African education system, educationists highlighted the need for clear content in the new curriculum. Sparks-Langer *et al.* (2004:100) alert us to the shortcomings of project based learning when they assert that, "(s)ome hands-on activities may not address central concepts and generalizations or build important skills". In addressing this shortcoming of project based learning, they state that educators "must decide which content can be taught for understanding and which can not be taught in less depth or not taught at all" (p.101).

In offering guidelines for making such decisions, Sparks-Langer *et al.*, (2004:101) quote Wiggins and McTighe (1998) who believe such material should:

- represent a big idea having enduring value beyond the classroom;
- reside at the heart of the discipline (involve "doing the subject");
- require uncoverage (of abstract or often misunderstood ideas); and
- offer potential for engaging students (Sparks-Langer *et al.*, 2004:101).

As guidelines for teaching and learning method or strategy that is defined as authentic project work, Sparks-Langer *et al.* (2004), referring to the work of Renzulli (1977), advise beginner educators on three stages to initiate project work. The first stage deals with learner's interests, gathering, organizing and display of learner data and ideas:

> A real problem has personal interest and value to the student or students who pursue it ...based on personal interests ... in solving a local problem ... as well as diverse individual interests and skills ...(t)he project requires students to gather and analyze data; communicate with local officials (or relevant people); organize and display ideas in a presentation suitable for (an appropriate and real) audience.

The second stage deals the open ended learning processes and the three categories of real problems, and the way in which these are to be addressed:

> A real problem does not have a predetermined, correct response. It involves processes for which there cannot be an answer key ... real problems seem to fall into three categories ...(firstly), research questions ... involve gathering and analyzing data and drawing conclusions ... (secondly), service learning or activism ... (where) students work in the community and/or attempt to improve some aspect of the world around them ... (and) finally, the expression of some theme, aesthetic, or idea ... (where they may) use words, movement, paint, or clay as tools for expression.
>
> In pursuing real problems, students should address the problem as much as possible in the way a professional adult would address it ... (for example) students who want to survey cafeteria preferences must learn something about survey design ... those who want to study bacteria on the school desks must learn about maintaining cultures and strategies about quantifying bacteria.

The last stage deals with the presentation and sharing of learner findings:

> When pursuing real problems, students eventually share information with a real audience ... (who) should have a genuine interest in the product ... (or who) are part of the natural school environment ... (or) other audiences may be created within schools to provide a vehicle for student efforts ... extracurricular activities provide opportunities and/or audiences for addressing real problems ... other audiences may be part of the local community (Sparks-Langer *et al.*, (2004 : 41-43).

Implementing PBL can become a frustrating experience for first time educators and learners. Careful planning by educators, and steady guidance for learners is key, and the following guidelines are offered for beginner educators:

- In collaboration with the teacher, students select a topic or interdisciplinary thematic unit of study;
- Allow students to choose whether they will work individually, in pairs or in small groups;
- The project should be broken down into parts with individuals or small groups of students undertaking independent study of these parts;
- Keep track of students' progress by viewing weekly updates of their work. Set deadlines with the groups;
- Provide coaching and guidance, allow students to develop their own procedures, but guide their preparation of work outlines and preliminary drafts, giving them constructive feedback and encouragement along the way. Aid students in their identification of potential resources and in the techniques of research; and
- Promote sharing. Insist that students share both the progress and the results of their study with the rest of the class. The value of this type of (teaching and learning) strategy comes not only from individual contributions but also from the learning that results from the experience and the communication of that experience with others.

(Kellough & Kellough, 2003: 282-283)

Against the backdrop of the above research on PBL, it follows that direct purposeful experiences that involve learners in sustained, engaging, meaningful, and authentic activities, enable learners to achieve powerful, diverse and complex learning outcomes (Gardner, 1999). Additionally, when the experience is more hands-on, the learning is better (Kovilk,1994; Wolfe,2001). Project based learning that makes learners take on project work, either individually or in small groups, sounds challenging for first time educators and learners.

However a study conducted by Wasserstein (1995:41) on what middle schoolers say about their schoolwork, he discovered that "(a)gain and again, students equated hard work with success and satisfaction. Moreover, they suggested that challenge is the essence of engagement; when students feel they are doing important work, they are more likely to buy in than not".

Sparks-Langer *et al.* (2004:41) concurs with the above finding, and intimate that, "(w)hen students were exploring ideas in ways that seemed meaningful and important, they worked hard and felt proud of their efforts". The above insights confirm that project base learning, as proposed in this study, will help learners negotiate learning that is meaningful to them, and, that it will create the space for this negotiation. The studies that are discussed below further illuminate how project work can foster learning that is meaningful.

In a study using project based learning conducted by Darling-Hammond; Ancess and Ort (2002) on inner-city New York high school students showed that students increased their attendance, learning, and college-admission rates when they were taught with more authentic activities and performance assessments.

Another study involving students in learning through doing project work was conducted by Lewis (1991) entitled: 'The kid's guide to social action'. In this study middle school students studied the problem facing their community since the state had banned the burning of sludge from factories and sewage.

Project work provided good opportunities for learning about waste management and energy conservation, and it saved the community lots of money. After this study the students came up with a list of possible alternatives for dealing with the sludge problem. They also developed plans for a makeshift solar greenhouse.

A longitudinal study of mathematics instruction was conducted by Boaler (1997) on project based learning. This study was conducted in two British secondary schools, and lasted three years involving both an experimental and a control group, and included a pre-test and post-test. A cohort of students (from Year 9 or age 13, to Year 11 or age 16) from each school were tracked through the period of the study. A variety of instruments were used to assess students' capabilities and achievements.

The participants in the study were considered to be from similar backgrounds or socioeconomic status and to be of similar ability. Prior to participation in the study, the students had experienced the same mathematics instruction, and showed similar achievement in mathematics in a number of tests including the national standardized test of mathematics proficiency, which is administered at the beginning of the year for Year 9's. The two participating schools where chosen on the basis that one used traditional or teacher centered approaches to instruction, whereas the second school used mostly project based instruction. The school using traditional approaches taught mathematics making use of whole class instruction, the prescribed text book, and regular testing. On the other hand, the school using the project approach allowed students to work on open-ended projects and in heterogeneous groups.

Teachers interacted with students using a variety of teaching methods, and their learners had a greater amount of choice and autonomy during their mathematics lessons. The open-ended project approach for this school ended in January of the third year of the study and more traditional methods were used so that students could be prepared for the national exam.

Boaler (1997) observed approximately ninety one-hour lessons in each of the two schools making use of interviews, questionnaires, assessments (standardized national assessment instrument) and collected documentation. Students were interviewed in the second and third year of the study, and all participants completed the questionnaire in each year of the study. Teachers were interviewed at the beginning and end of the study period. The results of this study revealed that:

- Students learning through open-ended projects performed better than those who learned through more traditional learning approaches on items that need rote learning of mathematical concepts,
- Three times as many students at the projects based learning school as those in the school using more traditional approaches to learning attained the highest possible grade on the national examination,
- A significant number of students at the school using open-ended projects passed the national examination administered in year three of the study, than students learning at the school using mostly traditional approaches to learning,

- Students learning through open-ended project work outperformed those learning through more traditional learning approaches on the conceptual questions, as well as on the applied problems developed and administered by Boaler (1997),
- A students' experience with project approaches to mathematics is associated with a reduction in anxiety towards the subject, its relevance to everyday life, and a greater willingness on the part of student to approach mathematical challenges with an open mind and a positive attitude.

A study conducted by Krajcik *et al.*, (1998) presents some of the challenges that are encountered by learners during project base learning activities. The authors of the study describe case studies of 8 students enrolled in two Grade 7 Science classrooms - two boys and two girls in each of the two classrooms. Participants were chosen as representative of the middle range of Science achievement, and because they were more likely to be interviewed.

The case studies were constructed by two teachers and was conducted over a 7 month period, which included a two month introductory project, one week of practice on team work and information sharing, and two subsequent projects for students to work on their own as a team, namely, "Where does our garbage go?" and "Water, water everywhere! Is there enough to drink?". Data for this study was collected using videotape in the classroom, and through frequent interviewing of students.

The teachers constructed cases for each student, and for each of the two projects using videotaped observations, artifacts, and interview results. Then summaries were constructed on how each student participated in each aspect of the inquiry, namely,

- generating questions,
- designing investigations and planning procedures,
- constructing apparatus and carrying out investigations,
- analyzing data and drawing conclusions, and
- presenting artifacts.

In these summaries attention was given to thoughtfulness, motivation, and how group conversation, teacher support and feedback influenced inquiry.

The results of the study indicate that students were good at generating plans and carrying out procedures, and that they had difficulty with the following:

- generating meaningful scientific questions,
- managing complexity and time,
- transforming data, and
- developing a logical argument to support claims.

The findings of this study according to the authors is that there is a "need to consider a range of scaffolds from teachers, peers, and technology that can aid students in examining the scientific worth of their questions ...and the accuracy of their data analysis and conclusions." (Krajcik, *et al.*, 1998 p. 348).

Mhlongo and Sanders (2001) conducted a study to address the problem of diarrhoeal disease in Swaziland. This study focussed more on an alternative approach to teaching in a formal school system. The authors set out to evaluate an alternative way of teaching learners about diarrhoeal disease, as the current teaching and learning methods at the school did not help in reducing the problem of diarrhoea in the community.

Constructivist approaches to teaching and learning were adopted in order to overcome, or reduce the problem of diarrhoea. Learning was based on a real-life problem in the community, namely, diarrhoeal disease, and a learning package was designed for this purpose. The purpose of the learning package was to provide the participants with opportunities to engage in science learning where they could investigate, evaluate and take responsible action on real science-related social issues.

Data was collected through learner observation and teacher interviews. The findings from this study reveal that the approach used maximized pupils' participation, the learners were fully and actively engaged, they showed interest, and had fun while learning. And, that they expressed willingness to help others in the community with the new knowledge and skills gained at school. The teachers viewed the approach in a positive light. They stated that it allowed learners to gain skills to work in a group in order to achieve a common goal, and to conduct systematic investigations.

In another study conducted by Ajewole (1991), the effects of discovery and expository instructional methods, on the attitudes of students to biology, were investigated.

Discovery learning, in this instance, is not equated to project based learning, rather, the participative, hands-on and student inquiry aspects thereof are pertinent if such learning leads to new skills and knowledge. In this study six intact classes of 40 Grade 10 biology students, randomly drawn from six selected secondary schools in the Oyo state of Nigeria, were assigned to experimental and control groups. The experimental group was taught ecology concepts using the discovery methods, while the control group was taught the same content through expository methods. A non-randomised pretest-posttest control group design was employed using the 49-item Scientific attitude Questionnaire.

An analysis of the results show that the experimental group scored significantly more favourable attitudes towards biology than the control group. Further analysis showed that this was also true when the scores were compared with the high, average, and low ability groups. No big difference was noted between the attitude of male and female students exposed to the discovery and expository methods.

In another study entitled 'From themes to Projects', conducted by Chard (1999), the author presents the reflections of several teachers on their experiences moving from the use of a theme approach in their classrooms to using the Project Approach. The participating teachers undertook a project on 'shoes' in kindergarten. The topic arose out of a discussion with children, most of whom were wearing new shoes on the first day of school at the beginning of the school year. According to Chard (1999), project work requires preliminary planning, and the preparation of the mind of the teacher for the possibilities that could arise from the children's study of the topic.

The author asserts that project work planning involves the "imaginative anticipation of the prior experience and the level of interest that might reasonably be expected from a given class of children" (p. 2), and not the objectives-driven kind of planning which is characteristic of direct instruction. The author also advises that the teacher can construct a topic web of ideas and information that may be used for investigative work by the learners. The topic web can then be used as a basis for discussion on the possibilities for field work, investigations, representations, and co-operative work with other learners.

Chard (1999) states that the kind of preparation mentioned above, allows the teacher to be mentally ready to use and engage the learner's experiences and interests, and, that he or she would then be more receptive to the different possibilities that may arise in the course of the project. The findings of this study reveal that:

- Teachers doing projects for the first time commented on the need for responsive and ongoing planing that involves frequent negotiations with the learners;
- The teacher has an important role as a model for the learners of dispositions that enhance learning;
- Learner's interests are important in energizing project work;
- Learners enjoy project work when they are allowed to make choices with guidance from their teacher, and where they make the choice, they try harder to make it work; and
- The children often show good recall and understanding in their presentations, and deliver explanations with considerable confidence.

Flowing out from the above review, is a clear indication that much still has to done in the area of project based learning in South Africa, when compared with what has been achieved internationally. Data gleaned from these studies suggest that project based learning fosters meaningful learning in co-operative settings through the sharing of experiences, as applied in real life and challenging situations. Key to this learning is learner autonomy, interest, intrinsic involvement, and mediated support from a teacher as model for the learners of dispositions that enhance learning.

2.4. Conclusion

Mediated learning experience (MLE) (Feuerstein, 2001) has as its construct 'interaction', while project based learning (PBL) engages learners in sustained, co-operative investigative work (Bransford and Stein, 1993) that is based on a driving question (Blumenfeld, *et al.*, 1991). Mediation involves participation. Without participation there can be no learning (O'Donoghue, 2001), and, participation is key to the process of negotiating meaning (Lave and Wenger, 1991) in collaborative social settings in which students learn. The collaborative aspect, which is also present in project based learning, provides the learner with the opportunity to work with others. An inextricable link thus exists between mediation and project work. It is through this type of link that we argue that project work, is mediation. This argument is explored further in Chapter 3 when we look at the methodology, and in Chapter 4 when we look at the results. The next chapter describes the methodology used to answer the research question and the three critical questions of this study.

Chapter Three

3. Research Methodology

3.1 Introduction

The methodology described below flows from the theoretical framework adopted for the study, namely Mediated Learning Experience (MLE) (Feuerstein, 2001). Mediated learning as advanced by Feuerstein (2001) is participatory in nature due to the notion of "interaction" which is its central construct. Such "interaction" involves participation by all the relevant role players within a mediated learning experience.

The research methodology for this study is grounded on the concept of dynamic interaction as espoused by the above theoretical framework. Through this study we intend to find out the ways in which learners negotiate their own learning through the dynamic and interactive processes of MLE and project based learning (PBL) (Bransford and Stein,1993). In this chapter I describe the methodology used to collect data for the research questions stated in chapter 1. The research purpose focus on the creation of opportunities that allow learners to negotiate their meaningful learning. The chapter will be divided into the following sections: participatory research, the recruitment of participants, participation process, development of curriculum, data constitution, how data was analyzed, and, a conclusion.

3.2 Participatory Research

This study is a participatory study using mainly qualitative methods that are complemented by some quantitative methods of data collection and analysis.
In participatory research the participants do not work in isolation but collaboratively on activities that are empowering (Elliott, 1991). In such activities individuals are shaped by organizational and structural forces, and there must be a free flow of information between participants, that is, extensive communication (Elliott, 1978). Other researchers refer to this type of research as a 'democratic activity' (Grundy, 1987 : 142) where the form of democracy is participatory, and incorporates, according to Morrison, (1998) democratic and consensual decision-making, equal rights of participation and discussion, shared responsibility and open accountability, and shared ownership of decisions and practices. In such research, researchers are part of the social world they are studying (Hammersley and Atkins, 1983). In participative research one can use a variety for data constitution, namely, questionnaires, diaries, interviews, case studies, field notes, audio and video recordings, rating scales, documents and records, or photography (Cohen, Manion and Morrison, 2000).

I used participative research, and my role as practicing educator, in order to explore and understand the social and human behaviour from the insider's perspective as it is lived by the participants (Arkava and Lane, 1983). I also committed all my intervals to being there for them, in case they needed further support or guidance, or to just sit and talk about their other interests or concerns.

In this way I could collect data through my sustained contact with the learners in a setting where they normally spend their time (Bogdan and Biklen, 1992).

I spent almost four months with the participants during normal school time and a few Saturdays interacting with them in sessions that they willingly participated, with parental consent (See Annexture 9). The role of teacher as researcher, and, participatory research methodologies, are discussed below. My role in the study, as intimated in the previous paragraph, is one of a "passionate participant" (Guba and Lincoln, 1994:115) involved with learners in my day-to-day classroom science teaching, learning, and assessment. My "prolonged engagement" and "persistent observation" (Guba and Lincoln, 1994:237) helped me build trust, deal with misinformation, and uncover learner's deep understandings about the topic. On the issue of objectivity, my prolonged engagement with the participants helped me practice, and become increasingly more aware of my own biases, so that these do not interfere with the outcome of the study.

The above role is to give support and facilitate learning through MLE and PBL as discussed in Chapter 2, and, for the researcher to be neutral in the process. In the context described above, the distinctions between observer and observed, subject and object, and , insider and outsider, are blurred. The researcher in this study is not 'detached' and 'objective' (Lincoln and Guba, 1985). The participative nature of the study also raises ethical questions: how do we deal with transparency and open access to the research findings?, and, will this ethical question enhance or limit the outcome of the study?

The participants and other education stakeholders will have access to the research findings, and the identities of the participants will be kept confidential, as discussed prior to participation in the study.

The use of participants' names in the study will be negotiated with them and would be restricted to their first names only as stated in the parental consent form (see Annexture 9). The main participants agreed, after discussions with each one, that their first names be used in the study. Additionally, the requirement for validity embraces broader research outcomes, namely:

- catalytic validity or generativity (that is, the extent to which the research facilitated transformation and commitments to on-going transformation) (Vithal, 2000). The aim of this study is to bring about change, and hence lead to the participants' empowerment, so that they can help other members of their community.
- participative validity (that is, the context to which the research design and conduct were participative and inclusive) (Lather, 2001).

In the spirit of participatory research, and, to foster participation by the learners, the learning activities in the probe or workbook (Annexture 13) were designed and based on the learner's interests, and, what they wanted to know. Against this backdrop of particpatory research, I present a brief outline of the participatory nature of the research process, the qualitative and quantitative aspects of the study, and how the theoretical framework links to a participative research approach.

Although the bulk of the rich data that was yielded from the study was qualitative, a limited section of the data was reduced into a quantitative form. The quantitative data was used to enrich and add value to the qualitative nature of the study, in the area of assessment. Assessment is an integral aspect of the study as discussed in the previous chapters. The complementary theoretical framework underpinning this research is mediated learning experience (MLE), whose construct is interaction. Interaction requires participation, in this case, through project based learning.

This study focuses on the interaction between the following role player: learners, educators, peers, adults, and, other as discussed in Chapter 2 (section 2.2.2). A short profile of the participating learners, and the community, including that of myself as educator, are discussed in Chapter 1 (Sections 1.6.1 to 1.6.3). This gives a short background on the context of the study. Infrastructure and low-cost housing development has just recently being introduced in our local community characterized by sub-economic and informal housing settlements. A large section of the community have not had electricity or tap water in or outside their dwellings before, and are going to have this very soon because of the new developments taking place in the area.

3.3. Engaging Participants

It is against the foregoing backdrop, that participants chose the topic (namely, electricity in our homes and school) as a project in order to empower themselves, and the local community, on the topic.

My closeness to the learners, and the trusting relations built over time, made it possible for the research process to be participatory. This process is outlined in the paragraphs that follow.

First, a macro-planning meeting was recently held at the school to which we invited the local Ward Councillor, together with other community leaders. Among these community leaders, were representatives from the local churches, the clinic, a doctor, businessmen, police, welfare, the local library, and, educator representatives, who teach Grades 8 and 9, from the six local schools. At this meeting, local community issues and problems were solicited from the people present. This meeting yielded a comprehensive list of real-life societal problems (see Annexture 1). This type of planning is part of the recommended steps that schools should follow in order to make the new curriculum relevant to the local community (DOE, 1997). Additionally, my role as chairperson of the local community development forum, in which the role of the Ward Councillor is key, I was fully aware of the pressing local community needs, which included houses, proper roads, tap water and electricity. Most of these basic needs are being met by the local council. Currently a new and major access road is being constructed and runs through the community, low-cost housing is being built for those members of the community who lived in informal houses, water standpipes and electricity are now accessible to families who did not have these before.

Second, the Ward Councillor intimated that there was a problem with electricity, as many residents were tampering with the electric cables, some were not aware of the dangers, origins, or proper use of electricity. As educator, I placed the challenges highlighted by the Councillor before the Grade 8 learners whom I teach. The learners took up the challenge, as they identified with the problems raised by the Councillor. I later informed the Councillor that the participants were ready to share their artifacts based on the problem points which he highlighted, with the interested and affected residents.

Third, although all the Grade 8 learners at the school were taught the learning unit on 'electricity in our homes and school', fourteen learners were recruited to participate in the study, while they were part of the normal classroom learning arrangements. Those learners participating in the study sat in the same group as further outlined below. The participants engaged in extended activities as indicated below (See 3.4), while the non-participants only worked on the science probe and the summative assessment task.
Fourth, and lastly, as part of the planning process, I developed a "lesson plan" (RNCS Overview, 2002), previously known as a learning programme. The use of the term learning programme in the study refers to the new term, that is, lesson plan. A lesson plan:

> "describes concretely and in detail teaching, learning and assessment activities that are to be implemented in any given period of time. It could range ...from a single activity to a term's teaching, learning and assessment ...it includes HOW (i.e., teaching style, approach and methodology) teaching, learning and assessment activities are to be managed in the classroom" (RNCS, 2003 : 2-3).

I developed the lesson plan (see Annexture 15) as described above in fulfilling one of the roles of an educator as interpreter and designer of learning programmes and materials (DOE, 1999). This role is described earlier in Chapter 1 (see 1.2). The curriculum for the General Education and Training Certificate (Grades R-9) is intended to be a participatory curriculum that is relevant and addresses local issues (DOE, 1999).

We summarize the participation process discussed above in graphic form (Figure 6 below), to show how, in this study, school curriculum planning is linked to, and incorporates, societal issues through PBL and MLE.

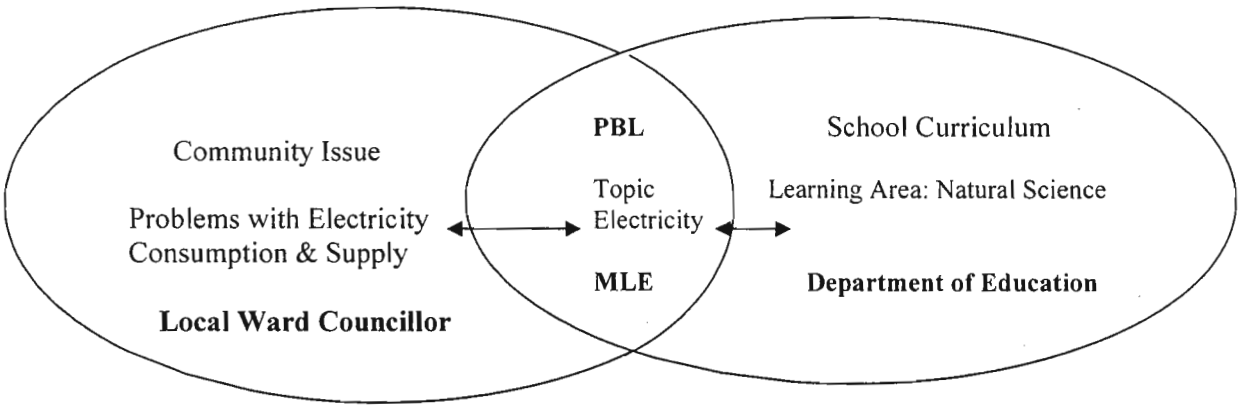


Figure. 2. Diagram showing the confluence between school learning and real-life problems.

The intersection in Figure 2 represents an authentic context for science learning, through which the local community can see that the proclaimed opportunities of science education is meant for them as well (Word Bank, 2001; Roseberry-McKibbon, 2001).

Flowing out of the lesson plan, and the role of an educator as described earlier in Chapter 1 (see 1.2), is the compilation of a science probe or 'workbook' (see Annexture 13) and a summative assessment task (see Annexture 12). The probe is a compilation of questions, investigations, assessment tasks, graphic text, assessment rubrics, guided activities, information sheets, graph paper, picture puzzles, tests, and blank sheets for report writing. The above topic related support material is stapled together in a 'workbook' form, with page numbers for easy referencing during educator and/or learner mediated learning. The science probe is used to gain entry to the negotiated space where project based learning takes place. In such a space curriculum becomes a process where learning and understanding come through dialogue and reflection.

The Department of Education (1999) quoting Doll (1993) assert that:

> ...learning and understanding are made (not transmitted) as we dialogue with others and reflect on what we have said - as we negotiate passages, between ourselves and others, between ourselves and our texts ...curriculum's role is to help us negotiate these passages (DOE, 1999:81).

Learner and/or educator mediated PBL is a dynamic learning process. This learning process, according to Es'kia Mpahlele quoted in the local press, "should not be perceived as a straight, horizontal line. Rather, we should think of it as a number of moments revolving in endless cycles, with not a single moment ever being the same twice. Hence, the exhilarating adventure that education is" (Daily News January 31, 2005:10). The endless cyclic nature of the learning process, which is consistent with the principle of lifelong learning, is best captured in the diagram below:

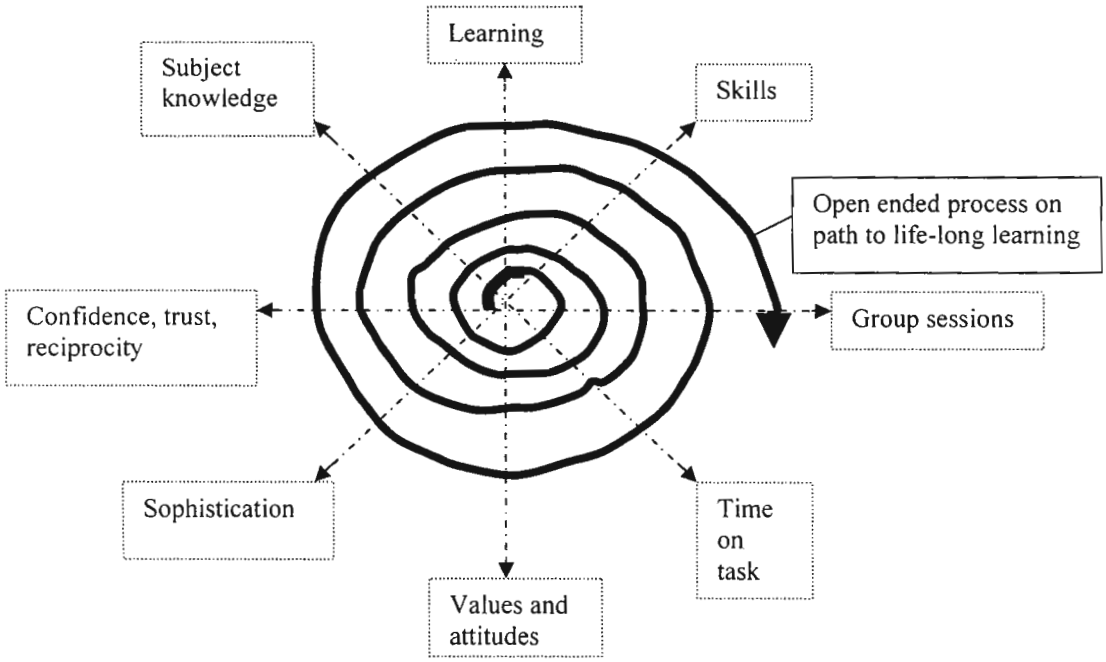


Figure 3. A process model (or spiral model) that provides learners with an opportunity to engage in sustained mediated project based learning. Adapted from Learning for Sustainability, DOE (1999).

The above model is elucidated as follows:

- The spiral moves outward in ever widening cycles representing progress over time
- It's circular nature means that it is recursive, i.e., it returns to the same point on its radius again and again. This allows and represents the opportunities for cycles of (action), learning and reflection that the spiral model provides. The model allows for the building of increasing degrees of sophistication and complexity in the uncovering of subject content.
- The spiral has no clear starting point, and it has no defined end point. This signifies the life-long learning and CASS espoused by the new outcomes based system of education. (Adapted from DOE, 1999)

Project based learning is engaging in sustained action in authentic performance tasks by the learner. For this reason voluntary recruitment of participants, who would engage in action-packed and challenging learning to address a local community issue, was done.

3.4. How Participants were recruited for meaningful engagement

The participants in the study are fourteen Grade 8 learners at Newlands East Secondary School, including their teacher as the researcher. A brief background was supplied on the participants in Chapter 1. The recruitment of the participants occurred at two levels as described in the table that follows below.

How participants were recruited (Level 1 - in school, and Level 2 – out of school):

Participants at **Level 1**, that is, at the level of the school	Participants at **Level 2**, that is, at the level of the community
Participation Criteria The learners in Grade 8A and Grade 8B were informed about the study at the beginning of the third school term where the new learning unit and topic was introduced. The learners were briefed on the nature of the study, that a sample of 14 learners (7 from Grade 8A and 7 from Grade 8B) would participate voluntarily, and, that parental permission is necessary for all participants in the study. Further, the participating learners would be required to participate during ordinary classroom lessons and activities, and, from time to time, would be requested to attend sessions during intervals and/or Saturday mornings. This latter requirement and condition reduced the learner numbers as all the learners indicated at the beginning that they wished to be included in the study.	Performance Assessment A performance task (accompanied by a performance assessment rubric), that is, a presentation of the learners' portfolio, was included to provide a platform for the participants to demonstrate their skills, knowledge and attributes gained through participating in the study. The participants were informed about a platform created by a Non-Government Organization called Project Citizen, which encourages school teams to showcase their knowledge and skills on issues that impact on their local communities.

The learners in the above two Grade 8 Classes were each given a consent form to be completed by the parents, in which a reply slip is attached, and this parental consent had to be returned to the teacher the next day.

Participation

The parental consent reply slips were returned the next day indicating approval or disapproval. In the Grade 8A class, the first 7 learners whose parents gave consent for their child or ward to participate in the study, were accepted as participants in the study.

For the purposes of the study, the research participants were seated in the same group.
In the Grade 8B class many learners arrived at school the next day with positive responses form their parents. The remaining 7 research participants came on board on a first come first served basis, as long as they met the criteria. In summarizing, 14 research participants were recruited to participate in the study.

Participation in the Clinical Interview.

Selection criteria

The recruitment of participants for the clinical interview was based on their sustained and regular attendance during the different stages of the study. Four learners who were self motivated and inspired to work on their own, even during intervals and after school hours were requested to share their insights and experiences.

Participation

Participants were all encouraged to participate, and to indicate their willingness to participate at this level. Letters seeking parental consent were issued to each one of the participants, and the parental consent was obtained from half of the participants.

Participation Criteria

Participation in the showcase made provision for only 5 learners per school. The participants, at a meeting with the teacher, agreed that the participation at this level be based on the amount of work put in during the compilation of the Portfolio boards.

Of the learners who returned their parental consent forms, those learners who had spent more time on the compilation of the presentation boards were given first preference to participate at this level.

The Showcase

As discussed above, an NGO has recently been launched in Kwa-Zulu Natal by the name of Project Citizen South Africa (PC-SA). PC-SA was launched with foreign donor funding in 2002, when, through an advertisement in the local Newspaper, 35 educators responded and were trained to implement Project Citizen in South Africa. I was one of the trainees that graduated and was enthusiastic about the hands-on approach that was used for learning.

Project Citizen also embodied all the principles of Outcomes Based Education, and I immediately sought ways of enhancing my learner's potential for learning by increasing the context for variation.

	PC-SA leaves school to choose their own community issue which has an impact on the local community. The learners, through small teams or class groups, research the local issue, and then prepare a presentation for the annual showcase which is held at a suitable venue. This year the showcase was held at Fern Hill Conference Centre at Howick on October 8, 2004. Twenty seven schools participated, each resenting a different social issue. The above showcase presentation also served as practice in preparation of the participants, if they were to be called upon by the local Ward Councillor to present the topic to a group of local residents who wish to know more about the topic. There was an indication by the community leader that this would be arranged soon, and that he would extend an invitation to the school and the team of learners.

Participants at the merging of Level 1 & Level 2

Ward Councillor and Local Residents

After introducing the topic on electricity to the learners, I briefed them on the imperatives of the new education system. Input from the parents and local community are to be solicited and incorporated for curriculum planning at macro-planning level (Department of Education, 1998).

My own vantage point and role as Chairperson of the local Community Development Forum , and close working relationship with the Ward Councillor, have made it possible for me to network with relevant community stakeholders. Local community leaders, including the Ward Councillor, have previously been officially invited to, and participated in, a school macro-planning meeting (See Annexture 1 for the results of the meeting).

(Merging of Level 1 & Level 2 continued)

Against the above backdrop of previous engagement with the school and myself as Educator at the school, the local community Ward Councillor enlisted the help of learners at the school to assist him in dealing with problems related to the use and supply of electricity to the local residents. Large-scale capital projects in the form of low-cost housing is being developed, and the concerns of the Councillor and community are:

Problem number 1: The majority of the new home owners are not familiar with the use, and dangers related to electricity in their own homes or streets.

Problem number 2: There are residents who are engaging in illegal electrical connections or theft of electricity.

Problem number 3: There are people who have been using other sources of energy for their heating requirements, and fear for the unknown - where electricity is concerned. They would like to learn about the safe and efficient utilization of electricity.

Response to the Councillor's call

The learners acknowledged the concerns of the community leader, that they are aware of the problem that exist in their community, and that the problem must be addressed.

Intervention at Level 1	Intervention at Level 2
Flowing out of the above, I developed, (1).a Lesson Plan (Annexture 15 for the topic electricity highlighting the skills, knowledge and attitudes to be developed through learning activities, and, (2).a probe (Annecture 13) with learning support materials (LSM) in order "to extend the learner's access to new areas of experience, knowledge and understanding that is based on their current strengths and learning needs" (RNCS Draft Facilitator's Guide, 2003, p.262).	Performance assessment. A group of learners participated in a showcase where they publicly presented information mounted on portfolio boards (1m X 1.5m). The boards displayed information related to the concerns of the local Councillor and was in the form of pictures, flow charts, graphical representations, processes and paragraphs on propositions and action plans.
The probe on electricity is characterized by the following: 1. RPL to check what learners already know. 2. What the learners would like to know regarding electricity. 3. Probe with sequence of activities which related to what learners wanted to know (incorporating formative and summative assessment tasks). Assessment on what learners took out form the sequence of activities. 4. Performance assessment. (See Level 2)	The caption on each portfolio board captured the concerns of the Councillor, namely, 1.Where does electricity come from? 2. How is it produced? 3.How does it reach our homes? 4. How is it used in homes? 5. How can we be safe with electricity? After the public address by the 5 learners, each had to defend some of the findings and propositions presented before a panel of judges. Some of the questions asked by one of the panelists read: 'What made you choose the topic of electricity?', and 'What are your data sources?' Each participating school was given a plaque, and each learner received a certificate of participation.

Table 1. How participants were recruited

3.5. Data Constitution

The following instruments are the data sources for the study, namely, questionnaires (Annextures 8 & 11), probe (Annexture 13) for formative assessment, video recorded instruction sessions with transcripts (see Annexture 2), assessment (summative and observation of learner's performance), semi-structured focus group interview (14 learners, Annexture 3), clinical interview (5 learners, Annexture 4), and learner's reflective diaries (Annexture 5). Entries were done on at appropriate stages of the study, that is, observations during activities (probes, video recordings), at the end of a learning activity or learning units (interviews, performances, diary entries).

Against this backdrop of the multiple sources for data collection, we expand on how each data source answers the critical questions through the use of a tabulated format (see page 88 below) comprised of four phases. The table (page 88) is comprised of two columns. The first column titled data source contains the instruments used to constitute data. Noticeable in this column are the different phases which indicate the separate and unique sequences of activities the learners were engaged in. The phases referred to here are similar to Wolcott's (1992) idea of stages when he asserts that "...naturalistic researchers should address the stages of watching, asking and reviewing, or, as he puts it, experiencing, inquiring and examining"(p.19). Similarly, in this study we formulate a detailed set of phases which reflect flexible time frames that allow for the sustained nature of project based learning, while at the same time working and honouring negotiated joint responsibilities and accountabilities for completion of set project tasks.

The second column provides commentary and information that addresses the research question(s).

The data constitution instruments used in phase 1 and 4 are the questionnaire and interviews respectively. In qualitative research the quality of interviews rely on the nature of the interactions with participants. In this study I used the "semi- structured interview" (Hitchcock and Hughes, 1989, p. 83). This type of interview has the following characteristics:

> (It) allows depth to be achieved by providing the opportunity on the part of the interviewer to probe and expand the interviewee's responses ... Some kind of balance between the interviewer and the interviewee can develop which can provide room for negotiation, discussion, and expansion of the interviewee's responses.
>
> (Hitchcock and Hughes, 1989, p. 83)

The semi-structured group interview was conducted with a "focus group" made up of 14 learners. According to Alant (1999: 72) the term "focus group" was coined by Merton *et al.*, (1956) to apply to a situation in which the interviewer asks a group of learners very specific questions about a topic they learnt. In this instance the focus group interview was based on the prior analysis of three sources, namely, learner's responses to the questionnaire, the probe as well as the reflective diaries in which the learners reflected on their learning during instruction. Interviews were conducted in an environment that was conducive to effective interviews (Burgess, 1988). The participants assisted in the location of a suitable venue that was free from disturbances such as loud noise and frequent movement in and out of the classroom. The seating and other climatic conditions were conducive to the interview process.

To gain insight into the way learners negotiate their own meaningful learning, and to interpret the situation form the viewpoint of the participant(s), my rapport with the participants ensured that I listen, and clarify statements made or questions posed. Semi-structured interviews place the interviewer in control of the process of obtaining information from the interviewee's, while at the same time allowing him/her to follow new leads as they arise (Bernard, 1988). The semi-structured interview made use of process questions posed as follow-up on the topic learnt after classroom activities, by directly asking learners for specific research related information (Kvale, 1996). "The framing of questions for the semi-structured interview will also need to consider prompts and probes" (Morrison, 1993:66). The participants were first interviewed in a group and then individually. A focus group is a "carefully planned discussion designed to obtain perceptions in a defined area of interest in a permissive, non-threatening environment" (Kreuger, 1988, p. 18).

The focus group of 5 learners was interviewed after considerable amount of work was completed by the learners, in order to obtain evidence of what the learners gained from their learning, and obtain their perceptions on the topic learnt. The 5 learners are those who participated in all aspects of the different phases of the study. The interview schedule contained five questions, and each member was given a copy of the questions, and notes were taken on the learner's responses. Some learners noted their responses on their sheets to guide their responses as they had to take turns in answering each of the five questions. Individual or one-on-one interviews were conducted at another sitting with each of the above 5 participants.

The individual or clinical interview "is a 2-person conversation initiated by the interviewer for the specific purpose of obtaining research relevant information, and for focussing him on content specified by research objectives" (Cannell and Kahn, 1968:527). This kind of interview was done to allow for discussion and expansion of the learner's responses obtained in the group interviews, and to obtain depth that was not possible during the group interview session. The disadvantage of this type of semi-structured interview is prone to subjectivity and bias on the part of the interviewer (Cohen and Manion, 1994).

In keeping with the purpose of the study, namely, to explore the ways in which learners negotiate their own meaning, the study addresses the question of subjectivity through a comparative analysis of the learner's responses, as elicited prior to the instruction, with that obtained through their reflective diaries, including that which the learners took out of their learning as reflected in the portfolio boards. The interviews therefore also served as monitoring device through which the learner's interests and needs prior to the instruction could be compared or related to what they took out of the learning they engaged in.

As intimated earlier, we use the following table to show the multiple sources for data collection, the four phases of learner engagement, and how each of the sources relates to the research and critical questions. The table also has a comments column that provides additional detail on each data source mentioned.

Table showing the data sources:

Data Source	Comment
Phase 1: Learner's Ideas 1. Questionnaire	This data source comes in two parts, namely: • RPL. This is the recognition of prior learning in which we find out what the learners know. • Learner Interests. This consists of a set of questions through which we find out what the learners would like to know or learn on the topic. Both of the data sources are in answer to CQ 1 which seeks to explore 'How learners mediate their own learning of a science unit on electricity'. Learner's previous knowledge and experiences are a basis for further learning. Establishing what learner's interests and needs are helps Educators in the design of relevant and engaging interventions or learning experiences.
Phase 2 : Meaning making based on learner's interests and prior knowledge 2. Probe	This is comprised of a variety of teacher made learning contexts which serve as a vehicle to gain entry to learning that involves a dynamic interaction. The probes also provide a negotiated space that allows the learners to negotiate their own identity as they learn in Science. These learning contexts were video recorded.

	Transcripts were made of these video recordings (see Annexture 2). The probes help us to explore the kinds of learning that comes to the fore in the various contexts . These different data sources are in answer to CQ1 (as cited above), and CQ2 which seeks to explore 'How learners approach their learning of electricity as drawn from their own lived experiences'. Aspects of the probes that answer CQ1 include - interaction with peers, the teacher and other available learning resources both physical and human. Aspects of the probes which answer CQ2 include - learners drawing on own or other's experiences, sharing of information , collaboration with peers, teachers or adults.
Phase 3 : Application of learning (production and presentation of artifacts), and what learners took from their learning 3. Assessment 3.1. Interventions in school 3.1.1. Formative Assessment 3.1.2. Summative Assessment	In OBE assessment is part of the learning process. It helps learners to gauge the value of their learning, and gives them information on their progress. It enables them to take control and make decisions about their learning. 3.1. With regard to the interventions in school, formative assessment is ongoing occurring during learning and teaching processes. It provides immediate feedback on learner's progress so as to improve learning.

	Summative assessment gives an overall picture of the learner's progress in a topic or grade, at a given time.
3.2. Intervention out of school 3.2.1. Performance Assessment (that is, of learner 's showcase presentations)	3.2. With regard to interventions out of school, the learners each do a presentation before an audience, of the portfolio boards prepared on electricity. This is a learning space which gives the learners an opportunity to apply the skills and knowledge they have gained, in unfamiliar contexts outside the classroom. These data sources answers CQ1, CQ2 and CQ3. CQ3 seeks to explore 'What Grade 8 learner's understanding of meaningful learning is'. Aspects of the assessment which answer CQ1 are - interactions initiated by the learners through the questions they ask, the use of available resources, and the interests that each learner pursued. Aspects of the assessment which answer CQ2 are - steps or actions taken by the participants in order to construct own meanings. Aspects of the assessment which answer CQ3 include the things that learners take out of the learning activities: what they learnt, and what made meaning for them, and things that addressed their interests.

Phase 4 : Learner's Reflections 4.1. Semi-structured focus group interview	This is a one-to-group interview where the learners respond to questions based on the activities they were engaged in during classroom activities. This data source is in answer to CQ2 in this way - participants reflect on what they did or said during past learning activities. They also share experiences, and comment on successes or challenges.
4.2. Clinical interview	This is a focussed interview, where the teacher and learner interact one-on-one so that the teacher could solicit greater depth of information from the 5 learners participating in the interview. This data source is in answer to CQ1 in the way that the participants made sense of the activities and what they took out of the activities. This data source is also in answer to CQ 2 in the way they interacted with their peers, resources and the learning environment.
4.3. Reflective Diaries	This is a reflection journal where learners reflect on their learning. This occurs at the end of an activity, and allows learners to think and express to others, what they gained or did not gain from the lesson.

	This data source is in answer to CQ3 in the following ways - participants express what they learnt, what they thought, what they will now do, and what they will do if they were given an opportunity to do it again.

Table 2. Data Sources

3.6. How data was analyzed

The study made use of multiple sources of data as indicated in the above table. In order to addresses the research question, I focussed on the appropriate data. Researchers Miles and Huberman (1984) intimate that data display is an important element of data reduction and selection.

Of particular interest in the data analysis is the idea of 'progressive focussing' in which Cohen *et at.*, (2000) quoting Parlett and Hamilton (1976) assert that progressive focussing:

> ... starts with the researcher taking a wide angle lens to gather data, and then, by sifting, sorting, reviewing and reflecting on them the salient features of the situation emerge. These are then used as the agenda for subsequent focussing. (Cohen *et at.*, 2000:148)

To analyze and report learners views as obtained from what I considered to be the main sources of data that address the research question, I used seven questions (see Annexture 6) that summarized the experiences of the 5 participants involved throughout the study, that is, the 4 phases of the study.

The seven questions, listed below, are drawn from the relevant sources listed in the table above, namely, the semi-structured interview, the clinical interview and the reflection diaries, as they address the key aspects to the research question. Different contexts for learning were created for the participants in the study (see Annexture 2). The different contexts for mediated project based learning were discussed in an earlier chapter (Chapter 2). Data obtained through the use of the seven questions stated above (emanating form the interviews and reflective diaries in phase 4), would be matched with the data provided by the commentaries and other information learners provided on the portfolio boards during their performance assessments (in phase 3). The information obtained in this way, constitutes data for analysis.

The performance assessment task that took place outside the school made provision for five learners only, hence it was imperative that the analysis focus on five participants only. The five participants' responses were obtained from the different and relevant data sources, namely, the interview sheets, and the learner's reflection diaries. The participants were asked to keep diaries in which they recorded their reflections after the lesson activities. This however proved to be problematic as the learners were not used to keeping diaries or reflecting on their learning. I provided them with guiding questions to assist each learner with his/her own reflections. The questions given as part of the learner's reflections in order to identify what they gained from their learning, included the following:

What I did today?, What I learnt?, What I thought about it?, What I thought before this?, and, How I will act in the future?

The questions for the semi-structured focus group interview (see Annexture 3) were intended to identify broadly the factors that influenced the participant's learning. Questions given as part of the learner's clinical interview in order to identify factors that influence their learning, included the following:

> What have you gained from your learning?, What stood in your way of gaining more from your learning?, What would you do differently next time?, What do you regret not doing while you were learning?, What is your understanding of meaningful learning?, and, How useful, or not, was the learning environment for your learning?

Data was obtained through the seven questions reflected below, and this data is tabulated (see Annexture 6, section 4.4) for discussion in the next chapter. The tabulated responses of the participants in the present form are an interpretation of a social encounter, and represent structured narratives that describe the contents of the interviews and learner's reflections (Cohen et al., 2000).

The data constituted here, together with the data yielded by the performance assessment, namely, the Portfolio Boards discussed in Chapter 4, will be interwoven in a single analysis and interpretation of the data.

As stated earlier (see 3.5 p. 84) the participant's responses form the interviews will be compared or related to what they took out of the learning as reflected in the presentation of the portfolio boards or final products. This is done to match the responses given in interviews to observed behaviour (Becker and Greer, 1960). The seven questions used for the purpose of analysis are:

What is it that you wanted to learn?, Why?, What did you learn?, What factors contributed to your learning?, What factors do you think did not contribute to your learning?, What do you understand by meaningful learning?, and, What in your understanding could be the opposite of meaningful learning?

The above seven questions, together with the different contexts created for learners to engage in their own learning, led to them participating in the last moment, that is, a presentation at a showcase of the five portfolio boards. These portfolio boards are the artifacts depicting what the learners put into, and took out from, their learning of a science unit on electricity through project based learning and the mediated learning experience. The seven questions discussed above constitute the main units of data analysis. The creation us such units of analysis is done by ascribing codes to the data (Miles and Huberman, 1984), where the codes pull together and bring some order to the wealth of material constituted by the study. The codes in this case derive from the data responsively, are descriptive, and include the perspectives held by the participants, process, activity, and method codes (Bogdan and Biklen, 1992).

The above approach to data analysis is consistent with the technique referred to as content analysis of field notes or qualitative data (Hammersley, 1979). This technique, according to researchers Brenner *et al.* (1985), involves several steps which, among others, include:

- Categorize the data...creating labels and codes,
- Synthesize the data...looking for key concepts,
- Cull the data, being selective is important because it is impossible to report everything that happened, and

- Interpret the data, identifying its meaning and implication

(Brenner *et al.* (1985:144)

3.7. Conclusion

The previous two chapters (Chapter 2 and Chapter 3) set out the theoretical and methodological framework for this study, and lay out the foundation for the presentation of the results of the study. In finding out how learners mediate their own learning, we provide them with opportunities to work collaboratively on activities that are empowering (Elliott, 1991) and where there is extensive communication (Elliott, 1978). In this participatory approach we use a variety of research instruments for data constitution, namely, questionnaires, diaries, interviews, field notes, audio and video recordings, rating scales, documents and records, or photography (Cohen, Manion and Morrison, 2000). In this chapter we explore and celebrate the participatory research nature of this study, and to express the complexity of this process. The participatory nature of the study is at the level of the participant and the research instruments.

In Chapter four we analyze the main moment, namely the performance assessment task. The performance assessment task is in the form of a presentation of the findings by each member of the five person team, with each participant presenting one portfolio board each, before a real audience and a panel. What they know is both visually and orally defended when the panel asks them questions. The participants' voices come to the fore through these persuasive arguments.

The results are obtained form three other data sources, namely, the focus group interview, the clinical interview, and the learner's reflective diaries. The participant's responses to these data sources are tabulated according to 7 questions posed (see Annexture 6).

CHAPTER FOUR

4. Analysis of Data (Stage One)

4.1. Introduction

The presentation and the analysis of the results of this study is done in two stages. Stage one, which is the focus of this Chapter, explores how Grade 8 learners gain access to meaningful science learning through the production of portfolio boards (PB's). Stage two, which is the focus of Chapter 5, looks at the relation between the mediation of meaningful learning and the negotiation of identity within a learning context by these Grade 8 learners.

As stated earlier, the purpose of this study was to explore how a group of Grade 8 learners negotiate their identity in a science classroom in order to gain access to meaningful learning in science through project based learning. The unit has covered/ explored problems and concerns communities might experience around the issue of the electrification of the new Reconstruction and development Programme (RDP) houses. This study moves from the premise that learning is meaningful if learners can negotiate an identity of themselves within the learning context. It is argued that the meaningfulness of the context of learning strongly depends on this negotiation.

The argument advanced is based on the view that the learning context is failing the learners; that there is little space or opportunity for the learners to negotiate their identities within the context of science learning. The two foci of the study are the following:

> Firstly, to explore the ways in which learners negotiate own identity through project based learning, and, secondly, to explore the relation between mediation of meaningful learning and negotiation of identity, through project based learning.

4.2. Portfolio Boards - interpretation and discussion

Stage one will deal with the different phases that the learners went through for the project based learning approach. A description of each of the portfolio boards will be done, looking at what each learner has taken out of their learning, as well as looking at how the learners used the portfolio board (s) to negotiate their learning. This negotiation is discussed by focussing on what the learners did, namely:

- what are they interested in and they would like to know;
- the two-way interaction between the learners and the mediator;
- the creation of the portfolio boards;
- display and presentation of the portfolio boards and defend their arguments before a panel; and
- reflection.

The penultimate step in which participants display and present their portfolio boards to an authentic audience, provides them with an opportunity to make persuasive arguments.

In this way their voices come to the fore, and what they know is both visibly and orally defended when the panel asks them questions.

The following diagram indicates the four phases that the learners were engaged in during the project work. This chapter will be based mainly on the third and fourth phases, including certain aspects in phase two. It is through the aforementioned phases that the participants were provided the opportunity to participate in project based learning and MLE.

It is through active participation in learning in these four phases that participants were afforded the space to negotiate their own meaning through sustained engagement in co-operative investigative work (Bransford and Stein, 1993).

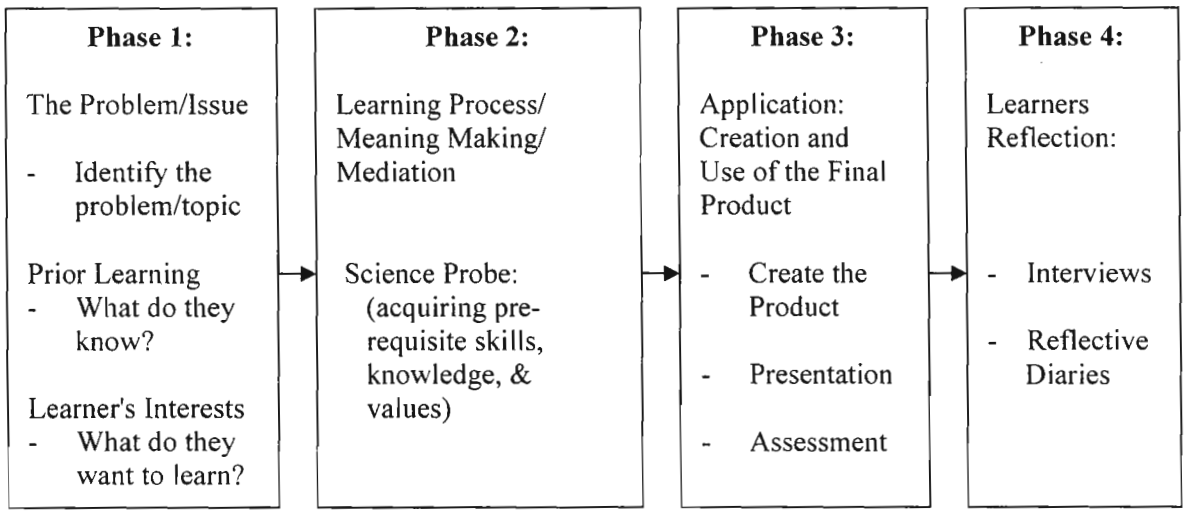


Figure 4. Diagram showing the four phases that the learners engaged in using project based learning.

As mentioned earlier in Chapter 2, the five panels of the portfolio boards each deal with a specific aspect of the problem identified, and, with each of the five learners being responsible for a panel. Figure 5 on the next page illustrates the way in which the portfolio boards are joined together to form a unit. Figure 6 (see page 104) provides a pictorial view of the actual portfolio boards as an inter-linked unit. The production process of the portfolio boards involved co-operative work, and, the presentation of the portfolio boards involved one learner, with each of the five person team taking turns to present one panel each. Learning as a dynamic and co-operative process occurred at every stage of learner engagement, including the final product. The final product was equally important, as it provided the compelling energy for the forthcoming or future presentation before an authentic audience. Malcolm (1992:23) asserts that "... a project focuses your attention on a specific challenge and concentrates your energy". The five person presentation team were then responsible for the presentation of the final product at the showcase, or at a future local public meeting with a group of local residents.

Kellough and Kellough (2003) concur by advising that a project can be broken down into parts with individuals or small groups undertaking independent study of these parts.
In this study the focus is co-operative and interdependent working relations. The learners were given a choice at selecting the portfolio board they would like to present, and the learners chose the board that each spent more time on during the production of the portfolio boards. Involving learners in making decisions gives them more control over the learning situation, as student direction and decision-making play a role in project work (The Multimedia Project, 1997-2001).

The analysis and interpretation of what the learners put onto the portfolio boards, as well as, what the learners took out of their learning, will be done by working with one panel at a time. Focusing on Phase 3, the presentation of the final product, we interpret each panel of the portfolio boards separately, and discuss the students' engagement and trajectory in the process of mediating their own learning. In the participant directed presentations, PB 1 stands for portfolio board one, and PB 2 for portfolio board two, and so on.

The five member team were constantly aware of the links between the separate portfolio boards, and shared the sub-problems of the core problem in the following way:

- Thandeka was responsible for PB 1: The problem, that is, what the problem is with regard to electricity in the local community.
- Nkosenhle was responsible for PB 2: Where does electricity come from?
- Lwazi was responsible for PB 3: How is electricity generated?
- Thapelo was responsible for PB 4: How does electricity get to our homes?
- Cameron was responsible for PB 5: How can we be safe with electricity in our home or school?

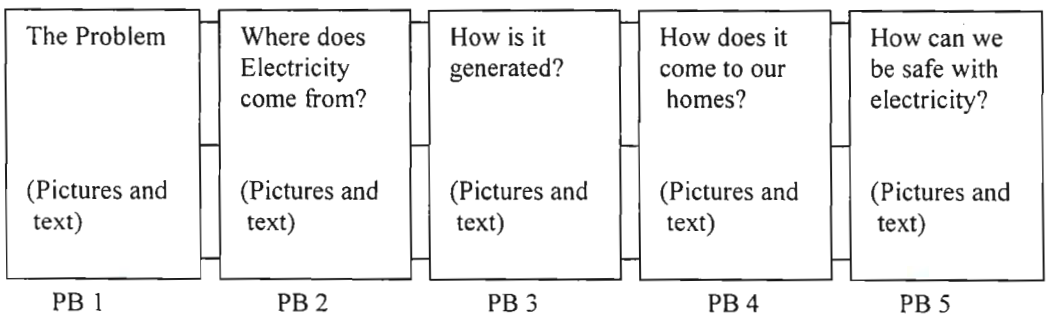


Figure 5. The five portfolio boards, from left to right, interlinked and as 'artifacts' of learners' engagement in PBL through MLE on the topic: Electricity in our homes or school.

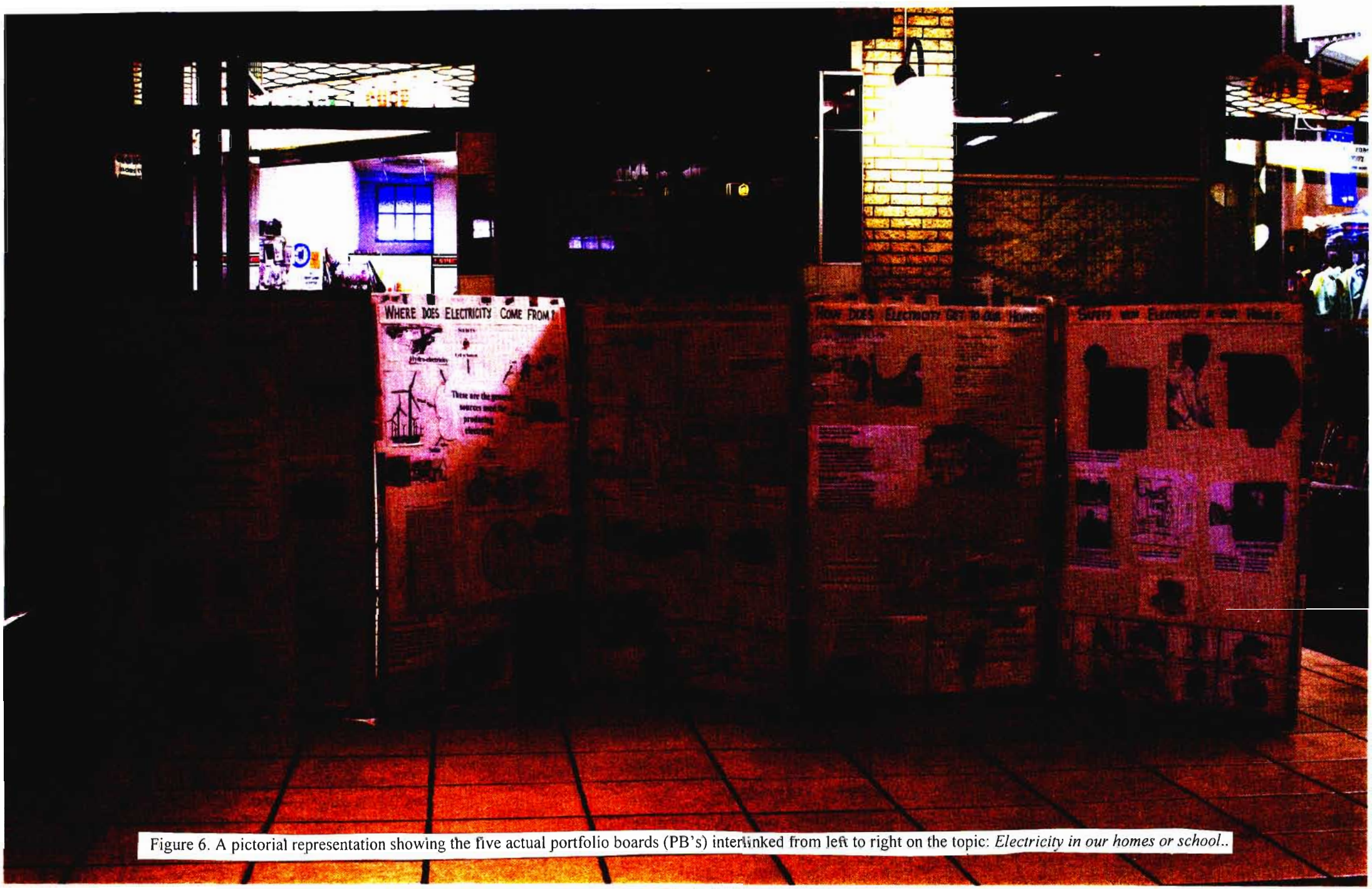


Figure 6. A pictorial representation showing the five actual portfolio boards (PB's) interlinked from left to right on the topic: *Electricity in our homes or school..*

We present the story of the final or culminating moment where 5 participants present their learning gained through co-operation and teamwork with other learners who participated in the study. The portfolio boards serve as tangible evidence to show other people what they know and can do (Tombari and Borich, 1999).

The story is told in my own words as a participant and researcher, and is accompanied by commentary in which we attempt to clarify the learning that emerged, as well as the role of the mediator in the process. We begin by looking at what each learner wanted to know and why, by listing their responses to the first two of the 7 questions (See Annexture 6, item 4.4). The remainder of the 7 questions and learner's responses are also discussed as and when appropriate.

4.2.1. Portfolio Board One (PB 1):

Thandeka wanted to know:

> *How does electricity work, and how is it produced, and how can we be safe with it?*

Her reason:

> *So that I can teach my family and others about what I learnt.*

We look at what Thandeka put into PB 1, and what learning she took out with respect to insights, attributes, and science is reflected in PB 1. Figure 7, on the next page, is a pictorial representation of the actual portfolio board (that is, PB1) constructed by Thandeka, in co-operation with the other members of the team.

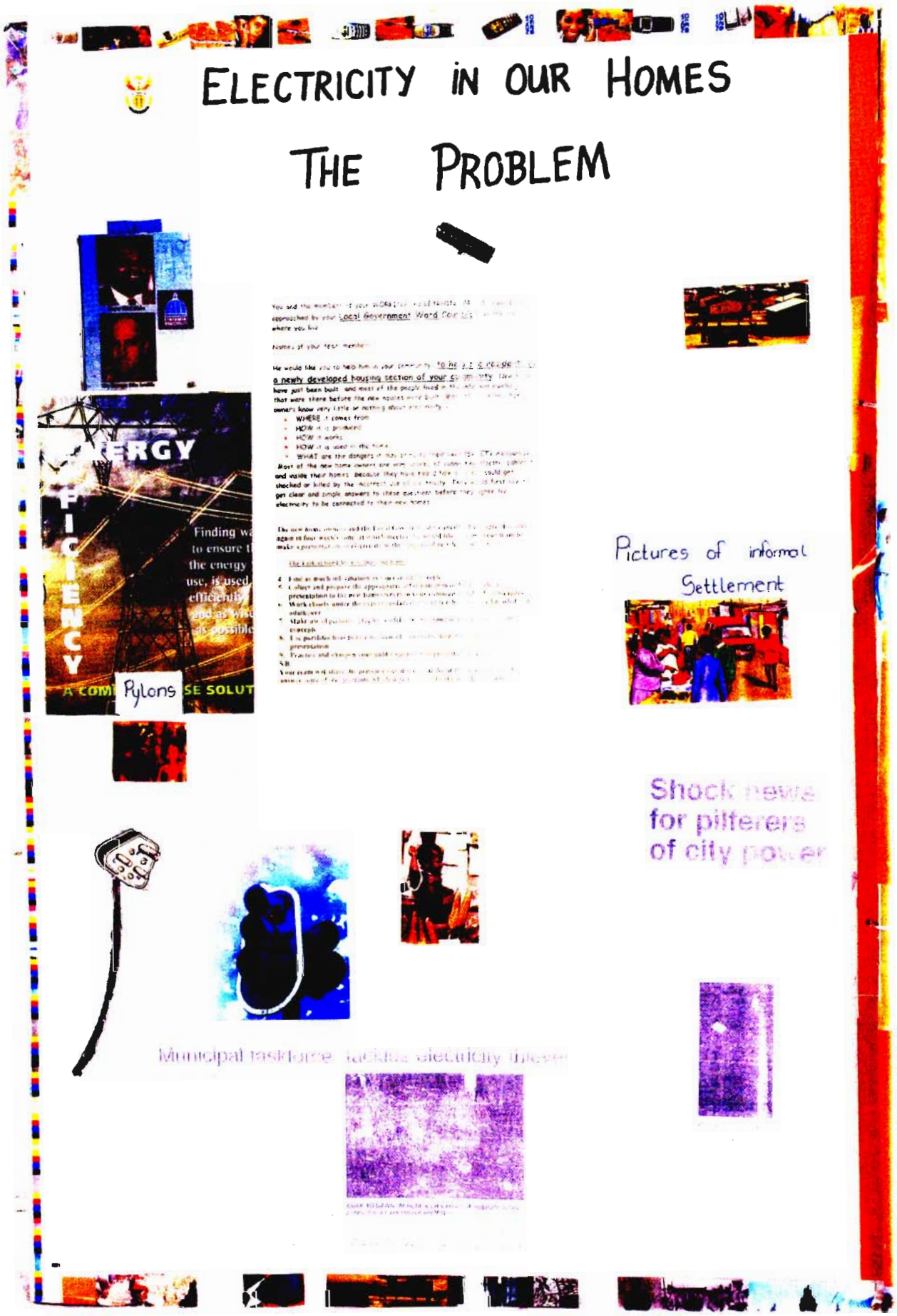


Figure 7. A pictorial representation showing the contents of the first portfolio board (PB1) as artifact of Thandeka's work.

The title of PB 1 reads: 'The Problem', and below this is the report containing the request from the local Councillor seeking the assistance of the learners regarding the problems related to electricity and the local residents in the community.

The problem, as discussed in Chapter 3, involved issues of consumption, issues of tampering with electricity supply, and cable theft. The report capturing the request by the Coucillor is contained in the probe (see Annexture 13, p. 247). The learner had this report enlarged and in placing it in the middle of the PB 1, made it the focal point of the project and presentation.

In focussing attention on the local problem, Thandeka placed pictures accompanied by captions and summaries, around the above report on the problem. Placed high on the PB are pictures of the City Mayor and the City Manager, with a picture of huge pylons nearby spanning electrical cables, which is a familiar sight and feature in the community. Through these sets of pictures the learner attempts to make a link between local government representatives, namely, the Ward Councillor, the City manager, and the political head of the City - the Mayor. The link, in this case, is in connection with the supply of electricity, as indicated by the picture of the pylons. What has been achieved by Thandeka in the above is consistent with a feature of PBL that emphasizes that school learning be connected to real life (The Multimedia Project, 1997-2001). The people appearing on the PB 1are real people who are well known locally.

Three pictures on PB 1 show people most affected by the problems experienced by the community. The first picture shows a child standing outside an informal settlement dwelling, with a caption that reads: *'This is a child that live in informal settlement and they don't have electricity'*. The second picture is of children standing outside an informal settlement house, with a caption that reads: *'These people don't have electricity and they want it'*. The third picture shows people with their newly built sub-economic houses, with a caption that reads: *'This is a picture of people and new houses and electricity'*. The learner weaves together a 'story' to show how a sector of the local community has only recently gained access to the existing infrastructure and electricity supply.

Thandeka has integrated learning activities with real world issues and practices (The Multimedia Project, 1997-2001). Researchers emphasizes the role of contextual issues in promoting meaningful learning. Contextual issues engages the emotions of the investigating parties, and an exploration of such issues is more than a technical investigation (Lotz and Robottom, 1998), and, by context we mean more than physical surroundings (Di Chiro, 1987).

The learner also has a picture of a traffic signal, and another of a 3-pin plug connected to a section of an electrical cord. Traffic signals have just been installed on the newly build road which has brought with it big improvements in the lives of the local community, improvements such as access to transport, water and electricity.

The lower end of PB 1 contains an enlarged newspaper cutting from a local newspaper dated July 23, 2004. The newspaper cutting captures most of the problems experienced by the local community. The title of the newspaper cutting reads: *'Shock news for pilferers of city power'*, and a second section of the report that reads: *'Municipal taskforce tackles electricity thieves'*. The contents of the above reports drive home the problems faced by the local residents, and the problems faced by the local council electricity department that is responsible for the supply of electricity.

The newspaper cutting is pertinent as it highlights the dangers associated with electricity, dangers that resulted in loss of life for some people due to a lack of understanding or ignorance on the part of some of the residents. Thandeka again integrates classroom learning activities with real-world issues and activities (The Multimedia Project, 1997-2001), and her learning is reflective of what is envisioned in the RNCS. The vision of the new education system is that of developing competent citizens who are better prepared to deal with the new challenges facing our modern society (RNCS, Overview, 2002).

Thandeka has taken great effort, through the pictures and newspaper cutting presented on PB 1, in drawing our attention to the fact that a problem exists in the local community. The problem is specific and is focussed on the supply and consumption of electricity. It highlights the problems experienced by the local community, and presents the different interested and affected role-players.

A key principle in PBL is the need for curriculum to be organized around some problem or critical question related to societal conditions and deemed important by the learners (Vithal, 2004). The principles of real-world connection, and problem orientation stood above the other principles demonstrated by Thandeka as reflected on PB 1.

The role of the teacher mediator for Thankeda was to provide support when this is requested by her, namely, photocopying and enlargement of certain text or information sheets, and the provision of guidance in the layout of information to achieve greater effect. For her the educator, as part of her learning environment served as a resource person and, as unobtrusive guide on the side (Blumenfeld, *et al.*, 1991)

Data obtained form the interviews (focus group and clinical interviews) and learner's reflection diaries reveal the following on what Thandeka has learnt:

> *How electricity is generated; safety with electricity ("my interest...is addressed"); learning skills and lots of knowledge and information; that electricity is invisible; the steps, of how electricity is produced; and how to connect a 3-pin plug and safety rules for connecting it.* (see Annexture 6, p.226)

On reflecting, she lists the factors that contributed to her learning as:

> *...the portfolio boards, learning visibly step-by-step how electricity is produced and sent to our homes; doing experiments, writing things, stuck pictures, talked and talked and talked, and my peers helped me understand.* (see Annexture 6)

The above response by Thanked is evidence of research findings that talk of learning that gives learners the opportunity to encounter the learning material and share their own experiences in a number of ways, for example, through reading, listening, viewing, and touching (Wolfe, 2001).

Meaningful learning to her means:

Understanding the work in such a way that you know what you are learning.

Thandeka's responses above confirm the assertion made by Doll (1993) that "learning and understanding are made as we dialogue with others and reflect what we have said as we negotiate passages, between ourselves and others, between ourselves and our texts" (p.81). How this co-operation and collaboration between learns occurred is discussed in Chapter 3 (see 3.3).

4.2.2. Portfolio Board Two (PB 2):

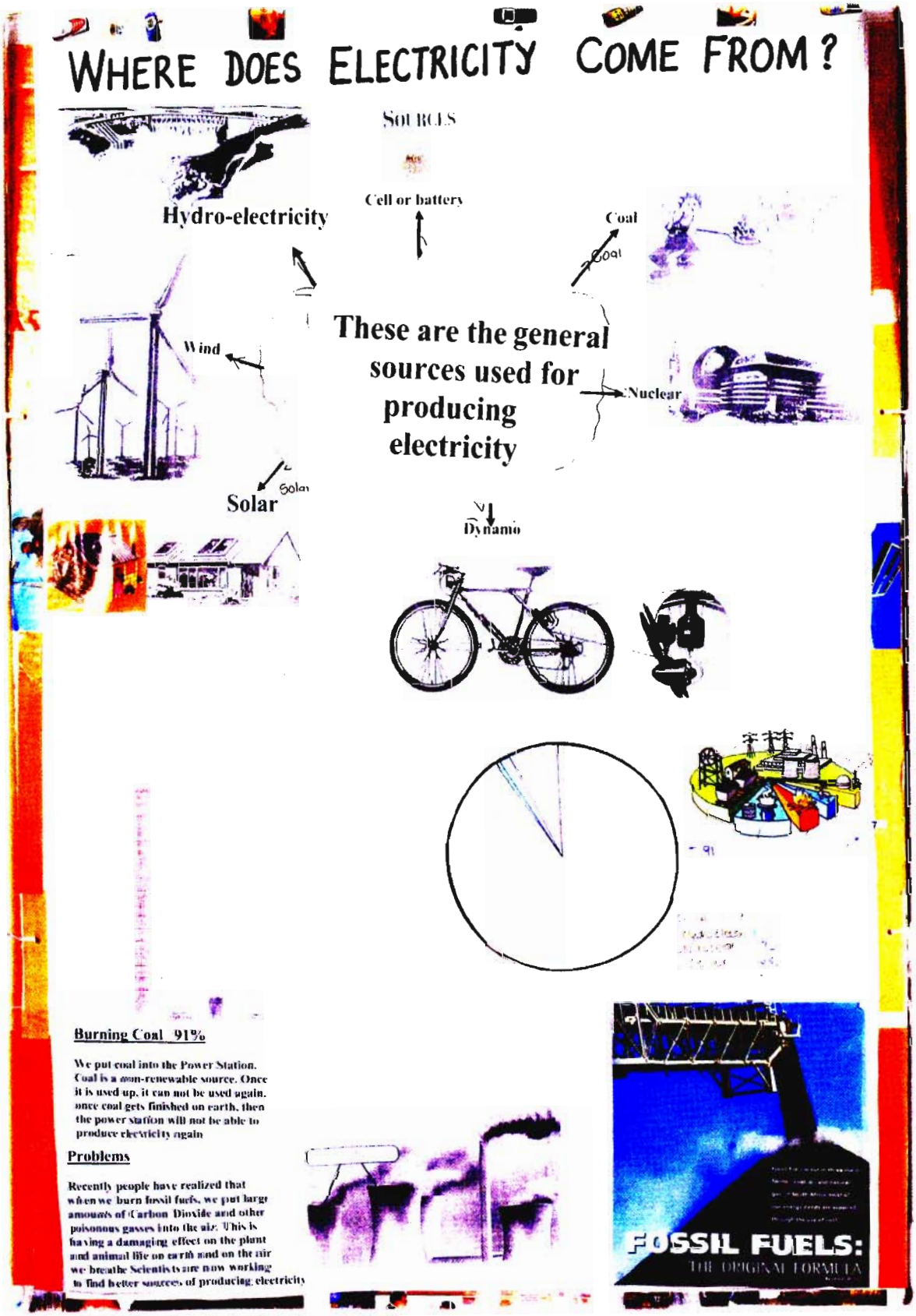
Nkosenhle wanted to know:

How does electricity go from house to house, and what dangers are there to our lives?.

His reason:

I want to know this so that I can try to help other people.

Nkosenhle worked on PB 2, and we look at what learning he took out with respect to insights, attributes, and the science that he reflected in PB 2. Figure 8, on the next page, is a pictorial representation of the actual portfolio board (that is PB 2) constructed by Nkosenhle in consultation with his peers.



igure 8. A pictorial representation showing the contents of the second portfolio board (PB2) as artifact of Nkosenhle's work.

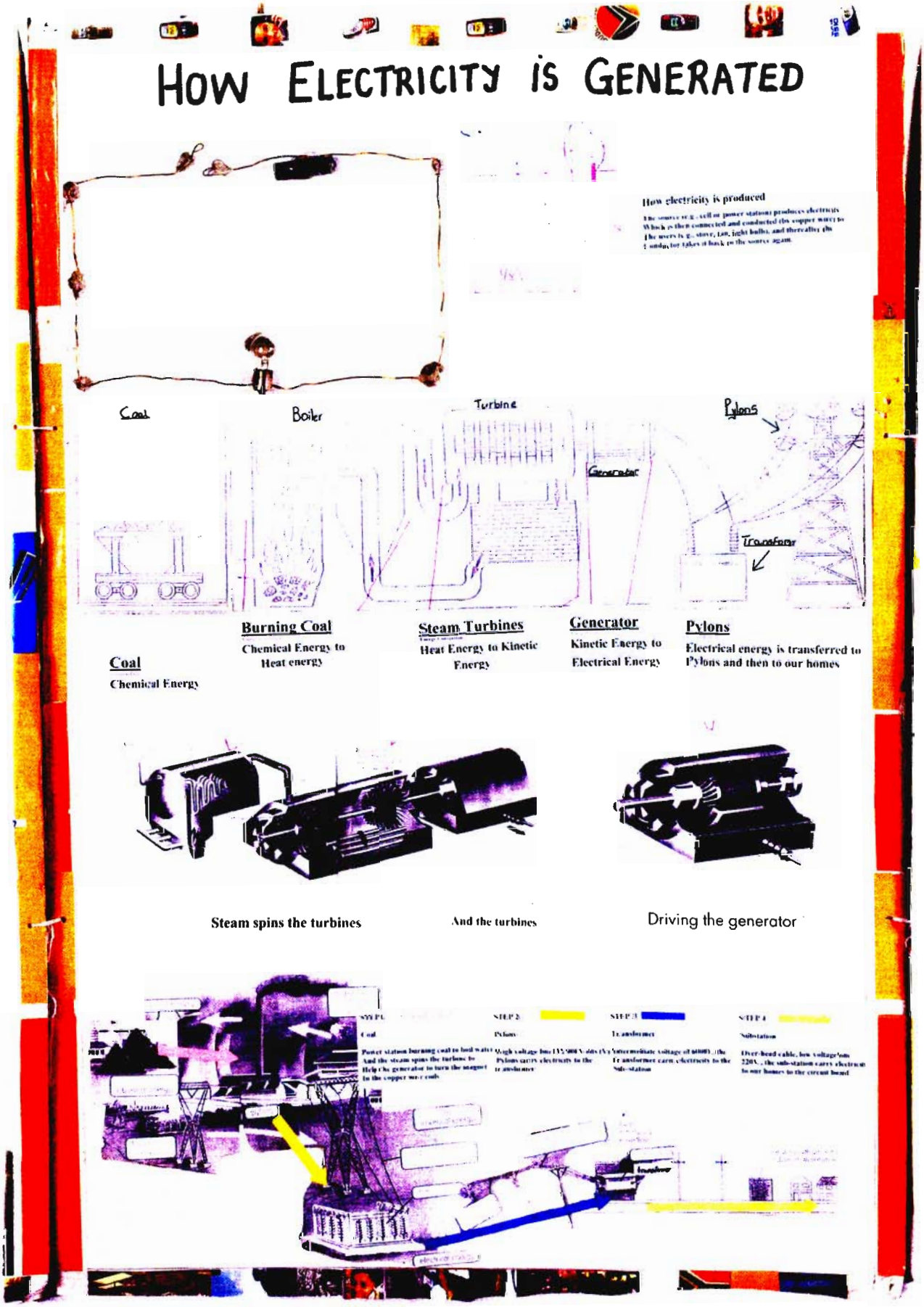


Figure 9. A pictorial representation showing the contents of the third portfolio board (PB3) as artifact of Lwazi's work.

The title of PB 3 reads: 'How is electricity generated?' Lwazi divided his data on PB 3 along four sequential steps or sections. In the first section of information, a diagram of a simple electric circuit is represented. The components stuck on PB 3 with prestick are copper wire, a light bulb, a torch cell, and an open switch indicated by a broken section of the copper wire that is lifted up (as shown in the sketch alongside: ( ).

The circuit diagram showing electricity (direct current) form a source (a torch cell) is likened to the production of electricity at a power station (alternating current). The caption for the circuit diagram above reads: *'How electricity is produced'*, and Lwazi explains the circuit diagram by stating in his own words:

> *The source (e.g. cell or power station) produces electricity. Which is then connected and conducted (by copper wire) to the users (e.g. stove, fan, bulb) and thereafter the conductor takes it back to the source. (Lwazi)*

In the above example, Lwazi uses the circuit diagram showing direct current, and likens this current to that of a power station, namely, alternating current. Additionally, in the above example, although our concern is the abstract idea of the flow of electric current through a conducting wire, we provide opportunities for the learner through project work and MLE to "explore its meaning through concrete instances" (Malcolm, 1992:82).

In the second section of PB 4, Lwazi gives an account of the process of generating electricity in a power station. The learners had to put together picture puzzle pieces, in a step-by-step sequential manner that shows the workings of a power station.

In this section of the board, the learner compiled the picture showing the process of generating electricity in a power station, indicating the power conversions at each step in his own words as follows:

> *Step 1: coal burns, chemical energy converted to heat energy*
> *Step 2: Water boils making stem, heat energy converted to kinetic energy*
> *Step 3: Steam turbines turn generating electricity, Kinetic energy converted to electric energy*
> *Step 4: electricity sent to pylons and to our homes.* (Lwazi)

The third section of PB 3 information consists of clear and appropriate pictures showing the internal moving components of the different sections of a power station, with captions that read: water boilers, steam turbine, generator coils.

The information on the lower section of the board traces the steps in the transportation of electricity from the power station to our homes. The steps are depicted as follows:

> *Step 1. Coal*
> *Power station burning coal to boil water. Steam spins the turbine to help generator to turn the magnet in the copper coils.*
> *Step 2. Pylons*
> *High voltage line, 132 000 Volts. Pylons carry electricity to the transformer.*
> *Step 3. Transformer*
> *Intermediate voltage of 6 000V. Transformer carry electricity to the sub-station.*
> *Step 4. Sub-station*
> *Over-head cables, low voltage line 220V. The sub-station carry electricity to our homes on the circuit board.* (Lwazi)

The above evidence and learner response to PBL reflect the need for content and learning material that "reside at the heart of the discipline", and "involve doing the subject", and, "require uncoverage of abstract or often misunderstood ideas" (Sparks-Langer *et al.*, 2004:101).

These authors also alert us to the shortcomings of PBL stating that some hands-on activities may not address central concepts. The learning outcomes by Lwazi , as evidenced above through PBL and MLE enabled him to achieve powerful, diverse and complex learning outcomes (Gardner, 1999).

Additionally, "(i)n pursuing real problems, students should use, as much as possible, authentic methodology: that is, they should address the problem as much as possible in the way a professional adult would address it" (Sparks-Langer *et al.*, 2004:41-43).

Data obtained form the interviews (focus group and clinical interviews) and learner's reflection diaries reveal the following on what Lwazi has learnt:

> *How electricity is generated in a power station ("this was my interest, it was satisfied"); the steps in the process of production of electricity; how to connect a plug and avoid sparks or shocking; knowledge to understand how and why I got shocked; knowledge to tell others and to open a business on electricity so I can be independent about something in my life; 3-pin plugs and electrical sockets; and about negative and positive charges.* (see Annexture 6, p.226).

Lwazi's view of the teacher mediator is one with whom he can negotiate with regarding the layout of the data, and to help him type his hand-written statements, captions and summaries. His reflections on the factors that contributed to learning:

> *Regulation of one's self is needed. The teacher and other learners helped me when I needed to know. They helped me to look and listen. Talking helped me. I did not like it when the teacher turned the (my) question around and asked me ...as I needed to know (and not be questioned further at that point).* (see Annexture 6)

The factors that did not contribute to his learning:

> *"Little time, Some learners are not sure if they wanted to know or not".*

His understanding of meaningful learning:

You can learn whatever you want to. Learning about something that has meaning.

The opposite of meaningful learning: *"...not understanding what you are doing".*

Lwazi's response to meaningful learning above concur with that reported by Boaler (1997), namely, that a students experience with PBL is associated with a reduction in anxiety towards the subject, and a greater willingness on the part of the student to approach subject challenges with an open mind and a positive attitude. His response also confirms the argument that when students are exploring ideas in ways that seem meaningful and important, they worked harder and felt proud of their efforts (Sparks-Langer *et al.*, 2004). Like Thandeka, Lwazi' stresses the importance of dialogue in personal mediation of learning. For him social interactions help him learn. This is consistent with Kellough and Kellough's (2003 : 283) assertion, namely, "learning that results from the experience and the communication of that experience with others".

The participants were collaboratively engaged throughout the study (Chapter 3, see 3.3), and the four phases that learners were actively involved in through PBL and MLE are discussed in Chapter 4 (see Figure 4).

4.2.4. Portfolio Board Four (PB 4):

Thapelo wanted to know:

How does electricity go from house to house, where does it come from?.

His reason:

> *I want to know how electricity is produced, what its source is, how it is distributed, and the dangers associated with electricity, so that I can warn people and friends who steal electricity so that they could make safe and proper connections to cables.* (see Annexture 6, p.226)

Thapelo's reason for wanting to know about the topic is an good example of service learning or activism as advanced by Sparks-Langer *et al.*, (2004).

This response also confirm the findings of a study conducted by Mhlongo and Sanders (2001) in which students expressed willingness to help others in the community with the new knowledge and skills gained at school.

We look at what Thapelo put into PB 4, and what learning he took out with respect to insights, attributes, and the science that is reflected in PB 4. Figure 10, on the next page, is a pictorial representation of the actual portfolio board (that is PB 4) constructed by Thapelo in consultation with his peers.

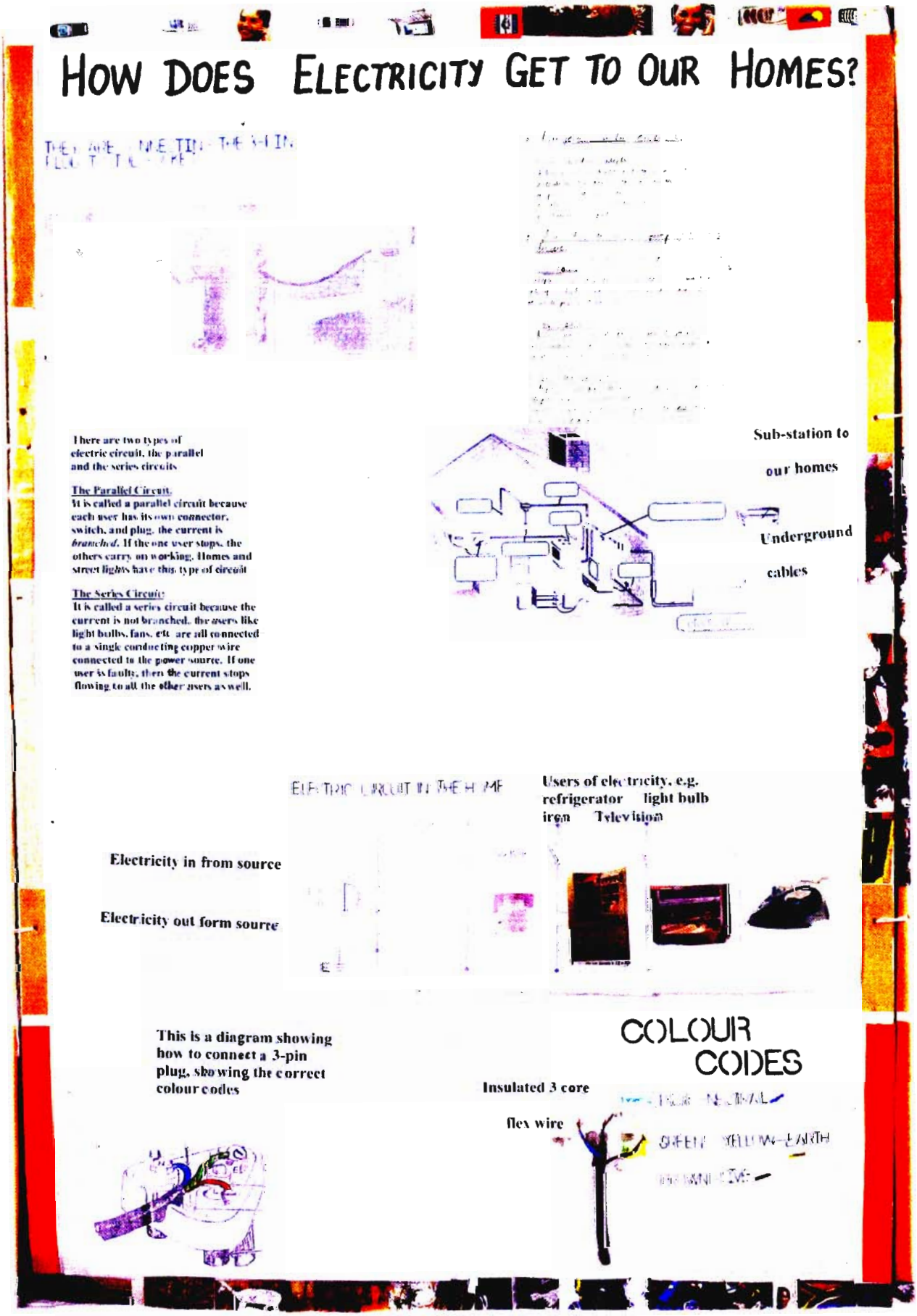
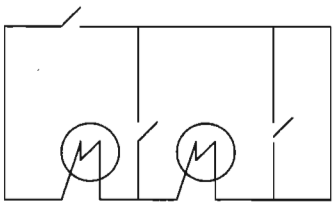


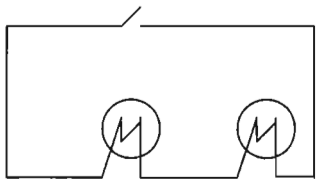
Figure 10. A pictorial representation showing the contents of the fourth portfolio board (PB4) as artifact of Thapelo's work.

The title of PB 4 reads: 'How does electricity come to our homes?' Thapelo's has arranged the data on the portfolio board along three focus areas. In the first one he has a picture of a house showing the different rooms and the electrical appliances, plug points, switches and light fittings, and, two diagrams showing parallel and series circuits with explanations for each:



Parallel circuit:

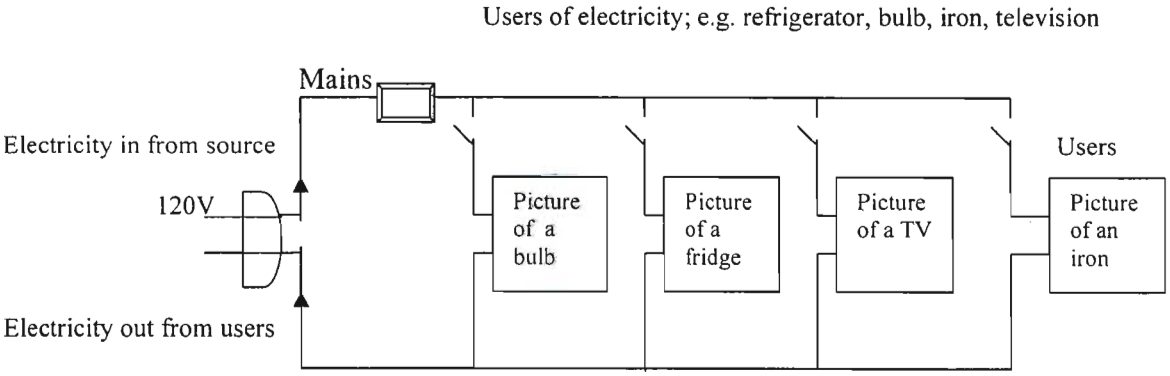
Each user has its own connector, switch and plug, that is, the current is branched. If the one user stops the others carry on working. Homes and streets have this type of circuit. The sketch to show this is drawn alongside.(Thapelo)



Series circuit:

The current is not branched, the users are connected to a single conducting copper wire connected to the power source. If one user is faulty then the current stops flowing to all the other users. (Thapelo)

Thapelo uses the second focus area to drew a diagram to show an 'Electric circuit in the Home'. The diagram is shown below.



The lower area of the PB is used to show:

(1) the diagram of an open 3-pin plug showing the colour coded wire connections and the plug pins. The caption reads: *'This is a diagram showing how to connect a 3-pin plug, showing the correct colour codes'* ; and

(2) next to the above, a section of three core flex wire, with the 3 individual colour coded wires showing, and the tips revealing a section of copper wire at their ends. The individual copper wires are labeled:

blue - Neutral, brown - Live, and yellow/green - Earth.(Thapelo)

The ideas expressed by Thapelo have a real-word connection. This knowledge that is linked to real life in the learner's home or school explains Perkins' (1992) idea of generative knowledge. Knowledge that is gained, and cannot be of use to the person who gained it to deal with the world, is worthless. Teaching, learning and assessment must be organized around meaningful use of content by the learner (Sparks-Langer *et al.*, 2004).

In addition to the above information, Thapelo attached his own handwritten summary on the top right hand corner of the PB which reads:

A. Dangers with electricity
1. overloading adapters
2. leaving un-insulated wires lying around
3. touching a socket with wet hands
4. playing with electricity
5. illegally connecting electricity
6. climbing the pylons

B. Action plan to avoid and prevent these dangers
<u>At home</u>: adapters shouldn't be overloaded in one socket, multiple adapters should be used, children must be taught not to play with electricity.
<u>At school</u>: all classes with bare wires should be reported to educators (number of classes = 5),bare wires should be insulated. The people/government should make sure that the school children know about the dangers about electricity.

> *In the Community: People should know about the dangers of electricity. People should never ever steal electricity, if you see someone steal electricity, phone the Eskom crime line 0800 112722. (Thapelo)*

Thapelo wants immediate action, as he is aware of imminent danger where he lives. This is evident in what he wants to know, and the reason he gave for wanting to learn (See opening paragraph above). Sparks-Langer *et al.* (2004) assert that real problems do not have a predetermined correct response. They can end up in activism, in which case learners work in the community and/or attempt to improve some local issue in the world around them. The urgency of Thapelo's handwritten plan is confirmation of findings by Krajcik *et al.*, (1998) which assert that students were good at generating plans and carrying out procedures. Data obtained form the interviews (focus group and clinical interviews) and learner's reflection diaries reveal the following on what Thapelo has learnt:

> *Safety measures with electricity in the home; where electricity comes from; negative and positive charges; how electricity is generated in a power station; connecting a 3-pin plug to a 3-core flex wire; about negative and positive charges; our homes have parallel circuits for connections; and that parallel circuit is safer* (where the other users of electricity continue working if one of them no longer works) *than a series circuit.* (see Annexture 6, p.226)

Thapelo's view of the role of the teacher as that of someone who assists him in accessing some appropriate pictures, and typing some hand-written learner summaries. Reflecting on the factors that contributed to his learning:

> *The experiment helped me to learn. It gave me an example on how electricity is produced".* (see Annexture 6)

The factors that did not contribute to his learning:

> *"I could not attend to all the group sessions as I had to rush home to look after the babies at home".*

Thapelo shares with us the factors that helped him to learn. Research suggests that learning is maximized if the context of such learning resembles real-life situations in which newly learnt material can be applied to (Brown, Collins and Duguid, 1989). Thapelo shares his domestic responsibility of baby-sitting as a barrier to his further learning.

4.2.5. Portfolio Board Five (PB 5):

Cameron wanted to know:

Is there life without electricity?

His reason:

I want to know what to do if a friend gets electrocuted, so that I can teach others about safety and the advantages and disadvantages of electricity. (see Annexture 6, p.226)

Finally, we look at what Cameron put into PB 5, and what learning he took out with respect to insights, attributes, and the science that is reflected in PB 5. Figure 11, on the next page, is a pictorial representation of the actual portfolio board (that is, PB 5) constructed by Cameron in consultation with his peers.

The title of PB 5 reads: 'How can we be safe with electricity in our homes? Cameron chose to begin with two pictures, one of woman outside a rural home, with a solar panel outside her mud house, with the caption: *'Left in the dark'*, and alongside this, is a picture of the President of the country, with electric poles running next to a country road.

gure 11. A pictorial representation showing the contents of the fifth portfolio board (PB5) as artifact of Cameron's work.

The middle section of the PB is taken up by 4 pictures of electric switches with captions for each:

Repair work by an electrician with the caption:

> *If you can't fix a plug or electric socket, get an electrician to do it for you. Those few rands you avoid to spend won't buy your life back; (Cameron).*

Internal parts and workings of an electric switch with the caption:

> *An electric switch controls the flow of electricity in an electric circuit; (Cameron)*

A child placing a finger in a plug socket and getting electrocuted with the caption :

> *Playing with electricity is very dangerous,* and a summary that reads: *Children should be kept away from electric plugs. They have small fingers and it would be easy for a child to put its finger inside a socket and get electrocuted, and possibly die; (Cameron).*

A picture of a sub-station.

Cameron demonstrates the principle of problem orientation which highlights learning that leads to action by learners, or leads them to do something in the local community (Freire, 1970). The lower end of the PB has pictures of electrical appliances and connections showing what type of connections or usage of electricity is (1) safe, and which is, (2) not safe.

Data obtained form the interviews (focus group and clinical interviews) and learner's reflection diaries reveal the following on what Cameron has learnt:

> *That un-insulated wires and fallen street electric poles can shock people and animals; overloaded plugs and sockets are dangerous; the confidence to teach other people about safety with electricity; that one can see the effects of electricity when it flows through conductors; coal is a chemical energy and electricity is generated (using it) in a power station; and that the cord holding the wires is a 3-core flex wire.* (see Annexture 6, p.226)

Cameron sees the role of the teacher as one involved in typing of the learner's hand-written summaries, and someone who can be consulted for assistance when this is needed. Reflecting on the factors that contributed to his learning:

> *The presentation or portfolio boards, and the Workbook notes helped me. The teacher gave us a chance to correct our work and gave us help when we needed it. My helper, one that I like, is a person who corrects me when I am wrong.* (see Annexture 6, p.226)

On the factors that did not contribute to his learning:

> *"The teacher, I could have learnt more if he left me to also learn on my own. If my group allowed me to do the investigation and collect the information needed. If I was serious about my work and focussed on what I was doing. The school could have taken action to reduce the noise while I was learning".* (see Annexture 6)

His understanding of meaningful learning:

> *Learning that is not only meaningful to the teacher, but also to the student. If I am learning something that I understand.*

The opposite of meaningful learning: *"...is meaningless learning".*

Cameron, in response to the factors that did not contribute to his learning, indicates that the he could have learnt more if the teacher left him to also learn on his own is affirmation of the view held by Spector (1993) in which he implores learners to foster a collaborative learning environment in order to discourage teacher-dependent attitudes by learners. Cameron's above response also confirms the argument by Blumenfeld *et al.*, (1991) on the need for teachers to be an unobtrusive guide on the side. It is a quest for greater student directed learning (Barell, 1998), greater learner autonomy, and/or speedier release of responsibility of learning to the student.

4.3. Conclusion

Against the backdrop of the above discussion, and, learning that is based on "action" on the part of the learner, classroom practices can no longer restrict what learners are to learn during teaching and learning opportunities. Learning that incorporates action on the part of the learner, as done through project based learning, enables him/her to achieve a diverse range of outcomes when he/she learns in this way - "students learn best when they are actively (hands-on) and mentally (minds-on) engaged in doing" (Kellough & Kellough, 2003 : 178). The results show that learners take more out of their learning when there is action on their part. Given the opportunity to negotiate their own meaningful learning, learners can apply what they are learning, that is, they can participate fully (RNCS, 2003), and can thus become active citizens in a democratic society (RNCS, Overview, 2002). Engaging actively provides learners with opportunities to take responsibility for their own learning and discipline. Such learning opportunities will assist them to embark on new beginnings in new spaces they open themselves, spaces where they create themselves by acting in concert (Greene, 1988).

The above approach to learning and teaching is a shift away from the objectives approach of planning that sets out to restrict what learners are to learn during classroom learning and teaching activities. Such approaches, as argued in this study, do not provide the learner with the opportunity to negotiate his or her own meaningful learning. The result of such teaching and learning approaches create dissonance between the learner's school life and real life experiences.

Project based learning, applied in conjunction with MLE, creates opportunities for the expression of planned or intended outcomes, as well as the expression of unintended outcomes. In other words, you, the educator and the learner, get more than what you 'bargained for', and thus promoting holistic development.

Providing opportunities for action in learning requires adequate development and support for all role-players. Learners taking an active role in their learning need to be given space to exercise their own voice through interaction in social learning activities. They must be given opportunities to interact with peers, learning material, human resources they deem necessary to their learning, and an appropriate structure for meaningful engagement. The democratization of the teaching and learning interactions in the classroom need to be attended to as well.

In Chapter 5 we discuss the analysis of data (Stage 2), and then consolidate the main argument advanced in the study, and make some recommendations for future work on project based learning.

CHAPTER FIVE

5. Analysis of Data (Stage Two), and Discussion and Recommendations

5.1 Introduction

In this chapter we present the analysis of stage two and then consolidate the main argument advanced in the study. This will be followed by the recommendations and the conclusion. As mentioned in the previous chapter, stage two entails the exploration of the relation between mediation of meaningful learning and negotiation of identity, through project based learning, as highlighted in the three research questions, namely,

CQ 1: How do they mediate their own learning of a science unit on electricity?

CQ 2. How do they approach their learning of electricity (if at all) as drawn from their own lived experience in the home, school and community?

CQ 3. What are Grade 8 learner's understanding of meaningful learning as derived from a unit on electricity?

5.2 Analysis of stage 2

The analysis of stage two is presented below in answering the research question: How do Grade 8 learners use a unit on electricity to negotiate their identities within a learning context? This research question is addressed through the three critical questions. Each critical question is addressed separately by making use of excerpts from the learners' own responses.

5.2.1. Analysis of Critical Question 1.

CQ.1: How do Grade 8 learners approach their learning of electricity as drawn from their own lived experiences within the context of PBL?

The question that directed the analysis of data was: **What is it that Grade 8 learners do?** The results point to three ways in which the learners approach their learning of electricity:

5.2.1.1 Identification of key community problems and the provision of solutions.

We see learners identify key community problems as well as seek viable solutions to solving them. For example, Thandeka constructs her section of the Portfolio Boards (see Portfolio Board 1, page 105) by centralizing the community problems highlighted by the local Ward Councillor. She highlights the plight of tempering with electricity supply and cable theft in her community.

She then draws on her own experiences as well as those of her peers and local residents to bring about awareness of this plight to the whole community, in terms of the danger involved in such activity (see Figure 7).

> *'This is a child that live in informal settlement and they don't have electricity'. 'Shock news for pilferers of city power', ... 'Municipal taskforce tackles electricity thieves'.*

The difficulties experienced by some community members living in informal homes, and the lack of proper infrastructure to these people, is highlighted.

> *"These people don't have electricity and they want it'. 'This is a picture of people and new houses and electricity"*

Nkosenhle, on the other hand (see Portfolio Board 2, page 111), draws attention to the problem of over reliance on coal as a source of electricity in South Africa:

> *...once used up, it cannot be used again. Once coal is finished on Earth the power station will not be able to produce electricity again.*

He then relates, in the next summary attached on the board, the problems associated with the use of coal:

> *Recently people have realized that when we burn fossil fuels we put large amounts of Carbon dioxide and other poisonous gases into the air. This is having a damaging effect on the plant and animal life on Earth and on the air we breathe. Scientists are now working to find better sources of producing electricity.*

Thapelo in his action plan (see Portfolio Board 4, page 122) highlights the problem of cable and electricity theft in the community, and the dangers this poses to life:

> *<u>At home</u>: adapters shouldn't be overloaded in one socket, multiple adapters should be used, children must be taught not to play with electricity.*

> *At school: all classes with bare wires should be reported to educators (number of classes = 5), bare wires should be insulated. The people/government should make sure that the school children know about the dangers about electricity.*
> *In the Community: People should know about the dangers of electricity. People should never ever steal electricity, if you see someone steal electricity, phone the Eskom crime line 0800 112722.*

Cameron (see Portfolio Board 5, page 127) shows concern for protecting life and those people using electricity:

> *If you can't fix a plug or electric socket, get an electrician to do it for you. Those few rands you avoid to spend won't buy your life back, Children should be kept away from electric plugs. They have small fingers and it would be easy for a child to put its finger inside a socket and get electrocuted, and possibly die; ...un-insulated wires and fallen street electric poles can shock people and animals.*

What the above responses illuminate is what Freire refers to as the emergence of consciousness and attempts for the learners to achieve a critical intervention in reality (Freire, 1970). We see here, how PBL allows for that space to focus on real-life issues, which get incorporated into classroom learning in a way that makes content meaningful.

5.2.1.2 Expression of concern for own and other's personal safety, and strong ultruistic tendencies with regard to the supply and use of electricity.

A key aim of the New Curriculum Statement (NCS) is to enable learners to participate in society as critical and active citizens. Below we explore knowledge "that does not just sit there but functions richly in people's lives to help them and understand and deal with the world" (Perkins, 1992, p.5).

Thandeka: *...how can we be safe with it?* Her reason: *So that I can teach my family and others.*

Nkosenhle: *How does electricity go from house to house, and what dangers are there to our lives?*. His reason: *I want to know this so that I can try to help other people.*

Lwazi: ... *so that I can be knowledgeable about it in order to help other people. I want to avoid getting shocked.*

Thapelo: ... *how it is distributed, and the dangers associated with electricity, so that I can warn people and friends who steal electricity so that they could make safe and proper connections to cables.*

Cameron: ... *Is there life without electricity?* His reason: *I want to know what to do if a friend gets electrocuted, so that I can teach others about safety and the advantages and disadvantages of electricity.*

The above responses from the learners reflect their concerns for own and other's safety or welfare play a role in meaningful learning in ways that bring out, on the learner's part, the concept of Ubuntu, that is, 'I am because you are'. The strong ultruistic tendencies flowing out of the above responses are reflections of learner's identities.

5.2.1.3 Use of pictures as representations of issues related to the topic to convey own encounters or experience:

Thandeka: ... *'This is a picture of people and new houses and electricity'.*

Cameron chose to begin with two pictures, one of woman outside a rural home, with a solar panel outside her mud house, with the caption: *'Left in the dark'*, and alongside this, is a picture of the President of the country, with electric poles running next to a country road.

The above responses from the learners reflect the important role played by pictures and other illustrations as representations of issues that related to, or convey, their own encounters or experiences in a science learning context. The pictures and representations used by the two learners above are used as tools of powerful persuasion to convey a message to others. The picture or representation captures the essence of what the learner considers as important in his/her meaning making process, and thus assists him/her in expressing his/her self better.

5.2.2 Analysis of Critical Question 2.

CQ.2: How do learners mediate their own learning in the learning of a science unit on electricity through PBL?

The questions that directed the analysis of data were:

- What kinds of meanings were arrived at? and
- How do they do what they do?

5.2.2.1 What kinds of meanings were arrived at?

The analysis shows a range of eight different aspects that the Grade 8 learners took out of their learning. These responses were obtained form the interview sheets and the learner's diaries. These meanings were derived from an analysis of the learner's responses to the question: what did you learn?

The responses are recorded and ranked according to the number of learners who learnt particular aspects. The analysis indicates eight focus areas on what was learnt.

- How electricity is produced - 5 learners;
- Safety with electricity – 5 learners;
- How to connect a plug – 4 learners;
- The source of electricity – 4 learners;
- About negative and positive charges – 3 learners;
- The steps in the electricity production process (local electric power distribution) – 2 learners;
- How to help other people – 2 learners;
- The effect of electricity on the environment (pollution or it can shock people and animals – 2 learners.

The above responses from the learners reflect (a) the different needs of the participants, (b) the meaningfulness of their learning is linked to their interests and needs, (c) that PBL activity foster greater levels of commonality of understanding in social learning situations, (d) that through groupwork each group member contributes to the meaning making process of others in the group. The above meanings or learning by participants indicates how engaging PBL can be in the generation of the kinds of meanings learners can make.

5.2.2.2 How do Grade 8 learners do what they do?

The results indicate six ways in which learners mediate own meaningful learning.

- **The use of own experiences as well as a knowledgeable other (teacher, adult, peer) to mediate their own learning.**

> Lwazi: ***The teacher... helped me*** *when I needed to know... helped me to look and listen. I did not like it when the teacher turned the (my) question around and asked me ...as I needed to know (and not be questioned further at that point).The* ***group****, it helped me when I did not know the answer(to a particular learning context* – see Annexture 2, 4.1*).*
>
> Cameron: ***The teacher*** *gave us a chance to correct our work and gave us help when we needed it.* ***My helper,*** *one that I like, is a person who corrects me when I am wrong.*
>
> Thapelo: *I listened to* ***others*** *(peers and guest speakers at the portfolio boards showcase) about their topic (*see 3.3.2 in Annexture 2). *The* ***team****, it helped me* (see Annexture 3).
>
> Thandeka: *That it was going to be difficult learning and understanding electricity, but I was wrong, and that my* ***peers*** *in class to-day taught me a lot about electricity* (see reflective diaries, 4.3 in Annexture 2).

The above responses reflect the extent to which learners make use of own, peers' and influential others' knowledge and experiences to mediate their own learning.

- **The use of available resources (as well as the Portfolio Boards or visual tools) to construct and showcase what one has learnt.**

> Thandeka: *...the* ***portfolio boards****, learning visibly step-by-step how electricity is produced and sent to our homes. I connected* ***a 3-pin plug*** *(see 4.1 in Annexture 2)*

Nkosenhle: *The **portfolio boards** helped me.* (see Annexture 3)

Cameron: *...The presentation or portfolio boards, and the **Workbook notes** helped me.*

Lwazi: *Working with (**pictures** of) the generator, and my interest in ... what electricity is* (see 4.1. in Annexture 2).

Thapelo: *Unscrambled **picture puzzle pieces** to show the process of producing electricity in a power station* (se 4.3 in Annexture 2).

The above responses show the extent to which available resources allow learners to participate meaningfully in own learning.

- **The use of peer collaborative group activities to construct meaning (sharing of experiences with peers, being focussed and listening).**

Thandeka: ... *my **peers** helped me understand.*

Lwazi: *...The **other learners** helped me when I needed to know. They helped me to look and listen.*

Thapelo: *The **team**, it helped me* (see Annexture 3).

The above responses illustrate the role played by one's peers in social learning situations.

- **The use of dialogue is seen as important in learning.**

Nkosenhle: (*We made) use of picture puzzles to **describe/discuss** the process of electricity production at a power station* (see context 5 in Annexture 2).

Thandeka: *...we talked and talked and talked (my peers in class taught me a lot about how electricity is produced - see 4.3 in Annexture 2).*

Lwazi: ***Talking*** *helped me to learn about electricity (in the different learning contexts in Annexture 2), 'Sharing behaviour'...useful learning tool. The group, it helped me when I did not know the answer. Because I felt that we would talk so that I would know what I know now, this helped me (see 4.1 in Annexture 2).*

Cameron: *The* ***presentation*** *(of portfolio boards as a persuasive visual)...I was a bit afraid, but when I saw the other teams deliver(using their portfolio boards) I got a more confidence (see 3.3.2 in Annexture 2).*

The responses provided above illustrate the importance of dialogue in social and meaningful learning situations.

- **The use of hands-on participation and the variation of activities.**

Thandeka: *...**doing experiment** on electricity, **writing things**, **stuck pictures** on electricity (see Annexture 4).*

Thapelo: *The experiment (on producing electricity using a magnet and copper coils) helped me to learn. It gave me an example on how electricity is produced.*

Nkosenhle: ***Connecting a** 3-pin **plug** using colour codes (using an actual plug, electrical chord and screw driver)* (see Annexture 4), and ***drawing** of electrical **circuit diagrams is** a good thing to draw using symbols* (see reflective diaries 4.3 in Annexture 2).

Lwazi: ***Solved/re-arranged a puzzle** of a power station (using picture puzzle pieces) ... to learn the steps of how electricity is produced (at a power station)* (see Annexture 5). *I learnt about the steps of producing electricity in a power station. This I learn with the experiment **we demonstrated** in the class, what was interesting was that it gave me an idea how it (electricity) is produced* (see the focus group interview, 4.1 in Annexture 2).

The above responses show how hands-on learning experiences that are varied, can make learning better (Kovalik, 1994; Wolfe, 2001).

- **The disclosure of the obstacles that stand in the way of achieving the desired learning.**

  Nkosenhle: *...**Other learners** saying I was stupid when I went to the science class during interval. Sometimes I felt dumb.*

  Thapelo: *I could not attend to all the group sessions as I had to rush home to **look after the babies** at home.*

  Cameron: *The school could have taken action to reduce the **noise** while I was learning.*

The above responses from the learners reflect the different ways in which learners gain access to learning that is meaningful to them. Furthermore, these responses allow us to bring to the fore some of the obstacles that the Grade 8 learners had to overcome, and the different idiosyncratic ways in which they make their own meaningful learning, through project based learning.

5.2.3 Analysis of Critical Question 3.

CQ.3: What are Grade 8 learners' understanding of meaningful learning?

In other words, CQ3 sought to find out the meaning that Grade 8 learners attach to their learning of a science unit on electricity through PBL. The question that directed the analysis of data was: **Why Grade 8 learners do what they do?** The results to this question indicate five meanings that learners attach to their learning.

5.2.3.1 Why Grade 8 learners do what they do?

- **The value of seeking understanding for oneself rather than for the teacher.**

Nkosenhle: *Understanding my lesson and work(see Annexture 7).*

Cameron: *If I am learning something that I understand. Learning that is not only meaningful to the teacher, but also to the student. If I am learning something that I understand.*

Thandeka: *Understanding the work(see Annexture 7).That what we learnt to-day is very interesting, and it is easy to learn and understand (by) getting the main idea helped me to think, and to identify spontaneously ... I got the main idea (on connecting a plug to an electrical appliance) to-day (see reflection diaries, 4.3 in Annexture 2).*

Lwazi: *Learning about something that has meaning (see Annexture 7).*

The above responses illustrate that learning with understanding contribute to increased learner performance as indicated by research (Whitelegg &Parry, 1999; Howie, 2001; Hewson *et al.*, 2001).

- **Being ready to face new challenges.**

Nkosenhle: *'Personal challenge' is a useful learning tool, it helps me to learn and know more, and to face new experiences.*

- **Learning that brings about change in a person.**

Thandeka: On what she learnt about connecting a 3-pin plug to an appliance:

How to connect a 3-pin plug, and safety rules for connecting it.

Awareness of self change helped me to learn. I recognize and understand my feelings of being confident and I learnt something to-day, and that was a change in me. Her thoughts before the learning:

(I thought) that it would be hard to learn about what I learnt, but it wasn't, I understand everything that we learnt (see reflection diaries, 4.3 in Annexture 2).

Thandeka's response illustrates how learning that is meaningful to a person can bring about a change in his/her life. The above response is consistent with the assertion that learning through approaches such as PBL enables learners to achieve powerful, diverse and complex learning outcomes (Gardner, 1999).

- **Awareness of how one learns – the use of appropriate learning tools.**

Thandeka: *'Awareness of self-change' helped me to learn* (see above discussion).

Cameron: *'Systematic exploration' is a meaningful learning tool (see Annexture 6 &7).*

Nkosenhle:*'Personal challenge' is a useful learning tool, it helps me to learn and to know more, and to face new experiences (see Annexture 6 &7).*

Lwazi: *'Self development' and 'Sharing behaviour' are useful learning tools* (see Annexture 7), and *awareness of self change and self reflection helped me to learn about a 3-pin plug and electric sockets (on connecting a 3-pin plug)* (see reflection diaries, 4.3 in Annexture 2).

Thapelo: Response to the focus group interview (see 4.1 in Annexture 2): *The experiment helped me to learn how to learn, it gave me an on example how electricity is produced.*

The above excerpts convey the uniqueness of each individual learner in the meaning making process through project based learning. This uniqueness of each learner is evident in the way that each learner went about constructing his/her portfolio board.

The portfolio board serves as tangible evidence of what the learner knows and can actually do (Tombari & Borich, 1999). Learner uniqueness brings diversity into social learning situations, contributing to rich discussions, and valuing different perspectives of group members. The above findings concur with the views held by Stewart regarding the diverse views held by the group members in the social learning that occurred in this study, "differences can generate increased understanding, knowledge and productivity" (Stewart, 1997, p.43).

In the discussion that follows I discuss, in light of the above backdrop and with regard to PBL and MLE, the challenges by referring to what worked, and what the limitations were. It needs to be noted that the use of the term classroom does not restrict learning to the classroom but includes other learning contexts as discussed in Chapter 3 (see 3.4).

5.3 Argument and discussion

As was stated earlier, the purpose of the study was to explore how a group of Grade 8 learners at a specific school negotiate their identity in a science classroom in order to gain access to meaningful learning through project based learning. The study is based on the premise that learning is meaningful, if learners can negotiate own identity within the learning context. It is argued that the meaningfulness of the context of learning strongly depends on this negotiation. Additionally, the argument advanced is based on the view that the learning context is failing the learners; that there is little space and opportunity for the learners to negotiate their identities within the context of science learning.

In this regard, the study set out to explore how Grade 8 learners create the space for the negotiation of meaningful learning. It is believed that learners can shape their own identities when given an opportunity to participate in a social learning situation centered around a communication rich framework.

Central to this stage, that is, Stage 2, is the notion of interaction. According to Feuerstein (2001), communication rich "interaction" with a "warm human being" stimulates mediation. A wide body of knowledge exists that supports the above assertion that interaction stimulates mediation (Klein,1991; Bransford & Stein, 1993; Wolfe, 2001; Howie, 2001; Hewson, *et al.*, 2001). Therefore, learning situations that encourage learners to be passive would invite a multitude of factors that will mitigate against effective action and mediation on the part of the learner. In this study I therefore assert, based on the argument that project based learning leads to meaningful mediation, that this mediation leads to the kind of action that assists learners in negotiating an identity of themselves.

It is against this backdrop, that I assert that project based learning and mediation are inextricably linked. This is seen in the extent to which participants are imbued with a strong desire to socialize with the intention to learn more. In other words, project based learning optimizes mediation. This mediation, then leads learners to take action as we saw with the construction of PB's.

The type of action with strong ultruistic tendencies discussed here is evident in the comments below that were made by the 5 participants who engaged in the different phases (see Chapter 4, Figure 4) of the study:

Thandeka:	*I want to know how electricity is produced, how it is transported to homes, and safety measures, so that I can teach my family and others.*
Nkosenhle:	*I want to know how electricity is produced, distribution and its dangers to our lives, so that I will try to help other people.*
Lwazi:	*I want to know how electricity is produced, what it is, so that I can help other people, be knowledgeable about it, prevent getting shocked, start a business, and gain independence about something in life.*
Thapelo:	*I want to know how electricity is produced, its source, distribution, and the associated dangers, so that I can warn people and friends who steal electricity to connect cables properly.*
Cameron:	*I want to know if there is life without electricity, and what to do if a friend gets electrocuted, so that I can teach others about safety and the advantages and disadvantages of electricity.*

We see how project based learning and mediated learning experience require that practitioners shift away from a traditional transmission mode of teaching and learning, to a more active or participatory one. The challenge thus becomes the extent to which teachers provide opportunities for teaching methodologies that are participatory. The practice, thus far, has been characterized by the packaging of learning material (done solely by the teacher) which is then used in the scaffolding of learning.

Dewey (1938) was against the notion of learners being seen to learn on their own – left to their own devices or as Kilpatrick (1925) argued, an "enterprise of the child". Dewey advocated that learning be seen as a joint or "common enterprise" between educator and learners. In this regard, mentor figures became key in one's learning.

Learning was seen as a common enterprise between the child and the teacher. It is in the process of mentoring that, Dewey argued, the processes of scaffolding and the packaging material come to be negotiated.

As practitioner and researcher, this study has opened up new areas of development regarding the theoretical framework employed in the study. The study thus brings the following question to the fore: What does it mean to democratize the learning space or context in the learning of science in terms of:

- providing spaces for the learner voice to come through;
- providing structures that allows for the sharing of power in the negotiation of meaning; and
- allowing schools to become nodes of care in a learning community?

On the required human virtues Meier (1997) argues that:

> Well-developed empathy makes it hard to feel untouched by the misery of others; it enables us to hear their voices inside our own head and to understand their explanations and their "side" of the story. ...Empathy subtly broadens our capacity for imagination; our natural childish playfulness is expanded. Good literature, great drama, and powerful art of every kind - all these help a person to develop empathy. Such is the purpose of a good education for democracy (Meier, 1997: 63).

Little is done to prepare educators to meet the new educational changes, and to fulfil their roles within the new learning context. With the responsibility to deal with the new curriculum, which teachers perceive as demanding and complex in terms of skills and knowledge, "teachers often seek faster, simpler and easier ways to do a number of things, including manage their classrooms" (Landou, 2004:12).

Teacher centered approaches combined with poor learner discipline, poor working conditions, teacher overload and time-bound curricula pose a challenge for effective PBL and MLE in a school (Shor, 1992). I discuss the challenges for effective PBL and MLE within a school context by focusing on the following issues: power relations; learning and self realization and affirmation.

5.3.1. Power relations.

The very fact that the educator stands (and/or sits) in front of the classroom, establishes a position of power. Sparks-Langer *et al.* (2004), (quoting Glasser, 1998) assert that learners "must have some control over their destiny through participating in decisions about the classroom and school. In this way they learn about their own power and the responsibility that comes with such freedom", and that "students come to their classes with five basic needs – Survival, Love, Power, Fun, and Freedom" (p.344). These insights are consistent with the idea adopted in this study, namely, learning that is based on learner's needs. Classroom interactions and power dynamics vary form one context to the other. However, who holds power, and whether that power is wielded, given away or shared, provides the structure for how all members of a learning community interact with each other, and reach decisions separately or together (Landou, 2004).

Within the context of the study, the concepts of PBL and MLE as well as the sharing of power, were explored against the background of seeking to enhance the educational experience of all the members of the learning community.

I, as a researcher/teacher, was aware, that the way the teacher handles issues of power, that is, wielding, giving away or sharing, would have an impact on his/her classroom management practices. This awareness is allowed for by the framework guiding PBL and MLE, because of its focus on social learning and rich dialogue.

The above is evident in the following learner's responses:

> *"Regulation of one's self is needed. The teacher and other learners helped me when I needed to know. They helped me to look and listen" (Lwazi), and "I could have learnt more ...(i)f my group allowed me to do the investigation and collect the information needed. If I was serious about my work and focussed on what I was doing" (Cameron), and "my peers helped me understand" (Thandeka).*

A sharing of power classroom structure embraces the "we" language that reflects the respect and trust needed in a true democratic learning environment, and serves to distribute power among the members of the learning community (Landou, 2004). Working in such an equitable environment, students learn behaviours that are appropriate for citizens in a democratic country. Citizenship expectations also help the role players in a learning community to focus on solving problems by working together.

According to Glasser (1998), quoted in Sparks-Langer *et al.* (2004, p.344), learner's acts in the classroom are aimed at fulfilling the five basic needs mentioned earlier, and that if the teacher can remember that the learner's behaviour is merely an attempt to satisfy one of these basic needs (namely, survival, love, power, fun and freedom), then the approach taken will be more sensitive and responsive. For MLE and PBL, including discipline, attendance to these needs is one of the most important factors for educators to consider when making classroom decisions.

Participants assisted in the creation of an environment that is conducive for the above, and a structure for sharing, collaborating and self-discipline was put in place. Commitment to this did not always work due to the following:

> *"Other learners saying I was stupid when I went to the science class during interval. Sometimes I felt dumb" (Nkosenhle), "Little time, Some learners are not sure if they wanted to know or not" (Lwazi), "I could not attend to all the group sessions as I had to rush home to look after the babies at home" (Thapelo), and "If I was serious about my work and focussed on what I was doing. The school could have taken action to reduce the noise while I was learning" (Cameron).*

The comment made by the last participant, Cameron, reveals more than just the need for learners to take responsibility for their learning, and for effective PBL. His statement reveals broader contextual dimensions that pose a challenge for effective or quality PBL and MLE, namely, on-going noise or disturbance that is beyond their control and quest for effective mediation of own learning. This factor calls for whole school development that is supportive of PBL and MLE.

The participant's quest for self actualization is evident in their reflections above. Self-actualization, according to Maslow (1987), refers to the need for self-fulfillment, the need to develop all one's potential talents and capabilities. Once this self-actualization or fulfillment is activated, learners hold in high regard such values as truth, goodness, beauty, justice, autonomy and humour (Feist, 1990). The participants recognize the value of learning in this way, that is, learning cooperatively through PBL and MLE, and therefore seek justice regarding the noise levels *(Cameron)*, freedom from home chores to learn more *(Thapelo)*, more personal commitment to achieve more from own learning *(Cameron)*, and survival or autonomy from peer's negative criticism *(Nkosenhle)*.

5.3.2. Learning.

The new vision for education in South Africa places the focus in schools on learning, and this has been succinctly idealized as a principle, namely, lifelong learning (DOE, 1997). Inclusive education compels educators to "focus on each individual to learn who their students truly are. And, regardless of who the students are, irrespective of their needs, values, and interests, they are there to learn. Teachers must be prepared to reach and teach each one of them" (Landou, 2004:9). The PBL and MLE framework gives learners opportunities to make own learning meaningful:

> "*Understanding the work in such a way that you know what you are learning" (Thandeka), "...to face new experiences" (Nkosenhle), "You can learn whatever you want to" (Lwazi), and "Learning that is not only meaningful to the teacher, but also to the student. If I am learning something that I understand" (Cameron).*

An analysis of the learning participants took out through engaging in PBL, as discussed earlier in this chapter. The above findings are reflective of the different needs of the participants, and what each considers meaningful. It also shows us that each one takes out personally meaningful stuff even from a collaborative PBL situation. Cockroft (1982) suggests that educators need to provide more opportunities for pupils to talk about what they are doing, to become aware of their own ideas and those of their peers, and to modify their own ideas where necessary. This is the closest that educators can ever likely to get to a teaching situation, such as project based learning, in which both teacher and learner expectations are fully realized.

The above type of meaning making requires effective collaboration in social learning situations. In the PBL classroom collaboration is not achieved overnight. All role-players have a role to play in overcoming problems related to (among others) domination, non-participation by some team members, or respect for others in the team. We need to take time in developing 'collaborative space' where each learner is allowed to articulate own ideas and listen to divergent views (Olsen, 1997). Such collaborative space must provide room for us to attend to multiple voices in our dialogue to negotiate new meanings (Castle, 1997).

Hence, accepting that students are there to learn, then, appropriate classroom management practices, other that the type that uses behavioural strategies discussed earlier, must be embraced to promote meaningful learning.

5.3.3. Self realization and affirming one's self.

Meaningful learning in a way that gives learners choice in their learning, that is based on their co-construction of meaning, and that is based on their needs and interests, is learning that promotes greater participation by learners. Such learning gives power to students. Greene (1988:9) asserts that learners who are affirmed and that develop through authentic learning activities with others reject "oppression or exploitation or segregation or neglect". She (Greene, 1988) argues that:

> (On) looking back, we can discern individuals in their we-relations with others, inserting themselves in the world by means of projects, embarking on new beginnings in spaces they open themselves. We can recall them...opening spaces where freedom is the mainstream, where people create themselves by acting in concert" (Greene, 1988:134).

New beginnings such as those discussed by Greene (1988) are consistent with the new vision for education in a new democratic South Africa. The role of the educator in teaching and learning interactions is still regarded by researchers as a critical one. The educator as mentor and/or mediator, where learning is a 'common enterprise' between the learner and the educator (Dewey, 1938) or other members of the learning community (see Figure 1, Chapter 2), is critical in democratizing the learning spaces. The main critical attributes of the mediated learning experience (MLE) described by Feuerstein (2001) (see Chapter 1 - 1.9 and Chapter 2 - 2.2.2), namely, reciprocity, intentionality, meaning, and transcendence, are essential in the process of democratizing such desired democratic learning spaces.

Such a democratized learning space does not arise by chance, but is a goal strived for with commitment and discipline from all members of the learning community. Project based learning (PBL) provides opportunities for meaningful and interactive learning where a democratic human management system such as MLE is put in practice. Depending on the entry level or the stage at which PBL is introduced, at the beginner level sufficient learner 'scaffolds' (Blumenfeld *et al.*, 1991) would be required, where such scaffolding would be gradually withdrawn in a way that provides for greater learner autonomy in PBL.

MLE is not without challenges. The PBL classroom is made up of learners from diverse cultural backgrounds, each bringing his/her own prior experiences, needs and interests to the classroom.

With respect to the person who wishes to adopt MLE, each learner has his/her own idea of the kind of mediator agent for their learning, for example:

> *The teacher and other learners helped me when I needed to know. They helped me to look and listen. Talking helped me. I did not like it when the teacher turned the (my) question around and asked me ...as I needed to know (and not be questioned further at that point) (Lwazi)* and,

> *The teacher gave us a chance to correct our work and gave us help when we needed it. My helper, one that I like, is a person who corrects me when I am wrong (Cameron).*

> And on the things that stood in the way to his learning:

> *The teacher, I could have learnt more if he left me to also learn on my own. If my group allowed me to do the investigation and collect the information needed. If I was serious about my work and focussed on what I was doing. The school could have taken action to reduce the noise while I was learning (Cameron).*

Learners who learn this way, using MLE, require feedback that is mostly positive especially is social situations that are '2-way rich' in dialogue as advocated by Feuerstein (2001). Learning is not about learners not knowing anything, all learners come with their own experiences, interests, strengths and barriers to learning which need to be accommodated (RNCS, Grades R-9 Schools, 2003). The teacher's role is also publicly known: "The teacher will understand and interpret provided learning programmes, design original learning programmes, identify the requirements for a specific context of learning and select and prepare suitable textual and visual resources for learning. The teacher will also select, sequence and pace the learning in a manner suitable to the different needs of learners" (DOE, 1999: 69). This policy interpretation and implementation role of the teacher is also highlighted in this study.

The lesson plan was fully addressed and participants made effective use of the learning opportunities and learning scaffolds:

> *The portfolio boards, learning visibly step-by-step how electricity is produced and sent to our homes; doing experiments, writing things, stuck pictures, talked and talked and talked, and my peers helped me understand (Thandeka),* and
>
> *The presentation or portfolio boards, and the Workbook notes helped me. The teacher gave us a chance to correct our work and gave us help when we needed it (Cameron).*

A challenge in the above is the on-going assessment and recording of sustained learning. In a MLE classroom a learner's experience with project approaches to science is associated with a reduction in anxiety towards the subject, its relevance to everyday life, and a greater willingness on the part of student to approach science challenges with an open mind and a positive attitude (Boaler, 1997).

According to Chard (1999), teachers using PBL and MLE need to plan for such learning opportunities, as this allows the teacher to be mentally ready to use and engage the learner's experiences and interests, and, that he or she would then be more receptive to the different possibilities that may arise in the course of the learning task or project. She asserts that the teacher has an important role as a model for the learners of dispositions that enhance learning. What worked for me in a PBL and MLE classroom, and as a paradigm shift, was to "transform courses of study into instances of democratic living" (Henderson & Kesson, 2004, p.102). Affirming learners in collaborative and 'joint enterprise' is all about practicing an ethic of care.

Henderson and Kesson (2004), quoting Noddings (1984), describe teachers working as caring professionals:

> When we attribute the best possible motive consonant with reality to the cared-for, we confirm him; that is, we reveal to him an attainable image of himself that is lovelier than manifested in his present acts ... Confirmation, the loveliest of human functions, depends upon and interacts with dialogue and practice. I cannot confirm a child unless I talk with him and engage in co-operative practice with him" (p.13).

Against the above backdrop, the multitude of challenges for effective PBL and MLE within a school context require new participatory approaches to both school and curriculum management. The involvement of all the school stakeholders is key in a school that is seen as a learning organization as described in Chapter 2 (see 2.2.4, Figure 1). Issues relating to power, learning and affirmation, as discussed above, need to be attended to in a way that allows for effective PBL and MLE in a learning context.

5.4 Recommendations

The discussion that follows explores the ways in which this research could be taken forward.

The results of the study confirm the view expressed by Gardner (1999) on the use project based learning, that it enables learners to achieve "powerful, diverse and complex" learning outcomes. As observed and discussed earlier in this chapter, participants in the study were afforded the opportunity to state what their needs and interests were in relation to the challenge posed to them by the local community leader.

The challenge posed related to issues linked to electrification and the consumption thereof by the residents in the existing, and the newly built RDP houses. The recently built RDP houses are in response to the President's commitment to 'a better life for all' its citizens.

Embedded in the President's call for "opportunities for a better quality life" for all, is the need for our education and curriculum to address the needs of all sections of our diverse communities, especially the poorer sections. The curricula mentioned here must bring about empowerment and change in the lives of the people -"Unity in Action for Change". As stated earlier in Chapter 1, such a curriculum, like the National Curriculum Statement (NCS), must embody the nation's social values, and, its expectations of the roles, rights and responsibilities of a democratic South African citizen as expressed in the Constitution. The underpinning principles of the NCS are social justice, a healthy environment, human rights, and inclusivity (RNCS, Grades R-9 Schools, 2003), and espouses learner centeredness and activity-based approaches to teaching and learning, and promotes life-long learning.

Against this backdrop, the following questions emerge for further research.

- How can schools build effective and sustained school-community interaction that will enable communities to bring local issues into the curriculum, so that schools can prepare learners for real-life?

- How can educators be involved in policy processes in ways that will help them implement such policies?

- How can practicing educators obtain the necessary continuous professional development and support, to help them use the project based learning approach as a vehicle to bring about real change? How can project based learning be used in poorly resourced schools to bring about the necessary change?

We live in a time of increased demands for teacher accountability and democratic practices and processes. This reality places the onus on educators to enlist appropriate and viable teaching and learning, and assessment, strategies that lead to positive and measurable outcomes or results. In essence, as educators we have to change the way we do things. This reality is reflected in the Education Departments new approach to educator development, namely, the Integrated Quality Management System (IQMS).

5.5 Conclusion

The involvement of the local community leaders and education stakeholders in school based curriculum planning is a crucial step for the successful implementation of project based learning. The integration, regularity and nature of community input in school curriculum planning must be initiated and co-ordinated by the School Management Team.

Project based learning provides a means for meeting the expectations of the learners (what they want to know), the expectations of the community (preparing learners for real-life), and that of the vision of the new curriculum in South Africa (achievement of the Critical Outcomes and the developmental outcomes). The multiple roles that emerged from this study include among others that of mediator, facilitator, co-discoverer, co-learner, motivator, roving resource person, guide, coach and assessor.

Appendix

Annexture 1

List of Societal problems obtained from a meeting with local community leaders.
Newlands East Schools Project results of a clustering exercise - 22 January 2002

1. Brief Introduction

This serves as a follow-up planning meeting by the Senior Phase educators in the Newlands East Schools. The meeting agreed to naming the joint venture as the - " Self-Help Action Project in Education" , in short: SHAPE. The meeting was facilitated by a member of the NESS OBE Team, however, the meeting agreed that the OBE co-ordinators (or a rep tasked for this specific purpose) of the participating schools meet to plan/co-ordinate future SHAPE meetings, and where possible, to rotate the facilitation thereof in order to build capacity.

The meeting programme (commencing at 10H00 & ending at 12H00):

1. Activity 1: Clustering as a concept (short introductory exercise)
2. Activity 2: Clustering of list of about 60 'topics' from the MaP meeting
3. Activity 3: Selecting & narrowing down of a possible list of PrO's
4. Activity 4: Results of activity 3 - placing each in the appropriate PhO. Equitable spreading of the resultant list of PrO's between the Grades
5. Way forward for SHAPE.

2. The aim of the clustering exercise was to arrive at a list of Programme Organizers (PrO), using the list of 'topics' solicited from the participants at a Macro-Planning (MaP) meeting of education stakeholders from the local community. (PhO stands for Phase Organizer)

3. The Senior Phase educators (i.e. Grade 7,8 and 9 educators) narrowed down the stakeholder input to the following list of PrO's :

1. Road Safety
2. Crime
3. Environmental Issues
4. Social Responsibility
5. Empowerment
6. Dysfunctional Families
7. Poverty
8. Abuse
9. Education
10. Personal Skills
11. Transport
12. Democracy
13. Conservation
14. Family Life
15. Entrepreneurship
16. Sexuality
17. Youth
18. Morals & Values (incl. Spirituality)
19. Media
20. Industry/Marketing
21. Technology innovations, Inventions and effect on society
22. International Relations
23. .....
24. .....

4. The Phase educators had hoped to obtain 24 PrO's whereby they would allow the team to spread the resultant list of PrO's equally between the different grades in this Phase, i.e. 6 each per grade. (Note: See the next page where this exercise was done)

The meeting also noted that some school OBE teams have already planned ahead (especially the Grade 7 educators), and seek clarification on the status thereof. The onus is on those Senior Phase educators first to see how they can synergize prior planning with the objectives of SHAPE. Nothing shall go for 'waste' in SHAPE.

Report of the adjourned SHAPE OBE planning meeting of 22 January 2002

1. In Attendance : Senior Phase Educators as per attendance register. Special acknowledgement goes to the Lakehaven Secondary School OBE Team reps. who joined the joint planning project.

2. The two outstanding items from the previous meeting are the following:
   - placing the final list of PrO's in the appropriate Phase Organizer (in an equitable manner)
   - the way-forward for SHAPE.

3. The first task needed a lot of debate and negotiation, not to mention the unplanned need for clarification and elucidation of C2005 planning terminology which had an influence on the division of the PrO's for the 3 different Grades.
   After much discussion and give and take (and sharing of prior experiences by the Grade 7 SHAPE members – many thanks to them), the meeting arrived at the following result:

	ILP LSM	Programme Organiser	Phase Organiser
Grade 7	ILP Workbook One ILP Workbook Two ILP Workbook Three ILP Workbook Four ILP Workbook Five	1.Entrepreneurship 2.Environmental Issues 3.Life then & now 4.Media(on info. highway) 5.Family Life(society & I)	Econ. & Dev. Environment Culture & Societ Communication Pers. Dev. &Emp
Grade 8	ILP Workbook Six ILP Workbook Seven ILP Workbook Eight ILP Workbook Nine ILP Workbook Ten	6.Industry & Marketing 7.Conservation 8.Morals & Values 9.Technology-innov., ... 10.Sexuality	Econ. & Dev. Environment Culture & Societ Communication Pers. Dev. &Emp
Grade 9	ILP Workbook Eleven ILP Workbook Twelve ILP Workbook Thirteen ILP Workbook Fourteen ILP Workbook Fifteen	11.International Relations 12.Environmental Issues 13.Dysfunctional Families 14.Transport 15.Personal Skills	Econ. & Dev. Environment Culture & Societ Communication Pers. Dev. &Emp
	* PrO's not yet selected.	Democracy Youth Empowerment Crime Poverty Road Safety Abuse Education Social Responsibility	

(Report by : Jafta T NESS OBE Team member. 24 Jan. 2002)

Annexture 2

A description of this study shows that the data constitution involved four phases, namely,

Phase 1, which solicited learner's interests and present knowledge, through the use of a questionnaire

Phase 2, which through a probe, used this to gained entry to the learning spaces that the learners were provided with. Video recordings were made, and these were transcribed and records made of the transcripts.

Phase 3, which was based on assessment types, namely formative (based and accompanying the probe), summative assessment, and the out of school performance assessment.

Phase 4, incorporates the focused interview, clinical interview, and the learner's reflection diaries.

1. Phase 1:

1.1. With regard to what learners would like to know or learn, the participant's responses were based on their personal interests on the topic. Fourteen participant responses were obtained from the learner's group discussions. Participant responses were largely based on a single area of interest. The results of the probe, with respect to what the learners would like to learn, yielded the following data, and were then grouped into the following categories:

1.1.1. What is this thing called electricity?
Two learners expressed interest in this area of the topic (Thabile and Lwazi)

1.1.2. How it works, or, is produced?
Three learners expressed this kind of interest (Sandisile, Felicity and Thandeka)

1.1.3. Distribution, source or generation (where does it come from, or go from house to house?)
Seven learners expressed this interest (Ntokozo, Nkosenhle, Thapelo, Siyabonga, Slindile, Fikile and Natasha)

1.1.4. Electricity in our lives, namely,
What dangers are there to our lives?
One learner responded in this way, namely Nkosenhle

1.1.5. Is there life without electricity?
One learner responded in this way, namely Cameron

1.1.6. Discovery of electricity (How and when was it discovered?)
One learner showed an interest in the discovery of electricity - how and when electricity was discovered (Jerome)

The learner's areas of interest as revealed through the above data and the different categories, are almost identical to the five problem areas that were identified by the local Ward Councillor (See Annexture 13, page 247).

1.2. With regard to what the learner's already know about the topic, and, in soliciting the prior knowledge, a questionnaire was administered to the participants. Fourteen learners responded to the RPL activity, and their responses were recorded. An RPL activity in the form of a questionnaire was administered to the learners, and the results were analyzed according to each question. The table below provides an analysis of the learners' responses to the RPL task.

RPL Questionnaire	Comment
1. From where do we get electricity I our home or school?	Eleven (11) responses indicated that electricity comes from the *'power station'*, one saying it comes from *'underground'*, another said *'electricity box'*, and another saying *'generator'*
2. How is electricity transported to our home or school?	Eleven (11) learners indicated that this comes via *'electric wire or cable'*. One responded that it is the *'power box'*, another said *'electricity'*, and a single no response.
3. The name of the switch that controls all the other switches in homes.	Eleven (11) responses revealed that it is the *'main switch'*, one learner calls it a *'control switch'*, another said a *'cord'*, and another said *'electricity'*
4. The name of the local authority supplying us with electricity	Nine (9) learners said *'Eskom or Martin West'* (the local municipality). The other learners - one response each, said *'Telkom'*, *'pylons'*, *'station'*, and one no response.
5. Appliance using the most electricity: fridge, TV, microwave, stove, radio.	Seven (7) responses indicated that it is a *'stove'*, three indicated *'fridge'*, two for *'TV'*, *'radio'* one and *'microwave'* one.
6. What could happen to a person if he/she is electrocuted?	Nine (9) learners remarked *'death'*, two said *'shock'*, and one response each for *'body shakes'*, *'hospitalization'* and *'the body gets stiff and numb'*
7. Electricity is a form of energy. What does the term 'energy' mean?	Seven (7) learners remarked that it means *'power'*, and five learners indicated that it is *'the ability to work or move'*, and one response each indicating

	that it is '*force*' and *'we live with energy'*
8. Name two forms of energy	The following responses were recorded: '*electrical*' four responses, '*solar'* three responses, '*heat*' two responses, *'energy in our body'* two responses, and single responses of each of *'nuclear', 'kinetic', 'dynamo', 'lightening & thunder', 'sugar & mielies'*, and one no response
9. What to do before fixing a broken electric kettle while in use.	Nine (9) learners indicated that one must *'first switch off the mains, or first disconnect or unplug'*. Two responses indicate that *'a repair man/parent must be called to fix the fault'*, and one response each saying *'check the plug and then the element', 'try switching it again'* , and *'buy another kettle'*
10.What is an electric circuit?	Six (6) responses indicate that it *is 'electricity in circular motion'*, four indicate that it is *'where electricity comes from'*, and one response of each where it is a 'force', *'drawing pictures into symbols', 'experimenting how electricity works'*, and ' *'it is important to someone without electricity'*.
11.The metal type that allows electricity to flow through easily	Seven (7) responses indicated that it is *'copper wire, plug or radio'*. Two responses indicated that it is *'iron or steel'*, and single responses each of - *'aluminium', 'magnet', 'umbrella'*, and '*power'*, and a single no response.
12.What is a power station?	Twelve (12) learners indicated that it is *'where electricity comes from'*, one said that it comes from a *'power box'* and a single no response.
13.An appliance that converts electric energy to heat energy	Nine (9) learners stated that this is a *'stove, heater or kettle'*, and three indicated that it is *a 'cable or cord'*, and one said '*plug*', and another said *'a magnet'*, and one no response.
14.Prior lesson it was learnt that atoms are composed of electrons and protons - which one moves?	Three(3) learners indicated that it is the *'electrons'*, two said '*charges'* four indicated *'molecule, matter or atom'*, one said '*fridge'* and four no responses.
15.What must be connected to an electric kettle for it to work?	Five (5) learners indicated that it is a *'plug*', two said *'water'*, another two said a *'cord or earth wire'* and five no responses.

16.How does electricity affect the environment?	Seven (7) learners indicated that it causes *'electrocution, death or harm'*, six indicated *that 'it makes life easier'* and one learner said that *'life is hard without it'*
17.People and electricity - what could go horribly wrong?	Ten (10) learners indicated the following, *'shock or death'*, two said *'stealing or theft'*, and one said *'not switching off'* and another said *'playing with electricity'*.
With regard to the last question, learners had to indicate whether has happened to them or not.	Four learners cited personal experience indicated that *'it happened to me'*, while ten (10) *'saw it happen to others'*.

Table 3. Learner's responses to RPL questionnaire

2. Phase 2:

This phase deals with a sequential set of activities or Probes based on what learners want to know. A subject probe was compiled be the educator in response to the needs of the learners and the local Ward Councillor. The probe provides the first of many settings of learning for the participants in the study. Further settings for learning will be explained as the study unfolds. For each learning context identified in this phase, a description of the context is supplied and this is followed by the learner's responses. An analysis of the learner's responses then follows at the end of each identified learning context or setting.

Context 1: Responding to the problem posed, namely, why they wished to learn about the topic?

The learners began by expressing their own interests on the above topic. The teacher facilitated mediation of learner responses with regard to their experiences and interests yielded the following : (As part of the interaction, the teacher requested that participants express themselves freely in whatever language they feel comfortable with).

Thabile: Ngi funulwazi ukuthi ugesi uqamkapi. (I wish to know where electricity comes from)

Teacher: Once you have this information, then what?

Thabile: Bese'ngazi, ngizofundisa abanye abantu abangazi
(Once I gain knowledge about electricity, I will teach people who don't know about it)

Teacher: What are you now going to do to get this knowledge and information?

Thabile: Ngizohamba ngiye elibrary, bese ngicela abantu abasebenza elibrary bangisize ngalento engfunukuyazi.
(I will go to the library to ask the librarian to help me access the relevant information).

Teacher: What about the team, the classroom and the teacher - how do you see their role and influence in your strife for knowledge and information? As we are all meeting like this to-day we are all seeking in some measure, for exactly what you are seeking, namely information, knowledge and skills.

Thabile: Yes, ngizozama ukuthi ngithole kulaba abaziyo la
(Yebo, I will try to seek help from those who know from amongst us)

Teacher: Who would you trust amongst all of us present here today, to assist you in your quest for knowledge, we are all here on a mission to learn and gain information and knowledge here today.

Thabile: From my peer, Lwazi.

Teacher: Ok, what about the work sheets, notes and other resources here in the classroom including the teacher who is talking to you, will you need their assistance or will you not?

Thablie: Ngizoba dinga, sir
(I will rely on them, sir)
Teacher: How are you going to depend on them for all this information/knowledge which you set out to obtain.

Thabile: Ngizoba buza, ngizobo buza, amapepha bese ngiyabala kuwona.
(I will ask them, I will ask them, and then record on the worksheets)

Teacher: Let us come to Sandisile, is there something you wish to express?

Sandisile: Ngifunulwazi ukuthi ugesi ugenerateka kanjani.
(I wish to find out how electricity is generated)

Teacher: And once you get that, what will you do with it?

Sandisile: Ngufun'ukuthi umuntu uba engibuza ukuthi ugesi uwakwa kanjani, ngimchazele. (I want to be in a position to explain to someone who asks me how electricity is produced)

Teacher: Have you come across some people who do not know about electricity, who do not know how it works, or people who are afraid of it, and, who you can then tell -how it works?

Sandisile: No sir.

Teacher: There are none?.

Sandisile: Bakhona, sir.
(There are persons, sir)

Teacher: Where do these people, whom you talk about stay, at home, near your home or far from your home?

Sandisile: They are at home.

Teacher: Ok, could you please assist us by giving us a clear picture of the people you are talking about, what type of places do they stay in.

Sandisile: Sir, eduze nasekhaya awukho ugesi, bakhona futhi abangazi ukuthi ugesi usebenza kanjani. (Sir, there is no electricity near my home, and there are people who don't know how electricity is produced)

Teacher: So, what do they use at this moment?

Sandisile: iTovu esebenza nge parafin, abanye basebenzis'inkuni.
(They use paraffin stoves, and others make use of fire-wood)

Teacher: The way you see it, or think about this matter, and seeing that it takes such a long time to prepare water to make tea or coffee among other things, how do you see these peoples lives being improved by the use of electricity?

Sandisile: Impilo yabo ibkuni ngoba ugesi abanayo, kanti ugesi ukwenza impilo ibelula.
(Their living conditions are difficult because they do not have electricity, and yet electricity can make people's lives easier)

Teacher: How does electricity make life to be a bit easier?

Sandisile: Mangabe nje ufunuk'ayina, kuyenzeka ukusikeni kushisik'ayina.
(If , for example, you wish to iron something, it sometimes happens that you overheat the iron)

Teacher: How will electricity be able to help a person in this regard? An iron can also get very hot and burn the clothes as well.

Sandisile: Kuya shesh'uku shisa.
(It gets hot very quickly)

Teacher: To get warm or to burn the clothes?

Sandisile: Uku fudumala
(To get warm)

Teacher:...

Ntokozo: Electricity would make people's lives better, because when you use candles, they can burn up the shack very quickly, but when using electricity it is much safer because there is no way it could make a fire, a candle could burn the house, maybe some person is sleeping and then the blanket they were using, maybe touches the candle in some way and it falls down and then apparently burns up, and the whole place burns.

Cameron: I have seen a shack in Siyanda near my home, where the people have no electricity and had no stove, but used a gas stove, and the gas tank exploded causing the whole shack to burn down.

Teacher: And if they had used electricity, how would this have been better?

Cameron: If they used electricity, they would not have used a gas tank and it would be easier for them to cook.

Teacher: Are you trying to say that electricity would never cause a house to burn .

Cameron: It can cause house to burn but their chances are low.

Teacher: Explain what you mean by that, what is it that makes it so when it comes to electricity.

Cameron: There are many things that could burn in a house, but it is not going to be easy for them to burn.

Teacher: Is there anyone who could assist Cameron, someone who knows about the device in a house which can make the chances low for the house to burn.

Jerome: The house has a lightning conductor.

Teacher: Explain how this works.

Jerome: It is made out of plank, which is not a good conduct, there is not a good chance of electricity going through it.

Teacher: What prevents fires starting in a house because of electricity faults?

Tapelo: The main switch, it switches off when a person makes a mistake.

Teacher: What is the term used when the main switch goes off in a house? It begins with a 't'.

Cameron: The main switch trips, so it is called a trip switch, caused by a fault in the wires.

Analysis of Context One

An analysis of this learning context, reveals what learners regard as important -

- Gaining knowledge and teaching other people
- Sharing of knowledge and information
- How one sources information
- Cameron and Ntokozo alert us to the dangers of gas and lit candles, relating this to previous experiences (a shack in Siyanda)

The aim of the investigation is to produce electric current in the copper wire without using cells, but by using a magnet with insulated copper wire coils. Teachers question: *If there were any, even just a small electric flow in the wires in your experiment: how would we know if there was any, seeing that we know that electricity is invisible?*

Thabile: The compass needle would move.

Siyabonga: It is not moving. (He then compressed the coils pressing them together in the vicinity of the compass needle and observes very closely, while a peer moved the bar magnet in and out of the coils).

Teacher: What caused the needle to move? How does electric current affect a compass needle? ... No response.

Observation:

1.The 2 free ends of the conductor were not joined firmly and hence a loose connection was made affecting the outcome.

2. A team member (Tapelo) noticed the loose connection and tied the wires firmly.

Teacher question: Do you think the electricity will flow through very loosely connected wires, or wires that have a gap between them?

Tapelo:	"No, the wires must touch each other for electricity to flow through."
Fikile states:	"I am pushing the magnet into the coil to see if the compass will move!"
Teacher:	Are you pushing the magnet into the coil to see if the compass needle will move, or are you doing this so that you can producing electricity?
Fikile:	I am pushing the magnet and the coil to see if there will be electricity.
Teacher:	What then will tell us if there is/ isn't electricity?
Cameron:	The compass needle will tell us if there is electricity.
Teacher:	How will the needle tell us?
Natasha:	It will move.
Teacher:	Explain a bit more.
Natasha:	She is pushing the magnet to see if there is electricity, and the wire will transfer it into the compass to see if there is electricity.
Teacher:	What does the team think about the point made by Natasha, she says that if the electricity is produced by the coil and magnet working together, the electricity formed will be pushed into the compass.
Cameron:	When electricity is produced, it will go around the conductor and go pass the compass, and when it goes pass the compass, the compass needle will move.
Teacher:	What is the groups' observation? (Silence- noticing that the bar magnet is stationary in the coil). Must the bar magnet remain still in the coil or should it be moving?
Cameron:	It must move all the time.
Teacher:	But I see that Fikile is just holding it in one place. Do you think electricity is made when the magnet is standing or when it is moving in and out repeatedly.
Tapelo:	Electricity is formed when the magnet moves slowly in and out. (Nothing happens as the for movement in the needle). Natasha, and then Tapelo tries to move the magnet in and out of the coil.
Teacher:	(Noticing their battles). Do you think we should move the magnet very slowly in the coil, or move it faster? (The team members move it faster and observe closely this time).
Cameron:	I observed that it moved a bit. (Seeming unsure as he checked if any one else in his group saw what he saw), and Ntokozo from the other group, that is, team 1, also stating that she detected a slight movement in the needle.
Teacher:	Did any of the other team members observe that as well, (no response).

Teacher:	(Giving the learners an opportunity to reflect on what they did/or did not do in the investigation, teacher checks with both groups if they had any questions about the experiment, or if there was anything they were not clear about while they were conducting the investigation.
Nkosenhle:	Why does the magnetic compass needle move when you place the needle into the toilet roll or coils?
Teacher:	The magnet has a magnetic field around it and this affects other metals brought close to it
Nkosenhle:	(Remembering this from the previous lesson).Electrons move around the stationary protons, (and on stating the type of charge on the electron, team members responded that it is 'positive' yet on checking information sheet supplied, response was changed to - 'negative'
Teacher:	(On finding out about the movement of electricity through a conductor teacher interacting with learners ...) Can a person see the electrons as they move along the copper wire?
Tapelo:	No, very small particles, and are called microscopic.
Teacher:	If something is said to be microscopic what does this mean?
Ntokozo:	That you can only see it using a microscope.
Teacher:	(Stating that electricity is the movement of electrons in the conductor). Can one see electricity while it is moving through the conductor? (Cameron says he can see it and Tapelo says he cannot see it, and teacher solicits views from others).
Nkosenhle:	We cannot see it. (Supported by Fikile and Thabile)
Teacher:	What do you think about the new home owners who are curious about what electricity is, how it works and the potential danger to themselves and their children - do you think this is so because electricity is invisible or because it can be seen?
Natasha:	I think it is because they cannot see it.
Teacher:	At your home where an electrical appliance is connected using a cord, are you able to see the electricity moving through the wires?
Natasha:	No.
Teacher:	Why.
Natasha:	The wires are covered with plastic.
Teacher:	If you had to remove the plastic exposing the copper wires would you then be able to see the electricity flowing through?
Natasha:	No, supported by Tapelo.
Cameron:	(Who said that he could see the electricity, explains ...) sometimes when you put two naked wires together you see an electric spark.
Teacher:	Does the spark tell you that it is electricity flowing?
Cameron:	Yes

Teacher: Sometimes when you join two wires end to end, a spark can be seen and at other times there would be none. When there is no spark, and the two ends are joined together, would you then see the electricity moving from one end to another.

Cameron: No, confirming that electricity is something we cannot see whilst moving through the conductor.

Teacher: (Returning to the investigation where the learners connected the two loose ends of the copper wires in the experiment, and pushing the magnet into the coil producing a small electric current which made the compass needle to flicker, asks the participants if they could see the electricity move along the conductor).

Cameron: I could not see it.

Thabile: Electricity is invisible or not visible. (And responding to the teachers question whether she has tried to look for it at home). No

Teacher: How do you then know that it is invisible? (A long silence follows).Did you see anything when your group did the experiment.

Thabile: No I did not see electricity moving in the wires

In response to Nkosenhle's earlier question and interest, "Why does the magnetic compass needle move when you place the needle into the toilet roll or coils?"

Teacher: What word or concept, do you think, the word 'electricity' is derived from?

Learners: (Not waiting to be asked to respond individually, shouted out together) - 'Electron'

Teacher: Has anyone heard an adult at home talk about an electric current, and what do you think this is? (Again the learners responded in unison - 'the flow of electricity', and, with Tapelo stating that it is the flow of 'electric charges', and when asked to express this in a sentence)

Tapelo: This is when electric current flows through a copper wire, electric charges are moving along the copper wire.

Teacher: The power station has to produce large amounts of electricity. Do you think the power station uses small or huge magnets and few or many coils to produce electricity? State why.

Cameron: Many coils, if you want more electricity you must have more coils.

Teacher: (Holding up the magnet) What else can be done to produce more electricity?

Siyabonga: Use bigger magnets

Slindile: They use big coils and big magnets, or big and strong bar magnets.

Analysis of Context Two

An analysis of the this context reveals what learners regard as important -

- A person must focus , be vigilant and observant when working with others on a task.
- Talking out loud in group investigations helps in making one's intentions known to others.
- Expressing own ideas and testing these in open discussion with others and mediator.
- Learning is about participation, doing and discussions of observations and respecting and valuing everyone's input.
- Asking questions about those things (science phenomena) that are not clearly understood.
- Previous learning helps and is useful in this context.
- Electricity cannot be seen, but is visible when seen through a microscope and when a spark sometimes jumps when two conducting wires touch, and, it can be experienced if one has felt a 'shock' or has been electrocuted.
- What happens at a power station occurs on a larger scale as compared with what was experienced in the classroom demonstration.
- Doing investigations raised critical questions (asked by Nkosenhle) and extends curiosity, level of interest and quest for knowledge: 'Why does the magnetic compass needle move when you place the magnet into the toilet roll with the copper coils?

Context Three: Informal discussion after the lesson, during interval

Reflecting on the lesson the teacher chats informally with the group - afterwards.

Teacher: What do you think about learning in this way, the way you have just learnt, that is, discussing, doing, thinking, questioning and so on?

Cameron: It is a way of learning in a way we want to learn

Teacher: Is it helping you, and how?

Cameron: It helps me to know more about electricity

Siyabonga: It helps me to learn more about electricity

Nkosenhle: (Whose hand by this time was stretched out into the air, indicating to speak) We ask questions, which we don't know, don't understand, not like in olden days - we couldn't ask questions, so it's easier for us to understand

Analysis of Context Three

An analysis of this context reveals what learners regard as important -

- It is a way we want to learn.
- It provides a space for learning the way they want to learn
- Freedom to ask questions in those areas where they don't know or understand, improves understanding on their part.
- It adds to their content knowledge.

Context Four: Responding to the question: Role and purpose of insulators.

Teacher: In the olden days, when people placed an iron in the fire to heat it, they had to put a cloth on the handle to hold it so they don't get burnt. What do electrical irons or appliances in your home have to prevent your hand from getting hot or electrocuted, and why?

Fikile: It has a plastic, for you're your hand not to get hot

Tapelo: It does not allow electricity to go through, so you do not get shocked

Teacher: Yes, what do we call those substances that do not allow electricity to go through, so you don't get shocked?

Cameron: Insulator

Teacher: Are such materials conductors or non-conductors?

Cameron: Non-conductors

Teacher: Turning to Slindile, what do you think about water, is it a conductor or non-conductor?

Slindile: It is not a conductor

Teacher: Is there anyone who can share their experiences with us so that we can help Slindile figure out the relationship between water and electricity?

Cameron: My mom was cutting grass outside, the chord was cut, and when I went to pick up the chord, my hands were wet and when I touched the naked part of the wire my hands got shocked.

Natasha: I was fixing our hi-fi radio because the plug was cut, my hands were wet and the switch was not off, when I was fixing the thing it made a sound - boo! and then my hand got shocked

Thandeka: My mom was fixing the iron and the wire was showing, and she got electrocuted, the switch was not off that time.

Tapelo: I saw my friend on the farm, he was washing his hands and then he touched the switch - the electric copper wire and his hands got shocked, it like shrunk.

Working on electric current, learners were asked what this is.

Jerome: The movement of charges inside a copper wire

Teacher: What causes them to move? (he hesitates for some time)

Cameron: The magnet causes them to move

Siyabonga: (assisted by Tapelo) Electricity moves from a side where there are a lot to an end where there are few.

Teacher: Where do they (that is, the electricity) move?

Nkosenhle: In the copper wire

Cameron was prompted to define what electricity is:

Cameron: (in his own words) Electricity is the movement of electrons from the end with most electrons to another with fewer, through a copper wire.

Analysis of Context Four

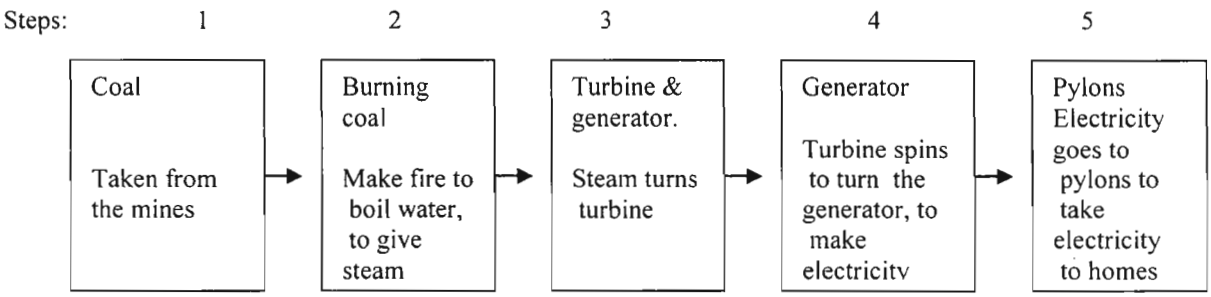
An analysis of this context reveals what learners consider as important -

- Electricity can be dangerous to people and they need to be protected (using insulators) and educated about these dangers or improper use
- Insulators are materials that do not allow electricity or heat to pass through them easily
- Such materials prevent people from getting shocked.
- Sharing of one's lived or personal experiences on electricity can help others who have limited or no experience, to learn and thereby broaden their experiences as well (in preparation for future use when needed).
- Sharing or verbalizing one's own understanding without being afraid of mistakes in areas where one has little or no prior experience.
- As seen by Thapelo, one's hands, if wet, can shrink if shocked by electricity.

Context Five: Use of Picture Puzzle pieces to describe and discuss the process of producing Electricity at a power station.

In the next task the learners explored the process of generating electricity at a power station (at say Eskom), through the use of coal as a source. The group is given one set of picture puzzle pieces (see workbook), which, when put together in the sequential steps, shows how electricity is produced, including the energy transfer occurring at each of the sequential steps (see workbook).

Result after the groups discussion and negotiations:



On questioning the energy conversions -

Teacher: What energy does coal contain?

Ntokozo: Chemical

Teacher: What energy conversion occurs in step2?

Nkosenhle: Heat energy to chemical energy.

Ntokozo: I think it is chemical energy to heat energy.

The group reached consensus and wrote: heat energy changes to kinetic energy for step 3, and in step 4 - the generator produces electricity.

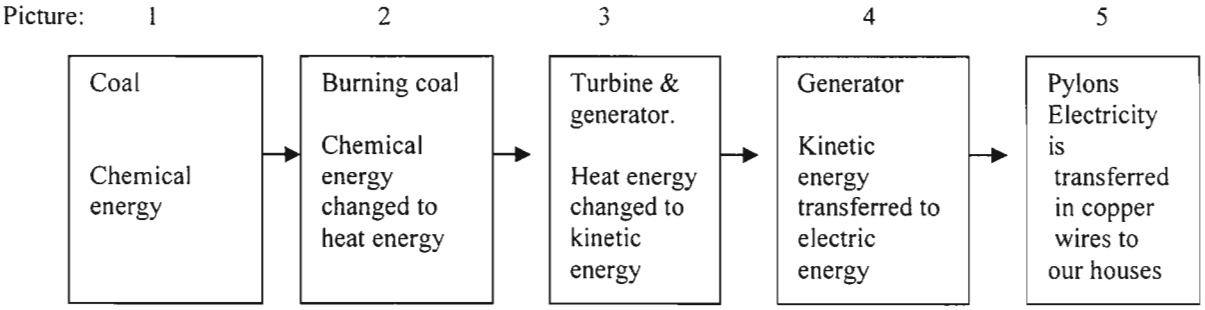
Teacher: What energy conversion takes place in step 4? (The group discussion yielded the following response): Kinetic energy changes to light energy

Teacher: Does the generator shine?

Siyabonga: No.

Lwazi: Kinetic energy changes to electrical energy.

Result after the groups discussion and negotiations:



After completing the above:

Felicity: (To the teacher) I would like to know what you think of our answer for picture number 5.

Teacher: What is your response?

Felicity: I agree that electricity is transferred from the pylons to our houses.

Teacher: What makes you think that it should be that way?

Felicity: I have seen it somewhere else and in this picture, now, and I have seen it on the streets and roads.

Teacher: Can you tell me a bit more.

Felicity: People working with electricity on the roads, when they are busy with pylons (near my home). I have seen people from Martin West (the local electricity supply department), hooking up on electricity boxes if electricity is faulty. Some of the boxes are on the house, and some on the road - cream in colour, with danger sign on it with a skeleton diagram on it.

With respect to the group's sequencing of the picture puzzle pieces to show the process of generating electricity at the power station:

Teacher: Where in the picture will the coil and magnet be found?

Fikile: (Pointing to the turbine) I think it is here.

Teacher: Reminding Fikile that earlier we heard how electricity and water do not mix, and that water is seen in that area.

Tapelo: I think they are in picture number 4 (pointing at the generator). Cameron and Thandeka also agreed with Tapelo.

Cameron: I have a question: How does the coal contain chemical energy? Where does coal get its chemical energy from, because I could have gone for rocks, bricks or plants.

Teacher: That is a very interesting question.

Cameron: I think the plants and animals in olden days got extinct, their bodies got fossilized.

Teacher: This must have happened millions of years ago. Which one do you think yielded the coal we have today - dinosaurs or tree trunks?

Fikile: I think it's the dinosaurs.

Teacher: Which one's body, dinosaurs or tree, would you say or guess turned into some kind of oil? You can always pay the library a visit to find out more.

Tapelo: I think the tree's body turned into oil

Teacher: Can you explain

Tapelo: The dinosaurs have like liquids in their bodies, and have fats too.

Teacher: Which one then can be turned into oil?

Tapelo: The fats

Teacher: So, which one can give us the oil and which can give us the coal?

Fikile: The dead dinosaur can give us oil and the dead tree can give us coal

Teacher: (to Cameron) our coal is possibly from dead fossilized trees, what do you think about that?

Cameron: I think its true

Teacher: So, where do you think coal gets its chemicals from?

Cameron: From fossilized tree stumps

Teacher: How do you think these chemicals got into the fossilized tree stumps?

Cameron: When the trees were growing they had chemicals in them, the tree died and still had chemicals in it, it was fossilized and the chemicals grow stronger. So I don't think rocks are used as they do not have chemicals.

Analysis of Context Five

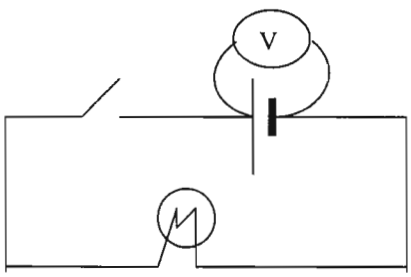
An analysis of this learning context reveals what the learners regard as important

- Sharing knowledge in a collaborative group helps in constructing meaning through the use of picture puzzles
- Respect for the contribution of peers helps to shape a negotiated meaning of the process of producing electricity at a power station
- Two different groups working on the same task arrived at the same outcome (sequential order of the process) yet with an emphasis on different aspects in the process, namely, group 1 focussed on what actually happens at each stage, and group 2 focussed on the energy conversions occurring at each stage. Combining the two ways of making meaning gave a more informed understanding to the participants
- Grappling with own (that is, the group's) understanding of the process of electricity generation first, before calling on the help of the mediator , and requesting for his opinion or thoughts on the topic of discussion - "what do you think of our answer?"
- Sharing one's own previous experiences on the topic has relevance in negotiating meaning in a social learning context
- Learning is about asking questions on the subject, directing these at one's peers and mediator, and/or then making an attempt to address one's own question and then checking if others agree or disagree.
- Sharing ones information gleaned from other sources or contexts such as the library.
- In the process of generating electricity, coal is experienced as having special properties as compared to any other type of rock mined or found in nature - the presence of chemical properties obtained from a previous pre-historic age ('the trees were growing and had chemicals in them' and 'in olden days got extinct' and in this way 'dead fossilized tree stumps' made 'the chemicals (to) grow stronger')

Context Six: Drawing Circuit Diagrams and connecting the components of an electrical circuit, and making comparisons with what happens at a power station

This Task was introduced to develop links and make comparisons with what happens in a power station. The focus was placed on the flow of electricity in a conductor from a source to the users. The participants worked as a group making use of the learner scaffold (see workbook), in order to draw a circuit diagram from a pictorial representation thereof, to one using symbols for the different components in the electrical circuit.

A drawing resulting from the groupwork:



Discussions from the group:-

Ntokozo: (explained to the group what she did in the above diagram, and how she drew her diagram, and why) See above

Slindile: Why did you use these symbols?

Ntokozo: It is said here that it is easier to use symbols instead of drawing the whole picture.

Nkosenhle: We use symbols instead of the picture of a cell or a globe.

Ntokozo to Nkosenhle: Why did you say we have to move the arrows?

Nkosenhle: Because the switch was not on, it was off and that was why we did not put these arrows.

Slindile: Waz'kanjani iswitch izo cima? (How do you know the switch is not on?)

Nkosenhle: Yes the switch was off (pointing to the diagram), you can see in the picture.

(In a session involving the following participants: Team Two: Thandeka, Thabile, Tapelo, Lwazi, Siyabonga)

Teacher asks: Does electricity move in a straight line from A to B, or in a circle formation, that is from A to B, and then back to the origin at A?

Tapelo: In a circle(circular) pathway, i.e. starts at A (source) and moves all aroud and then back to A.

Teacher: In the picture, who can trace this path followed by the electricity.

Thabile (pointig using the picture): The circuit starts from the cell and goes to open switch and the travels back to the cell.

Teacher asking Lwazi: Do you think Thabile has identified the path or do you think there is another one?

Lwazi: She followed the circuit, from the cell, to the light bulb, open switch and back to the cell.

Teacher: (Referring to the picture in the workbook, and reminding learners to use an appropriate thinking tool to help themselves to learn). Do you think the light bulb will shine, or not, in the picture while the components are connected in the way that they are?

Tupelo: I think it wouldn't shine, the open switch is off.

Teacher: So what must we do to make it shine?

Tupelo: Close the open swtch.

Teacher: There is something else which has not yet been mentioned that is connected in the pictorial electric circuit, what is this part called, look again?

Tupelo: A voltmeter.

Teacher: What is its job or purpose in the circuit?

Tapelo: To see how the electricity is,how strong it is.

Teacher: Where, in bulbs,switch or battery?

Tupelo: In the battery.

Teacher: Is this component part or adjacent to the main circuit? (No response, and on reframing the question) Is it part of the maincircuit, or is it forming another side circuit of its own?

Siyabonga: It has its own circuit, yet connected to the battery.

Teacher: What do you think it is there for, and what does it do?

Siyabonga: It shows how strong the electicity is.

Tupelo: I agree, it tells how strong is the electricity to make the light shine.

Teacher: (Passing a cell to one of the group members) Let us look at a battery and see how big the ability to produce electricity is in the battery as it is written there on it.

Lwazi: I see a letter V on the battery, and 1.5V is written.

Teacher: What does the V stand for.

Tupelo: Volt.

(In another session on circuit diagrams, the participants commented on the role played by each of the different components in the path of an electric current)

Teacher: What is the 'job' of the cell or battery?

Lwazi: It produces electricity and gives this to the open switch and the light bulb.

Teacher: (Pointing to the circuit in its current form) Will the bulb shine?

Thabile: Yes. Thandeka disagrees with Thabile and states that the open switch is off.

Thabile: Yes the bulb won't shine, (and responding to teacher's prompting question) the switch is not joining with the conductor, the switch is off. Lwazi agrees with her giving the same reason.

Teacher: What is the 'job' of the voltmeter?

Tapelo: It tells us how strong electricity from the cells, ... the voltmeter shows us 2.8V right now (2 cells in series)

Teacher: When we connect the light bulb (using the crocodile clips), the voltmeter reading shows another reading - (to which response are made: Thabile: 12V and Thandeka: 5V) - we used the 3V terminal to connect the voltmeter, hence our readings should not be more than 3V, let us use the readings from 0 to 3V (pointing to the inner scale on the dial of the voltmeter, to which the above learner's responses change, Thandeka: 1.2Voltmeter and this was corrected by Tapelo: 1.2Volts, that is, 1.2V).

We have observed that on its own the voltmeter reading shows 2.8V, and when connected with the light bulb shining as well, the reading shows 1.2V. Why do you think the voltage decreases (gets less) when the bulb is on or shining?

Tapelo: The bulb is using up electricity, (Teacher: excellent! What produces it? All the hands are raised almost immediately, to indicate that they would like to advance the response, regardless of what the other members think or, whether thy agree or not)

Lwazi: By the cells.

The groups then moved over to the corner where they would connect the components of an electric circuit, in the same manner as they have drawn in the diagram earlier.

Components given: circuit board, bulb, copper wire, voltmeter, switch, 2 cells.

Teacher inquiry with regard to the voltmeter, and how it is connected -

Ntokozo: Outside the main circuit.(and it is then moved to sit near the cell and is connected there. The cells, voltmeter, switch are all connected properly)

Teacher: If you need help, just give a call.

Ntokozo: How can we connect this (pointing at the open end between the bulb and the one end of the cells).

Teacher: Let us see how the picture diagram is connected and if we have any loose wires, let us join them up to complete the circuit. Electricity only flows if parts are connected properly.

Nkosenhle joins the loose ends using the crocodile clips (this was also then was used as a switch to show how the bulb shins or goes off by clamping or removing the clips).

Teacher: What happens to the bulb when the clips are removed?

Team: (Together this time)The bulb stops shining.

Teacher: Is it a complete or broken circuit?

Team: It is a broken circuit.

Teacher: Can one of you trace the path of the electricity as it moves around the circuit.

Nkosenhle: Electricity moves from the negative side ...

Teacher: Point out the pathway using a pencil and move it slowly from the cells back again to the cells.

Nkosenhle: The electrons move from the side where there is a lot of electrons to the side where there are less (without pointing at a path, but at the cell. He then points at the pathway, without talking- moving from the negative end of the cells, along the conductor to the shining bulb, and back to the positive end of the cells)

(Making use of the above learning and making links to and comparisons with the manner in which the power station works)

Teacher: Which part of our circuit diagram is like, or works like a power station?

Thandeka: The cell (pointing at it), confirmed by Siyabonga, and then by all

Teacher: What compares with the connectors or copper wire in our circuit? The copper wires of the circuit, what do they stand for at the power station?

Thabile: Copper wires. It shows us electricity from the power station, copper wire carries the electricity, the wires here show us the pylons.

Teacher: Are you saying that the pylons are the poles holding up the wires, or are you saying that the pylons are the copper wires?

Thabile: They are the poles that are holding up the copper wires carrying the electricity from the power station. (Teacher: that is very clear, thank you)

Teacher reiterates the role of the copper wire and the pylons when electricity moves to our homes.

Teacher: On the road near most home with electricity one finds a cream power box, what warning signs are seen on these?

Thandaka: Danger, ingozi

Teacher: From the power box on the road the cables move in underground cables to the house and is connected to a meter box outside the kitchen wall, and then enters the house to be connected at the circuit board which has a cover and switches inside, from here it goes to the users in the house. What uses electricity in our homes?

Lwazi: stove; Siyabonga: TV; Thandeka: Radio and microwave; Thobile: iron.

Analysis of Context Six

An analysis of this context, reveals what learners consider as important -

- Drawing diagrams helps in the clarification of concepts on electricity and how it moves along conductors from a source to users such as bulbs.
- Learning from peers with relevant prior knowledge.
- Discussion and visualizing information through the use of diagrams promotes learning and understanding of an abstract concept such as electricity.
- Written instructions are better understood when interpreted in a group, and meaning is shared or co-constructed.
- Access to science language is made possible through collaborative discussions with peers.
- Making comparisons using tangible information in the classroom and from the learner's own immediate environment facilitates transcendence to other learning situations (such as a distant or imagined power station).
- Local electrical installations and power boxes occurring in the community help learners in their learning about the supply or transport of electricity, and serve as evidence and existence of a distant source such as Eskom.
- Learning in the classroom is influenced by factors or realities outside the classroom, this learning is influenced by larger social and economic forces.

Context Seven: Steps to explain how electricity comes to our homes.

Learners use a wall chart poster to explain how electricity moves from the power station to our homes. The teacher first recapped what the group have learnt thus far i.e. power generation process up to the point where electricity goes to the pylons. Using the wall chart or poster, the learners attempted to recount out loud, the steps along the process which indicates how electricity reaches our homes.

Siyaboya: From the pylons, electricity travels to the substation, from there to the transformer, then to the overhead cables, then to the underground cables, then to the house lights and plugs.

Thandeka: From the substation to the transformer to the overhead cables to the underground to our homes through the cables.

Lwazi: From the pylon to the substation, then to the transformer and then to the substation to the underground cables to our homes.

Teacher, refering to the generator, and pointing at the portfolio boards completed by the learners, and pointing at the step dipicting the generator, asks: What is inside the generator,in this picture, that helps to produce electricity?

Tapelo: A magnet and ..... (seeking for assistance from the group)

Lwazi: ...and a copper wire.

Thandeka: ...and coils, a ... coiled copper wire.

Tapelo: ...and a magnet inside the coil.

Teacher: Great stuff! What must happen to the two, the coil and copper wire?

Lwazi: One of them must move. (Teacher: Yes, and probes him for the role played by the compass needle). The compass shows us the presence of electricity moving in the wire.

Analysis of Context Seven

An analysis of this context, reveals what learners regard as important -

- Learning as sharing information.
- Learning as collectively making sense of a wall chart containing multitude of pictorial data.
- Tracing the path of electricity flow in conductors by speaking out loud by one member to peers, and assisted by them when in doubt or unable to trace the path on one's own.
- Co-construction of knowledge even if learners and mediator have different skills and knowledge in relation to the topic.

Context Eight: Colouring-in activity to indicate the colour codes for connecting a three-pin plug.

Learners do a colouring-in exercise in their workbooks (see workbook), in which they explain how a 3-pin plug is connected to a standard 3-core flex wire used in most homes with electricity. The colouring-in activity also explores their understanding of the colour coding of the electrical connection. This task is in preparation of the learners when they would be required to actually connect a real plug to an electrical appliance found in homes i.e., a fan). The learners are given 4 crayons, blue, brown, yellow and green, or they use their own, to shade in the appropriate colour on each of the 3 individual wires of the 3-core flex wire. Learners are allowed to discussions with their peers. After some activity and discussion, the group asked for assistance from the teacher.

Lwazi: (To the teacher) Are the colours correct?

Teacher: What are the colours you have shaded for the different wires?

Siyabonga: (Pointing) Green, brown ...(and Tapelo interjecting asks:) Is blue the right colour?

Teacher: Please clarify your question Tapelo, can you say a bit more and be specific so that it can be clear to me so that I can be in a position to give you the appropriate help.

Tapelo: We coloured in live...blue, and number 1 is brown (Teacher interjecting asks is the plugs at home have a number 1 written on them, or if the letters of the alphabet are used instead. To this Siyabonga said: letters).

Siyabonga: We coloured in Nuclear...brown, (Teacher; nuclear?). Natural ...

Teacher: What does N stand for? ... (No response). What does E stand for? Siyabonga: Earth. What does L stand for? Thabile: Live. What does N stand for? Siyabonga: we not sure if it is nature or something else.

The learners were asked to name the letters they have seen on the gear lever of motor cars, and what the letter 'N' stood for.

Siyabonga: Reverse is R (Teacher asking them to think of the other letters found there on the gear lever)

Lwazi: N stands for neutral. (When asked whether any other learners have seen this letter - N, most of the learners responded affirmatively)

Teacher: Do you think we can label this letter N in our plug with the term neutral?

Siyabonga and Thandeka now smiling said yes, and everyone then wrote this somewhere in their workbook. (Tapelo: I will write the letters and what each one stands for to remind me)

Teacher: Can someone repeat the question or assistance you asked of me earlier.

Siyabonga: We asked you if blue is supposed to be here (pointing).

Teacher: Let us use the letters when asking a question, so that we are more specific.

Siyabonga: Is blue supposed to be connected to live?

Teacher: Does your group think that it should be connected to live?

Siyabonga: (First responded by saying that they said so, and when asked why he excluded himself and, if he was no longer part of the group, responded) All of us, we said so. We agree that blue goes to live and we are not sure.

Teacher: (Hesitating, and on the brink of giving the learners the correct answer, takes a 3-pin plug connected to the 3-core flex wire of a working classroom portable fan, holding up the plug, asks) What is this?

Thandeka: 3-pin plug.

Pursuant to the question the group asked the teacher earlier, the teacher asks the group to open the plug in order to find the answer to their question above. The group is given a screw driver and a plug connected to the fan.

Siyabonga opens the plug, and when he lifts the cover, all the other learners stand up, lean forward with heads almost clashing together to self-discover a 'hidden-truth' so to say, namely, what letters are there and which colour is each of the individual copper wires, i.e., the colour code.

Siyabonga: The blue is supposed to be in neutral and brown is supposed to be in live.

Teacher: So what is the group going to do now?

Siyabonga: (Realizing the urgency of the matter) We are going to try to fix it. (He begins erasing immediately without consulting the team, changing the colours to depict those reflected in the open plug in front of him)

Teacher: (Asking Thabile) What is the correct colour code?

Thabile: Blue wire is connected to the N, brown by live. (Teacher: great!)

Reflecting on the activity, the teacher checks with the learners who stated that they found things out on their own, and that they were helped by the teacher to find the answer by themselves. Teacher: How? Thandeka: by giving us the plug to find out for ourselves, we opened the plug and saw how the wires were connected and then connected our diagram. Siyanda: we are now 100% sure of our answer.

Analysis of Context Eight

An Analysis of this context reveals what learners regard as important -

- Learning by doing stimulates a lot of interest and can be fun.
- A colouring-in activity adds a tinge of reality to the learning situation - how a plug works.
- Learning in this way taxes learner's observation skills - challenging them to be more vigilant and to pay more attention when people repair or connect electrical appliances at home or elsewhere.
- Learning by doing heightens one's sense of inquiry from one's peers and teachers.
- Seeking confirmation of attempts at learning on one's own or from others.
- Seeking guidance from more capable or experienced others.
- Self determination through personal inquiry.
- Making mistakes as being part of learning in this context - one can always 'fix it' because an explosion cannot occur in this context.
- Learning through self exploration and discovery, that is, seeing is believing.
- Learning that one can act or do something about what is important to them, and gaining greater control over the learning situation.

Context Nine: Connecting a three-pin plug to an electrical appliance such as a fan.

Learners are given the context in which they must now connect a 3-pin plug to an electrical appliance using a screw driver. They make use of a guiding rubric which will be used to assess the groups skill in carrying out a proper connection.

Observation: Siyabonga carries out the first step recounting loud to the group what he is doing - opening the plug screws.

Thandeka reads the second step, Tapelo: untie the screws, Thandeka: colour coded wires to appropriate pin, and firm connection to plug pins, Lwazi: look for the holes in the pins and put the wires into the pin holes and tighten screws firmly. Siyabonga uses the screw driver, Lwazi twists the separate wire threads together before placing this into pin holes for tightening with screws. Screws in place, the cover is replaced and the team declare the task complete.

Tapelo: Now we can try it on in the socket and see if the fan will work.

Teacher: (Taking the plug and examining it from the outside, reminds the learners that they were to do a proper check as laid down in the assessment rubric before them).

Tapelo: (Asking for the plug after checking the picture in the workbook, states) We have made a mistake. (Holding the transparent plug with the pins facing upwards, states) The brown wire is supposed to go to the live.

Teacher: (To Tapelo) Hang on, let us look again at the picture in your workbook, how is the plug held, are the pins facing up or are they facing down, and, is this transparent plug held the same way? (Holding the plug with the pins facing down, teacher asks if the brown wire is on the right hand side. Team: Yes. Now let us place a finger on this side where the brown wire is supposed to be, and slowly turn the plug over to se if the brown wire is correct. The team looking said: Yes.

Teacher: (To Tapelo) So, what is it that you think is wrong? (Tapelo: I thought we made a mistake, the pins must face down) Not all plugs have a clear see-through plastic cover. Some even have the colour code paint markings on the inside next to the appropriate pins to guide you connecting the wires. Now, let us check again, do you think that you have met all the criteria to connect a plug correctly as guided by your rubric?

Siyabonga: Some of them are left out. (The teacher gives the group another chance to check again)

Observation: The group consulted with Siyabonga on those aspects that were not yet done, and he pointed out that the outer insulated wire was not between the cord grip because the three individual wires were visible outside the plug. The plug cover was removed, Tapelo stated that the three wires must not show outside the plug. Lwazi wanted the cord to be placed between the plastic (cord grip), and Thandeka reads the appropriate step in the rubric, namely, cord firmly held by the cord grip. The plug cover is then replaced.

Teacher again reminds the group to see if all the criteria have been met in connecting a 3-pin plug, and asks what the group did to complete all the steps.

Tapelo: We made sure that the 3-core flex wire is firmly held by the cord grip.

Teacher: That is a very important step, let us check. (Tugging on the cord while holding the plug in the other hand, and demonstrating this gripping action by holding Thabile's hand and asking her to pull it back. And cautioning) If the cord in your home is not held firmly by the cord grip, a spark may result in the plug if one of the wires is pulled out of its pins, and this may cause a fire in the house. Securing the cord and the individual wires inside the plug onto the pins is very important for safety with electricity.

The assessor then applies the assessment rubric to check if the group has met all the other criteria for connecting a 3-pin plug, by opening the plug. The plug is then connected to the wall socket and the fan works.

Analysis of Context Nine

An Analysis of this context reveals what learners regard as important -

- Interaction with peers and the Educator stimulates learning
- Co-construction of meaning is about democratic classroom learning processes, influencing how decisions are made, and how the topic is discussed amongst learners with (or without) the mediator.
- Great care is needed in making firm connections with appropriate colour codes in this context of doing.
- A heightened sense of caution and alertness, as fatalities are to be avoided in the context of real electrical appliances.
- Knowing the appropriate colour codes is non negotiable - learning is being more aware of possible errors.
- Competency in this task is seen as meeting all the criteria made public at the beginning of the task (as contained in the rubric for assessing learner performance of the task).
- Drawing on a different discipline in a way that leads to a better understanding of the task (namely, Technology - for the design, needs and wants related to 3-pin plugs)

3. Phase 3:

This phase deals with the assessment of the learners, and comes in three forms.

3.1. Formative Assessment

The ongoing day-to-day assessment of the formative type is part of learning and teaching/mediation. Assessment of this type includes the feedback given or received between the learner and the mediator of learning. It involves two-way rich communication during classroom interaction. The verbal or written feedback in the form of comments and/or marks is immediate, and informs development and progress in the teaching and learning situation.

Formative assessment is enabled and managed through the use of a workbook containing learning support material in the form of:

- assessment tasks (with assessment criteria),
- short tests,
- investigative tasks,
- information sheets, and
- reference material

Most of the above serve as learner scaffolds (See Probe, page 247).

3.2. Summative Assessment

All the Grade 8's at the school, inclusive of the participants in the study, wrote a common Summative Assessment task under normal controlled examination conditions. This type of assessment is an end of term assessment, which is combined with the formative and continuous assessment scores for each candidate. The summative assessment score is reduced and forms 25% of the overall assessment, while the summative assessment mark is reduced to a score of 75%. The overall assessment of each learners is based on the combination of the two types of assessment, giving a score of 100% as indicated on the table below (See Table 7, page 193).

With respect to the participants the following results were obtained for the summative assessment. The June 2004 Test Scores are those that are obtained as a result of the learner's participation in the study, and the March 2004 Test Scores, presented for making a comparison, were obtained before the learners participated in the study (See Table 4)

Learner's Names	March 2004 60	%	June 2004 100	% Increase/ Decrease
Felicity (FK)	38	63	73	+10
Cameron (Ck)	41	68	75	+7
Natasha (NL)	34	57	55	-2
Thandeka (TMa)	49	82	83	+1
Thapelo (TMo)	54	90	92	+2
Fikile (FL)	43	72	69	-3
Jerome (Jj)	36	60	74	+14
Silindile (Ss)	28	47	54	+7
Thobile (Ts)	42	70	71	+1
Nkosenhle (NM)	51	85	85	0
Sandisile (SMn)	39	65	45	-20
Ntokozo (NL)	48	80	89	+9
Lwazi (LG)	42	70	80	+10
Siyabonga (SM)	43	72	71	-1

Table 4. Participant's Test scores from the study (June 2004) and their previous Test scores prior to the study (March 2004)

From Table 4, we notice that 9 out of 14 (i.e., 64%) learners' test scores reflect a positive growth on previous test results, and 1 out of 14 (i.e., 7%) learners' test score reflect no improvement on previous test scores, while 4 out of 14 (i.e., 29%) learners' test results indicate negative growth on previous test results.

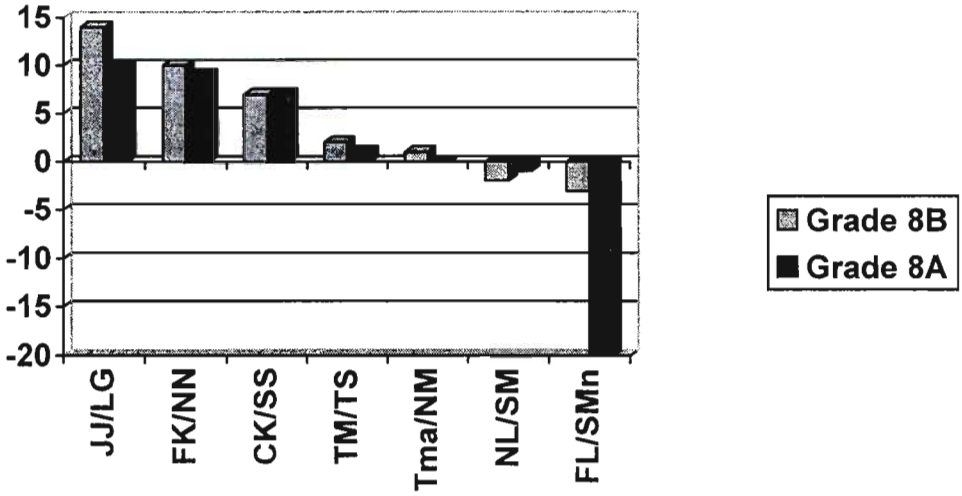


Figure 12. Percentage of participant's (Grade 8 learner's) current test scores showing increase or decrease as compared to previous (prior to the study) test scores

Figure 12 shows the percentage increase or decrease of each learner's current test score (as a result of participating in the study), compared to his/her previous score (obtained outside the study). The test scores are paired off where two learners with the highest mark, and from different class groups - 8A and 8B - were coupled for easy reference and analysis, and then the next two and so on, in descending order.

Graph showing percentage increase or decrease of each learner's personal score based on his/her previous score. For example, JJ's (Grade 8B) score in the June test has increased by 14%, whereas LG's (Grade 8A) score in the June test has increased by 10%.

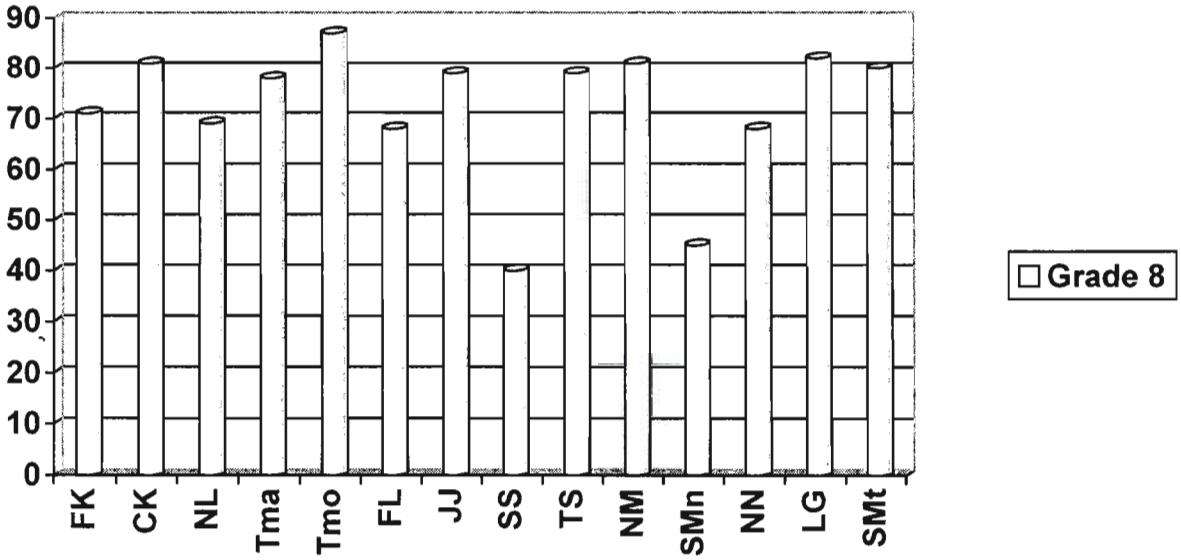


Figure 13. Grade 8 CASS scores -as percentage

The above graphical representations, Figure 13, reflect each learner's Continuous Assessment (CASS) Scores for the unit of study. The CASS mark is obtained by adding each learner's Summative assessment score (that is, the formal assessment score which is calculated as a mark out of 25) and his/her Formative assessment score (that is, the informal assessment score which is calculated as a mark out of 75), giving a total mark out of 100.

A statistical analysis of the CASS generated by the school's computer revealed the following data of the entire school's Grade 8 learner population who also learnt the same learning unit through, mainly, the constructivist learning approach.

80-100	70-79	60-69	50-59	40-49	33-39	30-32	25-29	20-24	0-19
A	B	C	D	E	F	FF	G	GG	H
9	21	32	49	39	14	5	5	1	35
Highest Mark 87%		Median 52%		Roll 218		Number Failed 46			
Lowest Mark 2%		Average 47%		Number Wrote 210		Number Passed 164			

Table 5. Statistical analysis of all the Grade 8 learner's CASS scores - June 2004

Table 5 reveals the learner achievement of all the 8th Graders at the school in the CASS conducted during the third term in the month of June 2004, the time in which the study was conducted. From the total number, (that is, 14) of learners who participated in the study, 10 of them (that is, 71% of the participants) are amongst the high achievers obtaining more that 70% achievement in their assessment scores, which are further broken down as follows: (6 learners achieving A symbols, 4 learners obtaining B symbols, 2 learners obtaining C symbols, one a D symbol and one an E symbol)

Achievement or non-achievement in the Outcomes Based Education framework uses the following rating system to assess learner performance. This rating system is comprised of codes, percentages and level descriptors (Department of Education, KZZN Circular No. 81 of 2004):

CODE	PERCENTAGE	DESCRIPTOR
1	1 -34%	NOT ACHIEVED
2	35 -39%	PARTIALLY ACHIEVED
3	40 - 69%	ACHIEVED
4	70 - 100%	OUTSTANDING/EXCELLENT

Table 6. Rating system showing rating scales (DOE, 2004)

The above rating system was used to evaluate or make overall judgements of learner performance in this study. It was also used to provide feedback, and to report to the different stakeholders (namely, the learners, moderator, parents and the institution)

The learning Unit or Probe (Workbook, see Annexture 13) and the final product presentation provided the continuous assessment mark (i.e., 75%), and the formal assessment task or 'test' provided the summative assessment mark (i.e., 25%). The learner's final assessment is obtained by adding the continuous and summative assessment scores (i.e., 100%), and in this way , the relevant code and level descriptor is obtained (see below).

Candidates	Continuous Assessment- (Workbook)	Presentation 5 learners	Total	Conversion	Summative Assessment	Conversion	**Total**	Code
	80	20	100/80	**75**	100	**25**	**100**	1-4
Lwazi	69	15	84	63	80	20	83	4
Cameron	66	16	82	62	75	19	81	4
Thandeka	61	13	74	56	83	21	77	4
Thapelo	68	17	85	64	92	23	87	4
Nkosenhle	65	14	79	59	85	21	80	4
Felicity	57	/	57	53	73	18	71	4
Natasha	59	/	59	55	55	14	69	3
Fikile	54	/	54	51	69	17	68	3
Jerome	64	/	64	60	74	19	79	4
Thobile	66	/	66	62	71	18	80	4
Siyabonga	67	/	67	63	71	18	81	4
Ntokozo	56	/	56	53	89	22	75	4
Sandisile	44	/	44	41	45	11	52	3
Slindile	31	/	31	29	54	14	43	3

Table 7. Table used to show how the overall assessment of the participants was arrived at

The above table provides the results of learners performance in the study unit or learning programme they participated in, that is, 'Electricity in our home or school'. Promotional minimum requirements for the end of year results are set by the Department of Education. In some Learning Areas the minimum requirement rating is a 'partially achieved', while an 'achieved' rating is required in the fundamentals (namely, Languages - LLC and Mathematics - MLMMS).

3.3. Performance Assessment

3.3.1. Mock Portfolio Presentation

A practice session for the Portfolio Presentation at a provincial showcase.

A small group (consisting of 7 learners) participated in a practice session in order to sharpen their presentation skills of information depicted on the portfolio boards.

In exploring the transportation and use of electricity to our homes, the learners make use of the appropriate portfolio boards to discuss how electricity enters, and, how it is used, in the homes.

Teacher: (Focussing on the picture -compiled by the team who worked on the board- showing 'how electricity enters the house' and then splitting up to each of the users such as a stove, TV, or a fan. A similar arrangement would apply where a portable generator or car battery is in use). On the diagram, how many sets of wires are there connected at the entry point to the home?

Tapelo: Two sets, one is moving away from the cells, and the other is moving back to the cell passing the bulb.

Teacher: Can any one please describe the path of the flow of electrical current.

Cameron: The movement of electricity in a copper wire from the source to the users and back to the source.

Teacher: With regard to the power station, does the electricity also move in a circular fashion as in a classroom demonstration of a circuit using a torch cell, or is there no such circuit there? Do you think that the electricity comes into the house and then it just gets used up, or stays there, or does it move in form of a circuit, meaning, that electricity comes from the power station, comes into the house, to the users and then out of the house back to the power station?

Siyabonga: It does have a circuit, electricity comes from the power station, into the house to the main box, to the users, then, ...

Cameron: ...it goes underground and, ...

Nkosenhle: ...after the users in the house, it goes back to the power station.

Then, going to the portfolio board, Thapelo explains how electricity works in our homes (pointing at the appropriate diagram)

Tapelo: From the power station, it comes into our houses, it goes to the users (pointing to the lower section of the diagram where in the circuit the individual appliances are connected, and then points to the top end of the connections, and then back out the second connecting wire).

At another practice session, a group of 3 learners again practiced their presentation Skills working with the portfolio boards. The teacher interacts with the members, and asks for an explanation from the learners.

Tapelo explains: (Reading the heading on the portfolio board) - 'How electricity gets to, and is used, in our homes'. The diagram shows us a parallel circuit. It is named like this because every appliance has its own switch, and its own plug. (Pointing to the diagram) The arrow shows that electricity comes from the source, to the users and then back to the source .

(Pointing to the next picture showing a section of a 3-core flex wire with a bit of the insulation pulled back to expose the colours of the individual 3 wires whose insulated tips are cleared to expose the copper wire of each, explains the colour codes shown, and the pins each is connected to.

(Pointing at the insulation, explains) this is used to keep the wires together, and prevents the electricity coming out.

Nkosenhle, working on another portfolio board with title 'Sources of electricity', is asked by Thapelo to explain how he managed to draw the pie chart which shows the sources used to generate electricity in South Africa.

Nkosenhle: You first place a mark on the circle for zero to begin with, so that you can measure in degrees. You then first say 91(as 91 is obtained from the 91% of coal which is used a source to generate electricity in South Africa) out of 100 multiplied by 360 as the whole circle has 360 degrees, and then you use a calculator to get the answer: 327,5 rounded off to get 328 degrees.

Then 360 - 328 will give you 32 degrees and you measure 32 degrees from zero. Then the second one was nuclear at 7%, ... 7% over 100 multiplied by 360 degrees will give you ...

Lwazi (coming to his assistance): So you did the calculation on a rough paper here (pointing to the sheet where Nkosenhle did the calculations)

Nkosenhle: Nuclear is 25 degrees. The problem is burning coal. People have realized that large amounts of carbon dioxide and other poisonous gasses are put into the air causing danger to plant and animal life on Earth.

Lwazi: I have also taken a look at this bar graph and realize that a lot of coal is used to produce electricity. Now what happens when all this coal gets finished as it is a non-renewable resource? I don't think its right because once it is finished we would not have electricity anymore. I think the Government should try to use other resources, what do you think?

Nkosenhle: Ya (yes), I think coal burning, it brings a lot of danger to our environment, it gives air pollution.

Thapelo: In the ozone, temperature rises and in few years our ozone layer would be damaged.

Nkosenhle: There are other sources (to be explored) like nuclear, it is a good source that can be used.

Thapelo: Why do you think so?

Nkosenhle: It doesn't bring danger, although it has its own dangers, it doesn't cause a lot of air pollution to the environment.

3.3.2. Portfolio boards presentation at a show case

A team of 5 participants were selected to participate at this level. The show case took place at a venue outside the school, at Fern Hill Conference Centre in Howick, Kwa-Zulu Natal. Of the 27 school teams that participated, each school team had to select their own topic of interest, and one which has an impact on the local community as a social issue of concern. Each team had to present its topic, where each team member approximately 4 minutes to present his/her findings before a panel of three judges. After the presentation the team had to respond to questions fielded by members of the panel (similar to the questions asked during the mock presentations in class). The following serves as feedback by learners on their own participation, that is, written comments on their experiences at this level.

Thapelo: It (the experience) was quite good because I listened to the others (other participating school teams) about their topic and they listened to us, but I was nervous. I needed to be more confident, but I think I tried my best.

Thandeka: It (the experience) was very good and exciting, although I was nervous, but I was still brave enough to share my findings with the other schools. It was a great experience, and the part that I enjoyed the most was the talk about poverty presented by the team from one of our neighbouring schools.

Cameron: I was a bit afraid, but once I saw the other teams deliver, I got a bit more confidence. Maybe, in my opinion, we could have done better than good if we had more hours of practice.

Nkosenhle: I was excited because it was my first time doing it. I did very well, but I had a problem when I was at the stage, I was nervous.

Lwazi; It was good for me. I enjoyed it. I also talked to other children and I learnt about other things. I think we all did good.

Analysis of Context of making a presentation

An analysis of this context, reveals what learners consider as important -
a. During mock presentations:

- Realizing that one can act or do something about what is learnt and important.
- Working in this manner helps in deepening understanding of science knowledge.
- Learning involves drawing on other disciplines leads to a better understanding of the problem, task or concept(s).
- Asking insightful and critical questions in relation to science process and resource use.

b. Presentation before a panel on stage:

- Justifying solutions or findings.
- Display or portfolio boards help in information sharing in a persuasive way.
- Listening to others, and being listened to is valued.
- Being afraid or nervous is normal and part of life and learning.
- First time experiences lead to nervousness, learning from these is exciting and great.

4. Phase 4:

This phase is based on the learner's reflections.

4.1. Focus Group Interview

Learner's Responses from the semi structured Interview using interview schedule (see Annexture 10). What follows are the transcripts of the learner's responses to the questions in the interview schedule.

Question 1: Learning environment

How would you say the learning environment contributed (or not) to your learning of the above topic?

You may comment on any of the following aspects: the activities, group discussions, workbook, the teacher, books/pictures, writing board, language, other learners or adults.

Cameron: The teacher, because if there was something that I don't understand, the teacher explained it to me. (Interviewer: Give an example where this happened) in the science lesson, contributing to my understanding, with electricity in our homes, the teacher helped me to understand.

Lwazi: The group, it helped me when I did not know the answer. (Interviewer: how, can you say a bit more) Because I felt that, we would talk so that I would know what I know, this helped me.

Jerome: (Prompted by the Interviewer) I think a ... the group discussions, example, if one person in the group don't know any answers, then all help each other to find it. (Interviewer: so the group helped you to learn something better, can you give an example to help me understand how this happened for you) When we talk we were discussing something about electricity, and I did not know it, maybe Cameron (my peer) will give me the answer, this helped me to know, and I can get the answer.

Siyabonga: (Prompted by the Interviewer) The portfolio boards helped me when we were connecting the plug to the 3-core flex wire. (Interviewer: How did that help you?) The portfolio board. (Interviewer: Say a bit more) Silent.

Thabile: The group discussion helped me, When I am scared to answer, and the group help me when I don't know what to do (say). (Interviewer: You mentioned that there were times when you were scared, say a bit more about those things, or people that made you scared to ask for help). The ... I think that sometimes the teacher is going is going to shout at me and he/she will say I don't listen. (Interviewer: were you shouted at one time?) No (saying this with a measure of reluctance.

Interviewer prompting all the interviewees to be frank and say exactly how they feel and how this issue affects your learning, and that no one would be victimized as this interview is confidential. So, what happens when a teacher shouts at you, or raises his/her voice, how do you feel?) I don't feel nice. (Teacher: do you learn better or not?) I don't learn better. (Interviewer: what kind of a teacher would you consider to be a good guide for you, so you can learn better?) If the teacher is telling me nicely, and not shout at me.

Ntokozo: (Prompted by the Interviewer) Language, I learn in English and isiZulu, both help me. (Interviewer: you stated that both languages helped you, explain) Sometimes I learn in English, if I don't know then I learn in Zulu. (Interviewer: do you learn in isiZulu and then you say it in English, or is it the other way around, explain). I think in Zulu, and say it in English, my group is mostly Zulu learners. (Interviewer turning to Jerome: How do you feel when your group members spoke in isiZulu in your group? Did this help you or not?) Jerome: I felt confused, I told them and they said they will explain it in English.

Question 2: Learning Point

2.1.What is the most outstanding learning point you gained from learning about this topic? Namely, electricity in our home. The portfolio boards were also opened to help the learners to focus.

Tapelo: I learnt about safety measures in our home, to learn more about electricity so that I can know what are the dangers about electricity and be safe. (Interviewer: explain how this helps you) To teach others to know how to be safe. (Interviewer: imploring the learners to comment openly, repeated the question in isiZulu so that learners can feel free to state what they learnt)

Ntokozo: I learnt what electricity is, and the interest I had was satisfied. (Interviewer: explain, say a bit more) Now I can tell people how electricity works.

Thabile: I learnt about safety with electricity in our home, I learnt that one must not overload the 3-pin plug, it is danger, it can make a fire, as this is something ... I have noticed this unsafe thing at home before.

Thandeka: I learnt about the electricity is generated, and my interest of safety with electricity in our home has been addressed. Now I can tell me brothers and sisters and family about the safety with electricity.

Lwazi: Working with the generator, and my interest in hoe electricity is generated was satisfied, also what electricity is. I also learnt about the steps of producing electricity in a power station. This I learnt with the experiment we demonstrated in class... what was interesting was that it (the experiment) gave me an idea how it is produced.

Nkosenhle: For me it was when I worked on the portfolio board one, that is, looking at the sources of electricity, I learnt about where electricity comes from using coal burning. (Interviewer: what do you think about this source, are there any problems associated with its use in our country?) It does cause harm at the power station, where it produces pollution to the environment.

2.2.What do you now know that you did not know before?

Lwazi: I know now to connect a plug, which I did not know before. I had to replace the plug by my house and I did not know and I put the wrong wire in the wrong place and it caused a spark, and I nearly got shocked.

Tapelo: I know how electricity is generated in a power station, I did not know before.

Slindile: (Prompted by the interviewer) I learnt how electricity is generated. (Interviewer: would you be able to explain to someone else if they asked you how it is generated?) I can. (Interviewer: can you give us one of the steps how this is done - repeating the sentence in isiZulu)

Burning coal, boils water, the spinning turbine is moved by water that is boiling, and the steam comes from the boiling water.

2.3.What can you now do that was not possible before?

Tapelo: Connect a plug to a 3-core flex wire, which is connected to a fridge.
(no further responses, as this appeared to be general skill learnt by most, and moving on)

2.4.How has this learning changed your outlook towards your life, or that of others?

Lwazi: I can help people by telling them what to do and what not to do, foe example, if they play by the power lines. (Interviewer: prompting learners for their responses in helping others who do not know about the dangers of playing near or with power lines or other exposed electrical cables)

Tapelo: I will warn them, and help my friends/people who steal electricity to connect cables correctly.

Lwazi: I am going to help people, I am going to give back everything I know, so they can know what is wrong themselves (so) they can help others.

Nkosenhle: I will try and help people

Thobile; I will tell my family that they mustn't overload the 3-pin plug because it can burn the house (if they do).

Question 3: Meta learning (learning how to learn)

3.1.Looking back at the way you learnt in the different tasks, what are the things that contribute (or did not) for you to learn how to learn?

Interviewer provides a brief motivation first, stating that teachers often assume that learners know how to learn what is being taught, and they carry on teaching a lesson regardless of the struggles some learners may have in learning the topic, whatever it may be. There may be a number of barriers to student's learning. Questioning a person verbally or in written form is one way of checking if a person learnt or did not learn anything.

The Interviewer reiterates the above question (repeating it in isiZulu as well)

Tapelo: The experiment helped me to learn how to learn, it gave me an example on how electricity is produced. Without it I would not have been able to understand how it is produced. (Interviewer: how did it help you?) When we connected the copper wire to the cells, the light was shining. (Interviewer: asking the team to assist here, did the experiment use cells or were there none?) Lwazi: There were no batteries, we used a magnetic compass ... Tapelo: I remember now, we used a magnet and coils, the faster the magnet move in the coil, and more electricity was produced.

Thandeka: The portfolio boards, in each and every topic we learnt about, we learnt everything step by step. It showed step by step how electricity is made and how it is transmitted to our homes. I was working with my peers who also helped me to understand.

(Interviewer: what did you do?) We did some experiments, did some notes, stuck in some pictures, and we talked and talked and talked, all about ...

Thabile: Agreeing with Thabile, there should be lots and lots of talking, it helps me to learn how to learn. It helped me because if people talk, I take their points.

Slindile: We should talk more in our groups, this helps me.

Lwazi: The talking also helped me. The teacher helped me too., when I needed to know, I asked the teacher a question. (Interviewer: there were times when learners asked the teacher a question, and he/she often did not answer, but turned the question around by asking the learner(s) to state what he/she thought the response to his/her question was.
How did you feel when he/she did this to you?) I did not like it, as I needed to know ... I had a question, now the teacher is asking me the question.

Ntokozo: Listening helped me. By listening to my group, I could answer lots of questions. I learnt better with the group, when they talk and we discuss things that I don't understand.

3.2.What does this, the above (3.1) look like? You may use "if ....., then ....."
statements to describe this learning.
Learner's responses with respect to the task: 'What electricity is, and how generated'

Ntokozo: If I use the Learning tool 'Feeling of competence', then I believe in myself and I try my best to help and share my thoughts, and with the 'Thinking tool -'Planning', I plan whatever I am going to do or say.

Thabile: On the Learning tool 'Sharing behaviour', it help me to behave myself and share with my group what I am thinking, and, with the Thinking tool 'Selective attention', it help me to plan well

Lwazi: The Learning tool 'Feeling of competence' help me to energize feelings and actions, thought and behaviour, and development of beliefs about being capable of learning and doing something effectively. If I use the thinking tool 'Selective attention, this help me to focus on the information needed in learning experiences.

Thandeka: If I use the Learning tool 'Feeling of competence', then I will energize my feelings, actions, thought and behaviuors, and I will develop beliefs about being capable of learning and doing something effectively. If I use 'Sharing behaviour', then I will be interdependent by sharing my thought with others and enhancing collaborative learning. If I use Thinking tool 'Selective attention', then I focus on the information needed in learning experiences and will understand what is going on.

Nkosenhle: Learning tool 'Feeling of competence', I am going to make it, I can not let myself down. I will make it, and Thinking tool 'Selective attention' helps me to focus on what I am doing, and make sure you do not focus on something else.

Siyabonga: If I use Learning tool 'Self development' this helps me to value my personal qualities and to enhance my personal potential. If I use Thinking tools then I will know I am doing like 'Planning' and to enhance my personal potential.

Felicity: If I use 'Feeling (of competence') and actions, thoughts and behaviour and developing beliefs about being capable of learning and doing something effectively, I felt like I was at home, I felt comfortable in front of my group members. If I use the 'Planning' tool to prepare a detailed method of approach to the learning experience, I will know how to plan in the future or next year, and, if I use 'Selective attention' to focus and listen to what others had to say and (then I) learn more.

4.2. Clinical Interview

These interviews were conducted with a small group of four learners. The learners were interviewed individually, each interview session lasting approximately 15 minutes. The interview is semi-structured to probe learner's for a detailed explanation of their experiences. Interview scripts were used as reference to derive other questions used to probe interviewees.

Six guiding interview questions were posed to each participant, to which other additional questions were asked leading from the responses made by the selected participants. The questions are described below:

On the Study Unit you learnt, namely, 'Electricity in our home or school' -

1. What have you gained as an active participant in the study?
2. What stood in your way of gaining more from the learning activities?
3. Looking back, what would you do differently in order to learn or get more if you were given another chance to do the activities again?
4. What do you regret not doing while you were learning about the topic?
5. Interpretation of meaningful learning.
6. Usefulness of the learning environment.

Thobile: 1.On what she gained from learning.

I have learnt how electricity is used, how it is produced at the power station, where it comes from, how to connect it using the different colour codes, the uses of electricity inside and outside the home. Learning about the dangers of electricity stands out the most for me - Why? Because some people do not know how to use electricity and some get shocked and die. I want to help my friend how to use electricity. Some have asked me if I can help them, because I told them what I know about electricity, and they trusted me.

2.How did this make you feel - what your friends thought about you? It made me feel happy and proud of myself.

3.What gave you the confidence to help others?

'The way I was learning it is that at home I was doing experiment and my teacher was helping me to understand it'

4.What stood in your way of gaining more from the learning activities?

There were people playing and making a noise while we were working in my group. Some members were not serious about working on the topic.

5.Interpretation of meaningful learning. It means that I am important to learning. It is that one must not say all the things the teacher says is true. It is also that one must have a question. Self regulation can lead towards successful learning and doing

6.Usefulness of the learning environment. I always pay selective attention as it helps me to understand because I focus on the information that is needed in learning experiences. The other children and the teacher helps me, and they explain to me when I don't understand. The people who help me give me a chance to speak and they listen to me when I'm talking.

Cameron: 1.Why was it important for you to learn about electricity?

Because I want to teach other people about safety. At school there are un-insulated switches inside and outside classrooms that might shock someone. At home one socket is over loaded with too many adapters and plugs and it might cause danger. In the community there are fallen street poles, and children or animals that play in the street might get shocked.

2.What gives you the confidence to help others?

The way that I learnt with my group, and when we investigated the safety measures. The presentation boards and my Workbook notes also helped me, and I was also working when my group and I were investigating, and the teacher gave us a chance to correct what we did wrong, and gave us help when we needed it.

3.What stood in your way of gaining more from the learning activities?

I could have learnt more if the teacher left me to also learn on my own. If my group let be do the investigation.

My group could have given me the task to do the investigation or made me collect the information. If I was serious about my work and focussed on what I was doing. The school could have taken action to reduce the noise while I was learning.

4.How can the teacher or the school help to gain more?

The person to help me is a person that I like to help me is a person that corrects me when I am wrong. For me school is like a garden, where the teachers have the water to put on the plants when they need it.

5.Interpretation of meaningful learning. It means learning that is not only meaningful to the teacher, but also to the student. Something is meaningful by the fact that I am learning some thing that I understand. The opposite is meaningless learning, and systematic exploration is a useful learning tool.

6.Usefulness of the learning environment. My friends, they help me understand the things that I don't understand. The teacher is a resource who knows best on the topic and helps with the explanation on what I don't understand. The environment helped me a lot.

Nkosenhle: 1.I have gained knowledge and skills, I know more about the dangers and safety measures, and how electricity is produced in the power station. I have learnt to do things on my own such as connecting a 3-pin plug using the 3 colour codes and their appropriate pins. I have learnt securing the 3 wires firmly in the cord grip to avoid dangers to the house - it might burn down and then we'll be homeless.

2.What got in the way, was when other learners were saying I'm stupid, asking why I went to the science class during interval, and sometimes I also felt dumb.

3.If given another chance, I would seriously do my work and only focus on the topic I am learning and just ignore those who tease me, and just do what I'm doing

4.Regrets I have. Not warning the children when they were playing with the half insulated switch which they kept switching on and off. It might have electrocuted someone, and I would feel guilty about it and regret not reporting exposed electrical wires to the school. Next time I will warn the school about being safe in the school with electricity.

5.Interpretation of meaningful learning. It means understanding my lesson or work, and the teacher must explain in a meaningful way. The opposite is not understanding and not knowing. Personal challenge is a useful learning tool as it challenges you to learn and know more about your work and to face new experiences.

6.Usefulness of the learning environment. ....

Lwazi: 1.I learnt how electricity is generated, and how to be safe with it. It is important for me to know because I can tell other people who do not know about it, I can even open a business with the knowledge that I have. I can be independent about something in my life, and others will be to. At one time I got shocked by electricity and I did not understand why and how it shocked me. Now I know and I understand why, and more people can get help through my knowledge.

2.What got in the way? We had little time and some children were not sure if they wanted to know or not

3.Improvements for next time. I would work more than last time and again give all my best in what I would like to know and find out more.

4.Regrets on what was not done. I would like to finish the project as soon as possible because it would now be easy.

5.Interpretation of meaningful learning. It means you can learn what ever you want. It is learning about something that has meaning. The opposite is not understanding the work that you are doing. Self development and sharing behaviour are useful learning tools.

6.Usefulness of the learning environment. Regulation of one's self is needed. The teacher and other learners helped me when I didn't know. They helped me to look and to listen.

4.3. Reflective Diaries

The learner's reflections are based upon the different learning tasks and experiences they were engaged in during classwork activities. Each learner kept his/her own journal entries book in which the date and topic for the learning activity was entered. Learners were assisted with the journal entries in so far as the provision of different categories for which they could enter their own comments, namely:

Category 1: What I have done to-day
Category 2 : What I learnt to-day
Category 3: What I think about it (that is, what I did or learnt)
Category 4: I thought ....
Category 5: How I will act in future.

The first journal entry pertains to the topic: What is electricity? And how is it produced? Learner's journal entries to category 1 were as follows:

Task: 1 What is electricity? How is it produced?

Learner's responses to category 1: What I have done to-day

I learnt about electricity and how powerful it is. Felicity,
How electricity moves. Siyabonga
An experiment on electricity. Jerome, Natasha, Thandeka, Fikile, Cameron
What electricity is and how it is produced. Ntokozo, Sandisile, Slindile
I investigated what electricity is. Lwazi
How electricity is made with a magnet. Nkosenhle
Made a chart on how electricity is connected and how it is produced. Fikile

Learner's response to category 2: What I learnt to-day. I learnt -

About atoms, electrons (-) and protons (+), and that like charges run away from each other. . Felicity
Where electricity came from and what a power station is, and that negative stand for something that move and positive for something that don't move. Siyabonga
Where electricity come from, how it is produced, and about negative and positive charges. Jerome, Lwazi, Nkosenhle, Tapelo
About how electricity works, and about the different sources. Natasha
About atoms, electrons (-) and protons (+), and a negative repels a negative. Felicity, Thandeka
That electricity goes through a copper wire, and that it is the movement of electrons from where there is a lot to where there is few. Ntokozo
What electricity is. Sandisile
That it is transferred from Mpumalanga. Slindile
That (the) Scientific model uses a microscope to see atoms. Thabile.
That electricity is invisible. Thandeka
What exactly electricity is, how it helps people, and the safety rules of electricity. Fikile
That you can see the effect of electricity on a compass needle when the components are joined together. Cameron

Learner's response to category 3: What I think about it (i.e., what I learnt)

I was confused at first, and learnt more and more as time went on. I also learnt of the different sources for generating electricity. Felicity
That electricity is better than using a candle because a candle can burn your house and make a big fire, and I think that we will never see electricity. Siyabonga
That electricity makes our lives much easier but we must know the dangers of electricity. Jerome, Tapelo
That electricity is not a thing to play with, you can put yourself in danger. Natasha
That electricity is good. Ntokozo, Sandisile, Lwazi, Fikile
That we (could) see the small object with naked eyes. Slindile
That electricity is so dangerous. Thabile
So far so good, I am still learning. Lwazi
That it gives me knowledge. Nkosenhle
To teach others and to understand it myself, and information I learnt is important to know. Thandeka
I think now that I learnt a lot about electricity. Fikile
That electricity is a very powerful but control-ful force. Cameron

That if you need electricity you just turn the button, compared to old forms of heating. Tapelo

Learner's response to category 4: I thought .... (i.e., about electricity)

That electricity was just a strong current that had a lot of power. Now I know it has a lot of power and can even kill many people. Felicity
That electricity comes from the Eastern Cape, and that it will not shock you if your hands are wet, and that you can see electricity. Siyabonga
There was only one source, but now I know there are different sources like solar, hydroelectric dams. Jerome
That electricity was not so powerful, now I know it is very powerful to (not) play with. Natasha
That electricity moves because of money that we pay. Ntokozo
That if I use electricity, I can not touch a copper wire if my hands is wet, if I do it (will) shock me. Sandisile
That maybe electricity come from generation. Slindile
That an example of energy that is man made is hydro-electricity. Thabile
That electricity was made by coal only, and not by using water , and a magnet.Lwazi
That they use a cell to make electricity. Nkosenhle
That it was going to be difficult learning and understanding electricity, but I was wrong, and that my peers in class to-day taught me a lot about electricity. Thandeka
That electricity was a circuit which moved around the copper wire, meantime it is the electrons that do so. Fikile
That electricity could never be seen through a microscope. Cameron
That when you touch a door knob and you get electrocuted, may be it was lightning, and the lightning struck on the door knob. Tapelo

Learner's response to category 5: How I will act in future (because of what I learnt)

I will tell or teach other people who don't know about electricity. Felicity, Jerome, Natasha, Ntokozo, Slindile, Nkosenhle, Thandeka, Fikile, Cameron, Tapelo
I will not touch electricity with wet hands or dry. I will not touch a plug if the switch is not switched off, and I will never say that you can see electricity. Siyabonga, Thabile
I will be a Scientist to observe things like electricity. Natasha
I will not play with electricity, I know how it can be dangerous. Lwazi
I will tell others about the advantages and disadvantages of electricity. Cameron

Task 2 : Drawing electrical circuit diagram

Learner's responses to category 1: What I have done to-day

Connected a electricity circuit. Ntokozo.
A electricity circuit. Slindile

Learner's responses to category 2: What I have learnt to-day. I learnt -

How to draw a electric circuit, and connect a electric circuit. Ntokozo
About the battery volt, and selective attention (learning tool) helped me to learn. Nkosenhle
About the circuit, and about the learning tool- planning- it help me learn that sharing can help me to learn. Sandisile.
The volt meter to move to number three. Slindile

Learner's responses to category 3: What I think about it (i.e., what I learnt)

What helped me to learn is the learning tools , i.e., feeling of competence. Ntokozo

That it is a good thing to draw symbols instead of drawing the pictures. Nkosenhle
To know how the circuit work. Sandisile
What helped me to learn is self development, sharing behaviour, systematic exploration. Slindile

Learner's responses to category 4: I thought ....
That there was no amp and volt meter. Ntokozo
That electric circuit was the power station. Nkosenhle
The circuit can tell me it is very easy to make a circuit, and there are so many way to make the electricity. Sandisile
To see it is easy to make the circuit. Slindile

Learner's responses to category 5: How I will act in the future
I can tell or help people who don't know about electricity. Ntokozo, Nkosenhle, Sandisile, Slindile

Task 3 : How Electricity is generated. First re-arranging the picture puzzle pieces of the process, then labeling the different steps, and identifying the energy types (and energy transformations at each step.
Learner's responses to category 1: What I have done to-day
The electricity generation process. Ntokozo
How electricity is generated. Siyabonga, Slindile, Thobile
Solved a puzzle of a power station. Lwazi
Learnt about the different types of electrical energy. Nkosenhle
Learnt about coal producing electricity. Sandisile
Wrote the process steps of generating electricity at a power station. Cameron
Unscrambled the puzzle pieces to show process of producing electricity in a power station. Thandeka, Natasha, Felicity, Thapelo
I learnt that coal contains chemicals from fossilized dinosaurs (plants). Tapelo

Learner's responses to category 2: What I learnt to-day. I learnt -
A lot about electricity, and how it get to our home. Ntokozo
I learnt the different energies. Siyabonga
The steps of how electricity is produced. Lwazi, Sandisile, Thobile, Thandeka
How the power station works. Nkosenhle
That coal is a chemical energy, and that electricity is also generated in a power station. Cameron, Natasha.
About electricity by re-arranging the picture puzzle pieces. Felicity
How electricity moves from power station to our homes. Fikile

Learner's responses to category 3: What I think about it
That it is easy to learn the different energies. Siyabonga, Nkosenhle
That I know more and better about electricity. Lwazi
That some people don't know where electricity comes from. Slindile
That electricity is so easy to produce. Sandisile
How Scientists use the Scientific model to explain about electricity as it is invisible. Thobile
That electricity can be very powerful if you increase your coils, or using a more powerful magnet. Cameron

That electricity is a very interesting topic to discuss, I learnt a lot and can teach others. Thandeka
That it is very nice to learn about electricity by doing puzzle about it. Natasha
That it was hard to right the energies at first, but I finally found out how to do it. Felicity
That they are very brave to produce electricity with coal, and they must watch out because coal will be finished (in) a couple of years. Tapelo

Learner's responses to category 4: I thought ....

That electricity came from magnetic bar and coils. Ntokozo
That we only have one energy, namely heat. Siyabonga
That the power station did not have to burn coal. Lwazi
That the electricity was produced by the cell. Nkosenhle
That electricity is so easily produced using coal. Sandisile
That electricity is made from underground. Thobile
That electricity can not be made at home, but now I know that it can, as we have learnt how in class. Cameron
That electricity is so easy to learn and understand. If you really interested in it, how it works and how it is generated. Thandeka
That coal comes from dinosaurs , but now I found out it comes from decayed trees. Natasha
That coal comes from dinosaurs, but now I know it comes from trees. Felicity
That electricity came from underground. Fikile
That the chemicals from the coal comes from fossilized trees. Tapelo

Learner's responses to category 5: How I will act in the future

I will tell other people who don't know how it works and how it is made. Ntokozo, Siyabonga, Lwazi, Nkosenhle, Cameron, Thandeka, Fikile
I think about my future and what electricity is transferred by. Slindisile
I will never touch copper wire with my hands. Thobile
I will tell others about safety with electricity. Cameron, Thandeka, Tapelo
I will learn more about electricity. Felicity, Natasha

Task 4 : How to connect components and a plug.

Learner's responses to category 1: What I have done to-day

I connected a 3-pin plug, wrote down the points of the 3-pin plug, and entered the colour codes. Thandeka
How to fix a plug. Thabile
How to connect a plug, and (ensure) firm connections. Tapelo
I fixed a plug, and learnt more about plugs and sockets. Lwazi
I have connected a plug to an appliance that did not have one. Siyabonga

Learner's responses to category 2: What I learnt to-day. I learnt -

How to connect a 3-pin plug, and safety rules for connecting it. Awareness of self change helped me to learn. I recognize and understand my feelings of being confident and I learnt something to-day, and that was a change in me. Thandeka
About a plug and electricity, and selective attention helped me to learn. Thobile
How electricity is produced in a power station , and that we have a parallel circuit in our homes for the connections, and that a parallel circuit is safer than in a series circuit. Tapelo
I learnt about a three pin plug and electrical sockets. What helped me to learn is awareness of self change, and self regulation. Lwazi

How to connect a plug to a three core flex wire. What helped me to learn was inner meaning, I have learned something. Siyabonga

Learner's responses to category 3: What I think about it

That what we learnt to-day is very interesting, and it is easy to learn and understand. Getting the main idea helped me to think, and to identify spontaneously - I got the main idea to-day. Thandeka

If you fixed up plugs, it is dangerous. The feeling of competence helped me to think. Thobile

That a Parallel circuit is more safer than a series circuit. Tapelo

It improved my knowledge about electricity, and planing helped me to think. Lwazi

It is not hard to connect a plug to a 3-cor flex wire. The thinking tool exploration helped me, this helped me, as I was not thinking of any other thing at the time. Siyabonga

Learner's responses to category 4: I thought ....

That it would be hard to learn about what I learnt, but it wasn't, I understand everything that we learnt. Thandaka

That it is easy if you fixed a plug.Thobile

That a neutral wire is a natural wire. Tapelo

That a plug is one thing with a socket. Lwazi

That we do not have the holes for the wire inside the plug. Siyabonga

Learner's responses to category 5: How I will act in the future

I will teach and help others. Thandeka, Tapelo, Siyabonge

I will not touch electrical wires with wet hands. Thabile

I will fix the plugs in my home. Lwazi

Annexture 3 The following tables serve as summaries of the data constituted in phase 4 above.

4.1. Focus Group Interview

Learner's responses from the above interview are recorded in the table below.

Learner	1.How has the learning environment contributed or not to your learning?	2.1.What have you gained/learnt?	2.2.What do you now know?	2.3.What can you now do?	3.1.What did you do to help you learn? What strategies?	3.2.What does this (i.e. strategy) look like? Use 'if... then...' statements.
1.Cameron	The teacher -helped me understand using explanations					
2.Lwazi	The group -helped me when I did not know the answer. Talking helped me to know what I know now	How electricity is generated in a power station. This was my interest, it was satisfied. Interesting to me was the experiment, it gave me an idea how electricity is produced.	The steps in the process of production of electricity. How to connect a plug and avoid sparks or shocking.	Replace a plug at home. I can now help people so that they can know and also help others (e.g. not to play with power lines)	The talking helped me. The teacher helped me too, as I asked him when I needed to know. I did not like it when he turned the question around and asked me ... as I needed to know.	'Feeling of competence' helped me to energize feelings and actions, thoughts and behaviour, and development of beliefs about being capable of learning and doing something effectively. 'Selective attention'

						helped me to focus on the information needed in learning experiences.
3.Jerome	Group discussions - we all helped each other find answers, especially when I did not know something, I picked this up from the discussion.	NB. I feel confused when my group switches to Zulu, I told them and they said they will explain it in English (this is in response to Ntokozo's input)				
4.Siyabonga	Portfolio boards - they helped me when we connected the 3-pin plug to a 3-core flex wire.					'Self development' helped me to value my personal qualities and to enhance personal potential. 'Planning' helped me to know what i/m doing and to enhance my potential.
5.Thabile	Group discussion - when I was scared	Safety with electricity in the	Do not overload a plug, it can cause a	Teach others how to be safe. I will tell	Agreed with another learner that there	'Sharing behaviour' helped me to behave

	to answer it helped me when I did not know what to do or say. I thought the teacher was going to shout at me and say I don't listen. I have been shouted at by a teacher before and I don't feel nice or learn well if this happens. A helpful teacher speaks nicely to me.	home	fire. I have noticed this unsafe thing at home.	my family not to overload the plug as it can burn the house.	should be lots of talking, it helps me to learn, I take (note of) their points.	myself and share with my group what I am thinking. 'Selective attention' helps me to plan well.
6.Ntokozo	Language -I learn in English and isiZulu, both help me. If I don't know something in English, then I learn in isiZulu. I think in isiZulu and say it in English as my group is mostly Zulu	What electricity is. This was my interest and it is satisfied.	...	I can tell people how electricity works	Listening helped me. Listening to the group helped me to answer lots of questions. I learn better with the group when we discuss things that I don't understand.	If I use 'Feeling of competence' then I believe in myself and try my best to help and share my thoughts. 'Planning' helps me to plan whatever I am going to do or say.

	speaking.					
7.Thapelo	The team -it helped me to remember things when I am stuck.	Safety measures with electricity in the home.	How electricity is generated in a power station.	Connect a 3-pin plug to a 3-core flex wire. I will warn people and friends who steal electricity to connect cables properly (so they can be safe).	The experiment helped me to learn. It gave me an example on how electricity is produced.	…
8.Thandeka	…	How electricity is generated. My interest in safety with electricity is addressed.	…	I can tell my family about safety with electricity.	The portfolio boards. We visibly learnt step-by-step how electricity is produced and sent to our homes. We did experiments, wrote things, stuck pictures, talked and talked and talked. My peers helped me understand.	'Feeling of competence' helped me to energize my feelings, actions, thoughts and behaviour, and development of beliefs about being capable of learning and doing something effectively. 'Sharing behaviour' helped me to be independent and

						share my thoughts with others and enhance collaborative learning. 'Selective attention' helped me to focus on the information needed in learning experiences and to understand what is going on.
9.Nkosenhle	The portfolio boards- helped me, especially the second one entitled 'Sources of electricity'	The source of electricity. I learnt where electricity comes from, especially with respect to burning coal.	Coal as a source of electricity causes harm by polluting the environment.	I will try to help other people.	...	'Feeling of competence' - I am going to make it, I can not let myself down, I will make it. 'Selective attention' helped me to focus on what I am doing, and to be sure that I am not focussing on something else.

10.Slindile	…	How electricity is generated.	The steps in the electricity generation process at a power station.	Explain to someone how this is done.	We should talk more in our groups - it helped me.	…
11.Felicity	…	…	…	…	…	'Feeling of competence' helped me in my actions, thoughts and behaviour, and developing beliefs about being capable of learning and doing something effectively. I felt like I was at home, I felt comfortable in front of my group members. 'Planning' helped me to prepare a detailed method of approach to the learning experience. I will know how to plan in

						future. 'Selective attention' helped me to focus and listen to what others had to say and this made me learn more.

4.2. Annexture 4. Clinical Interview

Learners responses to the above interview are recorded in the table below.

Learner	1.What have you gained from your learning?	2.What stood in your way of gaining more from your learning?	3.What would you do differently in order to learn more if you are given another chance?	4.What do you regret not doing during your learning?	5.What is your understanding of meaningful learning?	6.Usefulness of the learning environment?
1.Cameron	That un-insulated wires or fallen street electric poles can shock people and other animals. Overloaded plugs and sockets are dangerous. The confidence to teach other people about safety with electricity.	The teacher, I could have learnt more if he left me to also learn on my own. If my group allowed me to do the investigation and collect the information needed. If I was serious about my work and focussed on what I was doing. The school could have taken action to reduce the noise while I was learning.	I would get more pictures and more information so people could understand better	Not saying all that I knew including the Eskom crime line	Learning that is not only meaningful to the teacher, but also to the student. If I am learning something that I understand. The opposite is meaningless learning. 'Systematic exploration' is a meaningful learning tool.	The presentation/ portfolio boards and Workbook notes helped me. The teacher gave us a chance to correct our work and gave us help when we needed it. My helper, one that I like, is a person who corrects me when I am wrong.

2.Lwazi	How electricity is generated. How to be safe with it. Knowledge -so that I can tell other people who do not know about electricity, so that I can open a business on electricity, so that I can be independent about something in my life. Knowledge to understand how and why I got shocked.	Little time. Some learners are not sure if they wanted to know or not.	Work more and give all of my best in what I would like to know. Find out more.	Would like to finish the project as soon as possible because it would now be easy.	You can learn whatever you want to. Learning about something that has meaning. The opposite is not understanding what you are doing. 'Self development' and 'Sharing behaviour' are useful learning tools.	Regulation of one's self is needed. The teacher and other learners helped me when I did not know. They helped me to look and listen.
3.Nkosenhle	Knowledge and skills. I know more about dangers and safety measures (with electricity). How electricity is produced in power	Other learners saying I was stupid when I went to the science class during interval. Sometimes I felt dumb.	I will focus on the topic I am learning, and just ignore those who tease me. I will warn the school (leaders) about being safe with electricity.	Not warning the children (at school) when they played with a half-insulated switch - putting it on and off. It could have electrocuted them, and I would	Understanding my lesson and work. The opposite of meaningful learning is not understanding and not knowing. 'Personal challenge' is a useful learning	...

	stations. Connecting a 3-pin plug using colour codes.			feel guilty and regret not reporting exposed electrical wires.	tool, it helps me to learn and know more, and to face new experiences.	
4.Thabile	How electricity is used in or outside our homes. Where it comes from and how it is produced in power stations. How to connect it using colour codes. Learning about the dangers stands out most - because people have been shocked or died due to poor knowledge, some have asked me to help them, Some trust me on the topic as I have told them what I know.	Other learners playing and making noise. Some were not serious about working on the topic.	I will focus more for other information and some things that I didn't here nicely	Not paying careful attention, but I learnt some things.	It means that I am important in learning. Not saying that all that is said by the teacher is true, one must have a question. 'Self regulation' can lead to successful learning and doing.	I always pay 'selective attention' as it helps me to understand, because I focus on the information that is needed in learning experiences. The teacher and other students help me by explaining and giving me a chance to speak, and they listen to me when I am talking.

	This made me feel happy and proud of myself. Doing experiments at home gave me confidence.					
5. Thandeka	Learning skills and a lot of knowledge and information	I could not attend all the group sessions as I had to rush home to look after the babies at home	Make sure that I attend meetings after school, pay more attention to the information given	Paying attention, listening to others and understanding the work	Understanding the work in such a way that you know what you are learning	It was very useful because now I can share my findings with the others who don't know anything, and I can protect my family.
6.Thapelo	…	…	…	…	…	…

4.3. Annexture 5. Reflective Diaries

Learner's responses are recorded in the table below which reflects the 5 following categories.

Learners Task	Category 1: What I have done to-day	Category 2: What I learnt to-day	Category 3: What I thought about it	Category 4: I thought ...	Category 5: How I will act in the future.
Task: What is electricity, how is it produced?					
1.Cameron	An experiment on electricity	That you can see the effect of electricity on a compass needle when the components are joined together	That electricity is a very powerful but control-ful force	That electricity could never be seen through a microscope	I will tell or teach other people who do not know about electricity. Tell others about advantages & disadvantages about it
2.Lwazi	I investigated what electricity is	Where electricity comes from, how it is produced and about negative & positive charges.	So far so good, I am still learning, that electricity is good	That electricity was made by using coal only, and not by using water or using a magnet	I will not play with electricity, I know how it can be dangerous
3.Nkosenhle	How electricity is made with a magnet	(see above for Lwazi)	That it gives me knowledge	That they use a cell to make electricity	(see above for Cameron - first sentence)
4. Thandeka	An experiment on electricity	That electricity is invisible	Teach others and understand it myself, information I learn is important to know	That it was going to be difficult learning and understanding electricity, but I was wrong, and that my peers in class to-day taught me a lot about it	(see above for Cameron -first sentence)

5.Thapelo	…	(see above for Lwazi)	That electricity makes our lives much easier, but we must know the dangers with it	That when you touch a door knob and you get electrocuted, maybe it was lightning that struck the door knob.	(see above for Cameron -first sentence)
6.Thabile	…	That the Scientific model uses a microscope to see atoms	That electricity is so dangerous	Hydro-electricity is an example of man made energy	I will not touch electricity with wet or dry hands, or touch a plug if the switch is not off
Task 3: How electricity is generated. Use of picture puzzle pieces to indicate the process, and the different steps, and identifying the energy transformations.					
1.Cameron	Wrote the process steps of generating electricity at a power station	That coal is a chemical energy and electricity is generated in a power station	Electricity can be very powerful if you increase your coils or using a more powerful magnet	That electricity cannot be made at home, but now I know that it can, as we have learnt how - in class	I will tell others about safety with electricity
2.Lwazi	Solved a puzzle of a power station	The steps of how electricity is produced	That I know more and better about electricity	That the power station did not have to burn coal	I will tell others who don't know how it works and how it is made.
3.Nkosenhle	Learnt about the different types of electrical energy	How the power station works	That it is easy to learn the different energies	That the electricity was produced by the cell	(see above for Lwazi)
4.Thandeka	Unscrambled the puzzle	The steps of how	That electricity is a very	That electricity is so	(see above for Lwazi)

	pieces to show the process of producing electricity in a power station	electricity is produced	interesting topic to discuss, I learnt a lot and can teach others	easy to learn and understand. If you really interested in it, how it works and how it is generated	
5.Thapelo	I learnt that coal contains chemicals from fossilized dinosaurs (plants)	…	They are very brave to produce electricity with coal, and they must watch out because coal will be finished (in) a couple of years	That the chemicals from the coal comes from fossilized dinosaurs	I will tell others about safety with electricity
6.Thabile	How electricity is generated	The steps of how electricity is produced	Hoe scientists use the Scientific model to explain about electricity as it is invisible	That electricity is made from underground	I will never touch copper wire with my hands
Task 4: How to connect the electrical components and a 3-pin plug					
1.Cameron	I connected 3 wires to a plug -brown, blue, green & yellow	The cord holding the wires is called a 3 core flex wire	I thought it was just a cord	I thought there were only 2 forms of … in electricity	Will tell others so they will know what to do or not do.
2.Lwazi	I fixed a plug, and learnt more about plugs and sockets	I learnt about a plug and electrical sockets. 'Awareness of self change' & 'self regulation' helped me	It improved my knowledge about electricity, and 'planning' helped me to think	That a plug is one thing with a socket.	I will fix the plugs in my home

3.Nkosenhle	I connected the plug	How a plug is connected	That you plug in the switch	That there was a switch in the plug	I will teach those who don't know
4.Thandeka	I connected a 3-pin plug, wrote down the points of the 3-pin plug, and entered the colour codes	How to connect a 3-pi plug and safety rules for connecting it. 'Awareness of self change' helped me to learn, I recognize and understand my feelings of being confident and I learnt something to-day, and that was a change in me	What we learnt to-day is very interesting, and it was easy to learn and understand. 'Getting the main idea' helped me to think and to identify spontaneously - I got the main idea to-day.	That it would be hard to learn about what I learnt, but it wasn't. I understand everything that we learnt.	I will teach and help others
5.Thapelo	How to connect a plug and (ensure) firm connections	Production of electricity in a power station, that our homes have parallel circuit for connections, and that parallel circuit is safer that a series circuit	That a parallel circuit is more safer than a series circuit (connection)	That a neutral wire is a natural wire (i.e., N stood for Natural)	I will teach and help others
6.Thabile	How to fix a plug	About a plug and electricity and elective attention' helped me to learn	If you fix up plugs it is dangerous. The 'feeling of competence' helped me to think.	That is easy if you fixed a plug	I will not touch electrical wires with wet hands

4.4. Annexture 6. Learner's responses based on the 7 questions below.

The following is a table reflecting data from the different and relevant data sources such as the Interview sheets and learner's diaries. The Data is recorded in response to the 7 questions that are reflected below.

Question	Lwazi	Thandeka	Thapelo	Nkosenhle	Cameron	Comments & Analysis
1.What is it that you wanted to learn?	What is this thing called electricity? *How is it generated?*	How electricity works or is produced. *How it is transported to our homes* *Safety measures*	Distribution of electricity (where it comes from and how it moves from house to house) *How it is generated* *The dangers and safety measures*	Distribution of electricity What dangers are there to our lives?. *How it is produced*	Is there life without electricity? *What to do if a friend gets electrocuted.*	Each learners has one or more interests in the topic, with more of them showing an interest in production and safety measures
2.Why?	Help people so that they can know and also help others (e.g. not playing with power lines) *It is important to me because I need to know to understand why & how I got shocked*	I can tell my family about safety with electricity, and teach and help others *(So that) I can tell my family about safety with electricity*	I will warn people and friends who steal electricity to connect cables properly. I will tell others about safety with electricity	I will try to help other people	I will help to teach people who do not know about electricity, tell them about safety, and the advantages and disadvantages of it	There is an overwhelming need to help or teach others, followed by safety reasons. Other reasons include: - self knowledge, to open a business, to gain independence and

	I can even open a business with the knowledge that I have. *I can be independent about something in my life*					help people make safe illegal connections (theft of cables or electricity)
3.What did you learn?	How electricity is generated in a power station. This was my interest, it was satisfied. Interesting to me was the experiment, it gave me an idea how electricity is produced. The steps in the process of production of electricity. How to connect a plug and avoid sparks or shocking. Replace a plug at	How electricity is generated. My interest in safety with electricity is addressed. Learning skills and a lot of knowledge and information That electricity is	Safety measures with electricity in the home. How electricity is generated in a power station. Connect a 3-pin plug to a 3-core flex wire. … Where electricity comes from, how it is produced and	The source of electricity. I learnt where electricity comes from, especially with respect to burning coal. Coal as a source of electricity causes harm by polluting the environment. Knowledge and skills. I know more about dangers and safety measures (with	… That un-insulated wires or fallen street electric poles can shock people and other animals.	Ranking in terms of the <u>number of learners</u> who learnt various aspects: -How electricity is produced = all (5) -Safety with electricity = all (5) -How to connect a plug (4/5) -The source of electricity (4/5) -About negative and positive charges (3/5) -The steps in the production process

	home. I can now help people so that they can know and also help others (e.g. not to play with power lines) How electricity is generated. How to be safe with it. Knowledge Where electricity comes from, how it is produced and about negative & positive charges. The steps of how electricity is produced I learnt about a 3-	invisible The steps of how electricity is produced How to connect a 3-pin plug and safety rules for connecting it.	about negative & positive charges. ... Production of electricity in a power station, that our homes have parallel circuit for connections, and that parallel circuit is safer that a series circuit	electricity). How electricity is produced in power stations. Connecting a 3-pin plug using colour codes. Where electricity comes from, how it is produced and about negative & positive charges. How the power station works. How a plug is connected	Overloaded plugs and sockets are dangerous. The confidence to teach other people about safety with electricity. That you can see the effect of electricity on a compass needle when the components are joined together That coal is a chemical energy and electricity is generated in a power station. The cord holding the wires is called a	((2/5) -How to help other people (2/5) -The effect electricity has on the environment (pollution or it can shock people and animals) (2/5) Aspects learnt where there is no commonality are: -Electrical sockets -Electricity is invisible -Parallel circuits and connections, and, that for homes these are safer than series circuits. -Un-insulated wires can shock. -Coal is a chemical energy.

	pin plug and electrical sockets.				3 core flex wire	-Cord holding the wires is a 3-core flex wire
4.What factors contributed to your learning	Regulation of one's self is needed. The teacher and other learners helped me when I did not know. They helped me to look and listen. The talking helped me. The teacher helped me too, as I asked him when I needed to know. I did not like it when he turned the question around and asked me … as I needed to know. 'Awareness of self change' and 'self	It was very useful because now I can share my findings with the others who don't know anything, and I can protect my family. The portfolio boards. We visibly learnt step-by-step how electricity is produced and sent to our homes. We did experiments, wrote things, stuck pictures, talked and talked and talked. My peers helped me understand.	… The experiment helped me to learn. It gave me an example on how electricity is produced.	… …	… The presentation/ portfolio boards and Workbook notes helped me. The teacher gave us a chance to correct our work and gave us help when we needed it. My helper, one that I like, is a person who corrects me when I am wrong.	Only 4 learners responded. A number of factors that contribute to learning have been identified: -Help form the teacher (3/4) -Help form peers (2/4) -The talking (dialogue) (2/4) -Sharing findings with others -The portfolio boards (2/4) (visibility of things discussed, writing and sticking things) -Doing experiments (2/4)

	regulation' helped me to learn					-Workbook/ probe notes
5.What factors do you think did not contribute to your learning?	Little time. Some learners are not sure if they wanted to know or not.	I could not attend all the group sessions as I had to rush home to look after the babies at home	…	Other learners saying I was stupid when I went to the science class during interval. Sometimes I felt dumb.	The teacher, I could have learnt more if he left me to also learn on my own. If my group allowed me to do the investigation and collect the information needed. If I was serious about my work and focussed on what I was doing. The school could have taken action to reduce the noise while I was learning.	4 Learners responded. Factors they think did not contribute to their learning: -Little time -Some peers being unsure -Peer pressure against my attending extra work sessions -Peers not allowing one to do certain tasks on one's own. -Not being serious enough about my work. -Taking care of siblings at home -The teacher, could also leave me to

						work on my own -The school, in not reducing noise levels in school
6.What do you understand by ML?	You can learn whatever you want to. Learning about something that has meaning. 'Self development' and 'Sharing behaviour' are useful learning tools.	Understanding the work in such a way that you know what you are learning 'Awareness of self change' helped me to learn, I recognize and understand my feelings of being confident and I learnt something to-day, and that was a change in me	...	Understanding my lesson and work. 'Personal challenge' is a useful learning tool, it helps me to learn and know more, and to face new experiences.	Learning that is not only meaningful to the teacher, but also to the student. If I am learning something that I understand. 'Systematic exploration' is a meaningful learning tool.	4 Responses only. Learner's understanding of meaningful learning: -learning what one wants to learn -learning something that has meaning to them -understanding the work - it is the application of useful and appropriate learning tools that helps a person to learn more.

7.What in your understanding could be the opposite of ML?	The opposite is not understanding what you are doing.	…	…	The opposite of meaningful learning is not understanding and not knowing.	The opposite is meaningless learning.	3 Responses only. In their understanding the opposite of meaningful learning is: -not understanding what one is doing -not knowing -meaningless learning.

ML = Meaningful Learning

4.5. Annexture 7. Summary of the remaining five questions.

The following is a summary of findings on the 5 remaining questions, namely, what I learnt, what contributed, what did not, my understanding of meaningful learning (ML), and the opposite of ML.

Learners	What I learnt	What contributed	What did not	ML	Opposite of ML	Comments\ Analysis
Lwazi	Interest(s) met: -how electricity is generated -what electricity is Beyond own interest: -how one gets shocked -how to avoid getting shocked -how to replace a plug -how to be safe with electricity	-The teacher, when I needed to know -other learners, helped me to look & listen -talking -self regulation & awareness of self change	-little time -peers not being sure if they wanted to learn or not	-Learning whatever you want to (learn) -learning about something that has meaning -self development -sharing behaviour	-not understanding what you are doing	
Thandeka	Interest(s) met: -how electricity is produced -how to be safe with it -how it is transported to our homes.	-Sharing my feelings with others -portfolio boards, visibly learn step-by-stem how electricity is produced & sent to our homes	-Childcare, rushing home after school and not attending some sessions	-understanding the work -knowing what you are doing -awareness of self change, recognising and understanding my feelings of being confident and, I learnt something to-day, and that was a change in me	…	

	Beyond own interest: -learnt skills, connecting a plug -gained information -electricity is invisible	-doing experiments -writing things -sticking pictures -peers helped me -talking, talking & talking				
Thapelo	Interest(s) met: -safety measures -how it is generated -distribution Beyond own interest: -skills, connecting a plug -presence of positive & negative charges -existence of series & parallel connections -parallel connections are safer	-doing experiments gave me an example how electricity is produced in power station	…	…	…	
Nkosenhle	Interest(s) met: -dangers & safety with electricity -how it is produced -distribution	…	-Peers calling me names when attending sessions on my own during intervals	-understanding my lessons and work -personal challenge, helped me to learn and know more, and to face new experiences	-not understanding -not knowing	

	Beyond own interest: -sources of electricity -coal is important source in SA -coal contributes to pollution of the environment -about negative & positive charges -skills, connecting a plug		-feeling dumb - because of this- at times			
Cameron	Interest(s) met: -safety with electricity -what to do if a friend gets shocked -is there life without electricity Beyond own interest: -fallen street poles and un-insulated wires can shock people & other animals -overloaded plug sockets are dangerous	-Portfolio boards -workbook notes (info sheets) -teacher gave us chance to correct our work and helped when it was needed	-The teacher - not leaving me to work on my own at times -the group or my peers, they could let me do the investigation, and to collect information needed -myself -if I was serious about my work and focussed on what I was doing	-learning that is meaningful to the student and not to the teacher only -understanding something being learnt -systematic exploration	-meaningless learning	

	-coal is a chemical energy -cord connecting appliances is a 3-core flex wire -electricity flowing in a conductor has effect on a compass needle near it		-the school - if it took action to reduce the noise outside the classroom			
Comments Analysis	Learner's interests were met (two learner's interests were wet in the variation of the contexts in which learning occurred) Learner's learnt beyond what their own interests were	Learning through participation and interaction with others, engaging in activities and with available resources contributes to learning effectively	Peers, self, the teacher , domestic responsibilities and the school can stand in one's way of learning optimally.	Understanding what one is learning or doing is rated highly, followed by meaningfulness to the learner Also mentioned were: -knowing what one is learning -learning whatever you want to -awareness of self change where recognising & understanding one's feelings of being confident -self development -sharing behaviour -personal challenge to face new experiences -systematic exploration	Three learners responded. Not understanding what one is doing was mentioned by most learners Other responses pointed out that not knowing or meaningless learning was the opposite of ML	

Annexture 8

Infrastructure and Technology check Questionnaire. Name: .....
Please supply the following personal information (which will be treated confidentially) to be used in the design of appropriate learner centered teaching and learning experiences for all learners of Natural Science at Newlands East Secondary School (NESS)

There are some questions that require you to write a sentence, a tick (□) or for you to fill in Y for Yes, or N for No. (NB: Participation is voluntary, i.e., you may decline to complete the sheet).

1. Tick in the box that applies to you:
   1.1. How do you get to school? Walk□ ; by bus □ ; by taxi □ ; parent's car □ ; bicycle □ ; other (specify) .....
   1.2. Which area do you live in? N. East □; Mashu □ ; Inanada □ ; Ntuzuma□ ; N. West □; other (specify) .....
   1.3.Who do you live with? Mother only □ Father only □ both parents□ Relatives □ Brother □ Sister □ Grand parents □ in a hostel □ other (specify) .....
   1.4.The people I live with are: both working □; one is working□ ; both/all unemployed (not working) □
2. The place where I live is/has:
   2.1. A private home (fenced in) □; a private home (no fence)□ ; a block of flats□ informal settlement□; a farm □ ; a rural area home □
   2.2. The place where I live also has:
   Tap water □ ; river water□; tank water □ ; an inside water-flushing toilet □ an out-door pit latrine (toilet) □ ; other (specify) .....
   2.3.In the house we have:
   electricity for lights□ ; electricity for cooking (electric stove, kettle, iron, microwave)□ paraffin primus stove □; gas stove □; use fire wood stove □; outside/floor fire for cooking □
   2.4.Homework: There is privacy in our home□ the place is overcrowded and we .... all share .... room(s)□
3. Tick the ones you have at home: Cell phone□ ; telephone□ ; fax machine □ ; radio (battery operated) □ ; radio (electricity operated)□ ; TV□ ; DSTV □ ; play station □; computer □
4. I often help at home with: Cooking □; gardening □; baby-sitting □ ; part-time job □

Thank you for your responses and for taking the time to answer the questions.

Annexture 9

Parental Consent for learner's Participation

School's Letter Head and Contact Details (Including the School Stamp)

To: .....
.....
.....
.....

Newlands East Sec. School
Box 76 101 Garfish Crescent
Newlands East
4000

Dear Mum/Dad

Re: Request for your child's/ward's participation in a Science Learning research study

A request is hereby made for your sons/daughter/ward, ... to participate in the above mentioned study to be undertaken at the above school during the week of 17 May to 28 May 2004, at the above school by teacher, Mr T Jafta (Science Teacher Grade 8/10 at NESS), The purpose of the study is to find out how learners mediate effective learning facilitated by a teacher, in an environment which is conducive to learning and teaching.

Through this study, ways will be searched for whereby learners could be helped to engage in meaningful learning. The process would entail active engagement by the learners during learning (this involves doing, discussing, drawing, reporting back and presenting information) instead of learners being passive during learning (this is the traditional or old approach where the learner sits and listens the whole lesson to what the teacher says, and then repeats that later, in a test).

The study requires that the learners participating in the study be allowed to take part voluntarily (that is, no one be forced to take part), that their names not be used in the study (if so this be negotiated with them on fist name basis only), and that confidentiality be upheld at all times during the duration of the study.
I, Mr Jafta, have spoken to (Learner's name)....., who has indicated willingness to take part in the above study.

Reply slip:
I, Mr/Mrs/Ms ..... hereby give ☐ /do not ☐ give consent for my son/daughter/ward ..... in participating in the above study as outlined in the above request.
Signature: ..... Date: .....

Annexture 10

Interview Schedule (Focus group)

This semi-structured interview is designed with the intention to determine

i. the extent to which the learners were afforded (during teaching and learning activities) the opportunity to shape their own identity, and/or

ii. the extent to which the learners made use of the learning and teaching environment to negotiate an identity of themselves.

Section 1: Biographic data

1. Grade: ..... Date: .....
2. Topic of study: .....
3. Male\Female: .....
4. Home language: .....
5. Interest: .....

Section 2: Learning Environment

1. How would you say the learning environment contributed (or did not contribute) to your learning of the above topic? You may use the following aspects to comment on the learning environment:
   a. activities
   b. group discussions
   c. workbook/work sheets
   d. teacher
   e. other books/pictures
   f. writing board
   g. language
   h. other learners or adults

Section 3: Learning Point

1. What is the most outstanding learning point you gained from learning about this topic?
2. What do you now know that you did not know before?
3. What can you now do that was not possible before?
4. How has this learning changed your outlook towards your life, or that of others?

Section 4: Meta Learning (learning how to learn)

1. Looking back to the way you learnt during the different tasks, individual and/or group-work, what are the things that contributed (or did not contribute) for you to learn HOW TO LEARN?
2. What does this look like? Use the following : "If ..... , then ....." statement to describe this learning.

Annexture 11

Questionnaire

This is a recognition of prior learning (RPL) Task

Work on your own by first reading and then answering the *background knowledge* questions as best as you can. Think of the 'things' that you have seen or heard before, or call on your own past experiences that you have gained from home or your community.

Questions:

1..Where do we get the electricity in our school or home from? .....

2. How is electricity transported to your school or home? .....

3. What is the name of the switch in your home that controls all the other switches in the house? .....

3. Name the local authority that supplies your school or home with electricity. .....

4. Which item uses the highest amount of electricity in your home: refrigerator, television set, microwave oven, stove or radio ? .....

5. Name one thing that may happen to a person if he or she gets electrocuted? .....

6. Electricity is a form of energy. What does the term 'energy' mean? .....
.....

7. Name two other forms of energy. .....

8. If your electric kettle suddenly stops working, and you think that you could fix it, what would you or your parent do first, before you or your parent try to fix it? .....
.....

9. What is an electric circuit?. .....
.....

10.Name a type of metal that allows electric current to flow through it very easily. .....

11.What is a power station? .....

12.Name an electric appliance in school or home, that converts electric energy to heat energy. .....

13.An atom is the smallest part of all substances (learnt from previous lesson), it is made up of charged particles called protons and electrons. Which one of the two types of charged particles in an atom moves or, is in constant motion? ....

14.What must be attached to a new electric kettle before it can work properly? .....

15.How does electricity affect the environment? .....
.....

16.What could go horribly wrong - as far as people and electricity is concerned? Explain in one concise sentence. .....
.....
.....(Did you here this from someone, **or** did you actually see or experience this in your own life, or where you live?) .....
With regard to number 16's answer above, HOW do you think this happened, or what was the cause? .....

Annexture 12

Summative Assessment Task

Newlands East Secondary School

Natural Sciences
(NS)

Tasks for Assessment

Grade 8

June 2004

Learner's Name and Surname:

.....

Time: 1Hr
Marks: 100
No. of Pages: 6

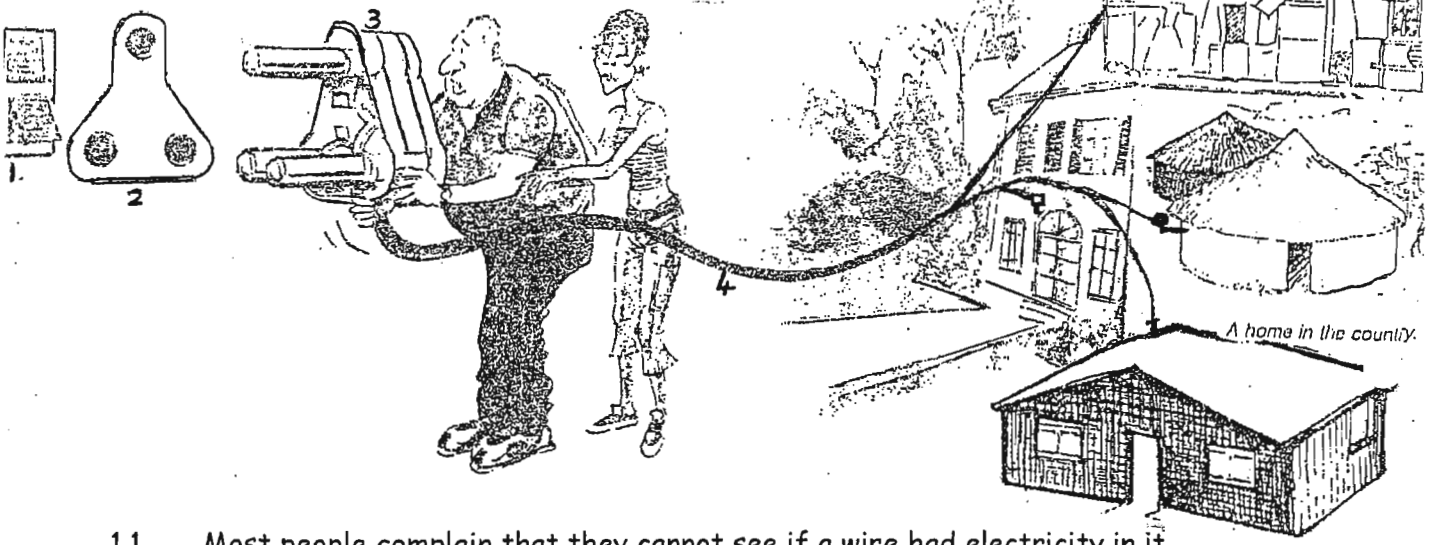
Programme Organiser: Industry and Marketing
Focus: Electricity in the Home/Industry

Development of Assessment Task: T Jafta (06.06.04)

QUESTION 1: Electricity for ALL

The Government has promised to ensure that the basic service of electricity supply reaches every household through the 'Electricity for all' campaign. More and more people in South Africa are now using electricity as a form of energy in their homes.

Study the pictures and answer the questions that follow.



1.1 Most people complain that they cannot see if a wire had electricity in it before they touched it, and that feel an electric shock. Scientists use a **Scientific model** to explain what happened.
What is the scientific model?.....
..... (2)

1.2 What type metal wire is used to conduct electricity easily? ..... (1)

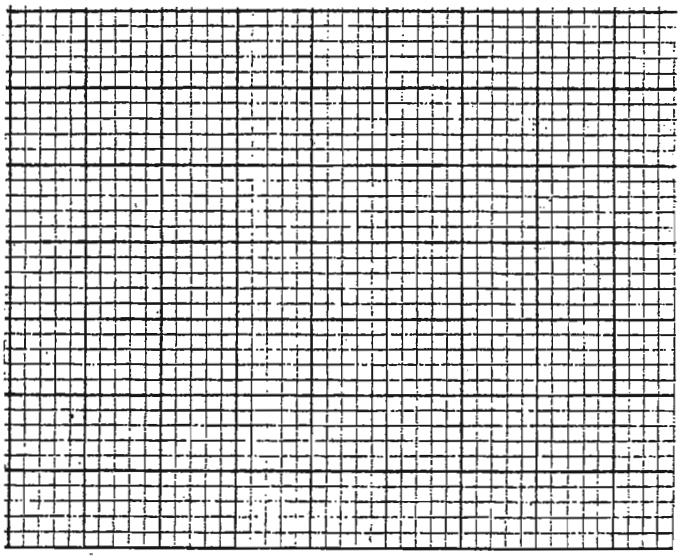
1.3 What is an insulator? Give one example. .....
.....(2)

1.4 Name the parts labeled 1 to 4 in the above picture.
1. ..... 2. .....
3. ..... 4. ..... (4)

1.5 Most of the electricity generated in South Africa is through the burning of a fossil fuel as a source. Name this source of generating electricity, and also name the company that is responsible for electricity supply in South Africa.
a) name of the source ..... (2)
b) name of the electricity supplier ..... (2)
[13]

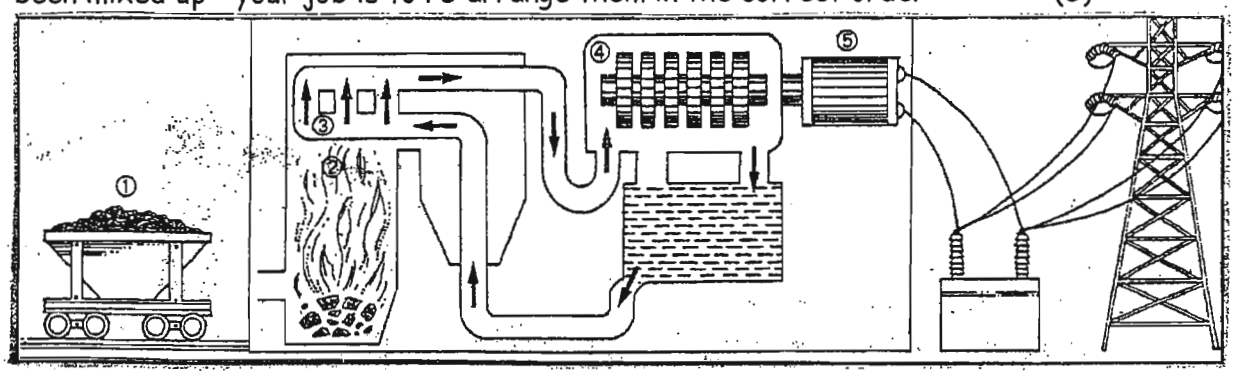
QUESTION 2: Generating Electricity [17]

South Africa makes use of four sources in the process of generating electricity, namely coal, hydro electric, nuclear and other. About 90% of the electricity generated in South Africa comes from coal-fired power stations, hydro-electricity is 2%. The electricity generated through nuclear power makes up 8% , and other sources make up 1%.



1. Draw a bar graph to represent the above statistics of on the different sources of generating electricity in South Africa
   The graph must meet the following criteria: -a title
   -appropriate scale
   -label both axes
   -plotted points
   -shaded bars (9)

2. Which of the above sources is non-renewable? ..... (1)
3. Explain why you consider it to be non-renewable. .....
   ..... (2)
4. The following picture shows the different stages of the electricity generating process inside a power station. The energy transfer occurring at each stage has been mixed up - your job is to re-arrange them in the correct order: (5)



range the rect der...

Kinetic Energy (movement energy) of steam → Chemical energy in coal → Kinetic energy (movement energy) of turbines → Heat energy → Electrical energy

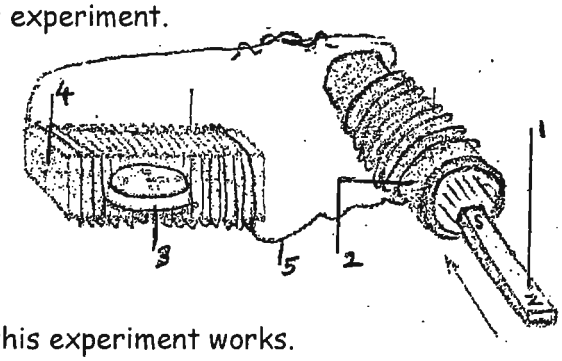
....

....

QUESTION 3: Concept and transportation of Electricity [20]

In the experiment used to demonstrate how electricity is produced at a power station, the following apparatus was used.

1. Name the apparatus used in this experiment.
   a) .....
   b) .....
   c) .....
   d) .....
   e) .....

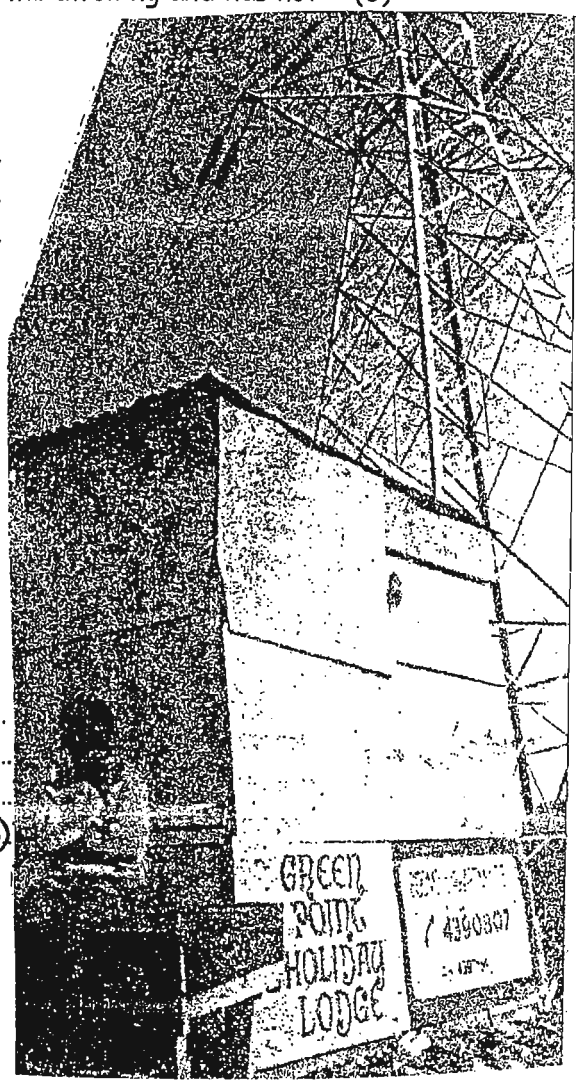


(5)

2. Explain briefly and clearly how this experiment works.
   .....
   .....
   ..... (4)

3. What would you say is electricity? .....
   .....(2)

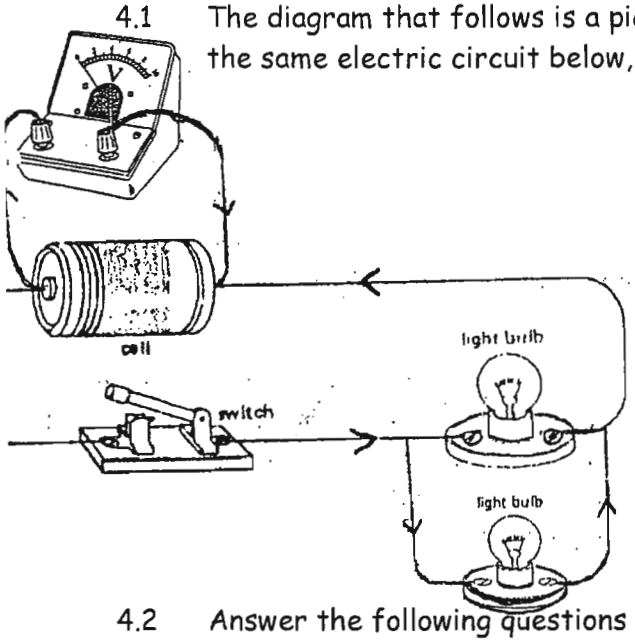
4. The young girl in the picture below lives in an informal dwelling and has not heard of electricity, and yet she lives so close to it. How would you help to explain to her what electricity is by making use of her own surroundings? Explain briefly in 3 short sentences. (6)
   .....
   .....
   .....
   .....
   .....



5. **Safety**
   outside the home
   List three safety measures that you can give to this young child about electricity outside the home: .....
   .....
   .....
   ..... (3)

QUESTION 4: Electric Circuits [27]

4.1 The diagram that follows is a picture diagram of an electric circuit. Re-draw the same electric circuit below, but this time use symbols for the pictures. (5)



4.2 Answer the following questions based on the above circuit diagram:

a) what is the function of the cell in the circuit?
..... (2)

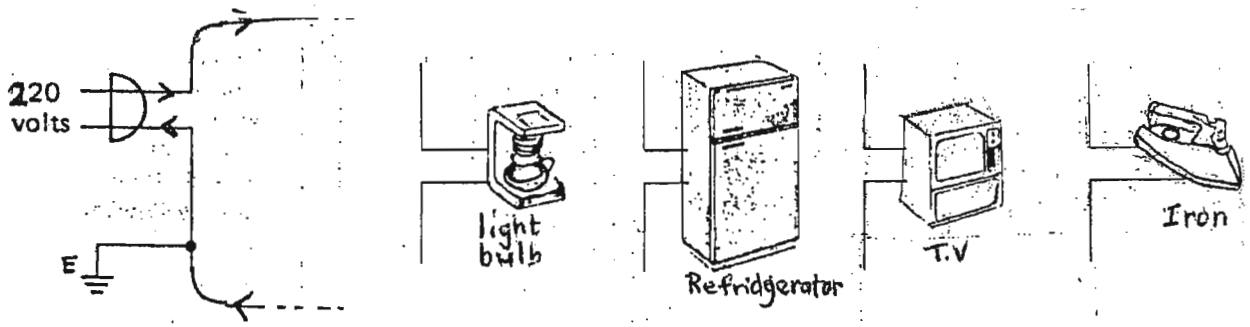
b) what is the function of the voltmeter? .....
..... (2)

c) will the electricity flow in the above circuit? State why. .....
..... (2)

d) how are the light bulbs connected ? (in series or parallel) and what is an advantage of connecting the bulbs in this way? .....
..... (3)

e) state what the energy conversion is when the switch is closed and the light bulb shines. .....(2)

4.3 Complete the following electrical circuit in a way that shows how these appliances are connected in our homes, by add connecting wires and switches. (5)



4.4 What is the correct colour coding used when connecting a 3-pin plug? (6)

QUESTION 5: Safety with Electricity in the home [23]

In the case of an electrical accident, you should be very careful. Here are some precautions that you can follow :

5.1 never touch a person who has just been shocked

5.2 if possible turn the power off at the plug point or power source

5.3 call the relevant emergency services (be aware of who to call in the event of an electrical accident, and how to make such a call)

5.4 look for electrical danger signs and be aware what they mean - they are found on most high voltage appliances inside and outside the home.

In the above precaution number 5.1, why should we not touch a person who has just been shocked or electrocuted? .... (2)

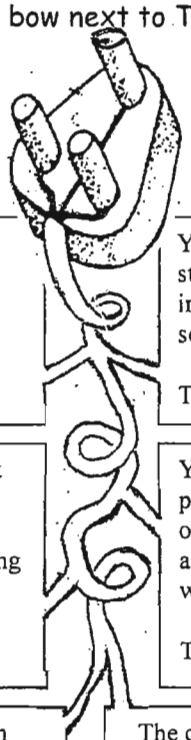
In precaution number 5.4, name or draw one danger sign that you have seen on a high voltage electrical power box or installation on the side of the road near where you live. Also state what the sign means. .... (2)

The following pictures are examples of the lack of awareness of the potential dangers that the use of electricity in our homes can bring to us. (7)

Take a close look at each picture, and state whether you see, or do not see a potentially dangerous situation, and also **state why** you can see (or do not see) a potentially dangerous situation in each picture below:

Wired for fun!

Choose the correct facts from the boxes below to wire or work with plugs correctly. T=true & F=false. Fill in T or F in the small bow next to T/F



You can safely place a carpet over electrical cords

T/F ☐

You should not stick anything into electrical sockets

T/F ☐

You should not remove a plug from the wall socket by pulling at the cord

T/F ☐

You can safely pull a plug out or insert it into a wall socket with wet hands

T/F ☐

Holding a 3-pin plug with pins facing down, connect the yellow/green to E, brown to L, and blue to N

T/F ☐

The correct colour code for the plug wires is:
Live - brown
Neutral - Blue
Earth -yellow/green

T/F ☐

(12)

Annexture 13

Probe

NATURAL SCIENCE

Programme Organiser: Industry and Marketing

NS Focus:

Electricity in Industry/Home

Grade : 8

September 2004

Science Probe

Learner's Workbook

Part 1	20	
Part 2	19	
Part 3	8	
Part 4	23	
Part 5	10	
Total:	80	

School : Newlands East Secondary School

Learner's Name & Surname: .....

Grade Educator : .....Mr T Jafta.....

Room Number : .....15 .....

[Exemplar Tasks for Learning & Assessment developed by : T Jafta (08.05.04)]

Programme Organiser: Industry and Marketing
Learning Programme: Natural Science
Focus : Electricity in Industry / Home

Background information on the Programme Organiser

Modern industry and technology has contributed to the many advances and improvements in our daily lives. Technology has been used to our advantage in a positive life-supporting manner. Many of us have also observed on the television set how in some cases, people can use technology to other people's disadvantage by harming, threatening or destroying life.

Our country is regarded as a developing country, meaning that we as a nation have not reached the level of development as that achieved by other countries such as England, America or Japan. These countries have advanced in many ways, and the quality of life and living standards of the people living there is very high - and modern technology has played a major role in this.

Our country, South Africa, is also still suffering from the ravages of the recent historical past. Many of our people and communities are still living in abject poverty, with little or no access to basic services and infrastructure such as water, proper houses or electricity. The rate of unemployment is also very high.

Learners, this background helps us to realize that :

- modern technology and innovations, in many spheres of industry, have helped many people to make their lives simpler, easier or better.
- many people in our country do not have access to modern technology (for various reasons)
- modern technology coupled with the use of electrical energy, is available (at a price)
- innovations (i.e. new ideas and devices) are constantly helping in the upgrading and improvement in technology today
- high illiteracy rate (i.e. number of people who cannot read or write) in our country has made many people fear or fail to see the advantages or disadvantages of technological devices.

Most of the technological devices require electricity to function.
Innovations have made it possible for some devices (very few) to work without the use of the usual household supply of electricity. It is through modern technology and innovation that we, here in Newlands or Kwa-Mashu are now also part of the Global Community.

It is possible and convenient for us today to use all sorts of electrical tools, vehicles, instruments and devices in order to live and work with greater ease.

1. Introduction

Welcome to the electrifying wonderland of flashing bright 'stars'. South Africa has a long poverty past. Many things could be said about the lack of basic municipal services such as water, electricity and houses in some parts of the country. South Africa is generally a developing country and with regard to electricity, has reported incidents of electrical black-outs, cable theft , and in some cases, lack of understanding of the dangers which may be associated with the use of electricity. Consequently the Department of Electricity and local council need your help. They want you to be an electricity detective (including other necessary roles). Use the stimulus material provided to find out about the electricity related issues in your country, province and local community. (Your Educator/facilitator will assist and guide you where this is needed)

Page 5 of the Workbook shows us how electricity may be linked up to our homes. Our 'job' in the workbook is divided into 4 stages, namely,

1. Recognition of prior learning (RPL) and
   Gaining background knowledge
2. Accessing, sifting, analysing information
3. Making sense and meaning
4. Taking action and reflecting
5. Reporting back

Working in your workgroups of 4 to 6 learners (Home Group), your task - with, and sometimes without the guidance of your learning facilitator, is to read the guidance and instructions that go with each TASK, before attempting to perform the required activities.

2. Description of the workbook TASKS

The 'Workbook' consists of several TASKS which are clearly numbered, and each one will be explained to you.
The 'Workbook' also contains some **stimulus materials** for individual or group work.
With the guidance or coaching from the Teacher, you may be working, individually, in pairs, small groups, or as a whole class group.
Note: Working groups are those groups consisting of six (6) learners in which you do the tasks that require groupwork

3. 'Expert groups' may be formed (where this is needed) under the teacher's guidance. These groups will each do an in-depth study of a specific section as stipulated in certain sections of the workbook.

4. Members of the 'expert group' will return to their Home groups with relevant information that will help the rest of the members of the Home group in their quest for knowledge about electricity

5. Taking Action. Each individual learner (pair or group of learners) will select one task or action item from a given list of action items, do the activity and then present it to the rest of the class.

The RPL Task

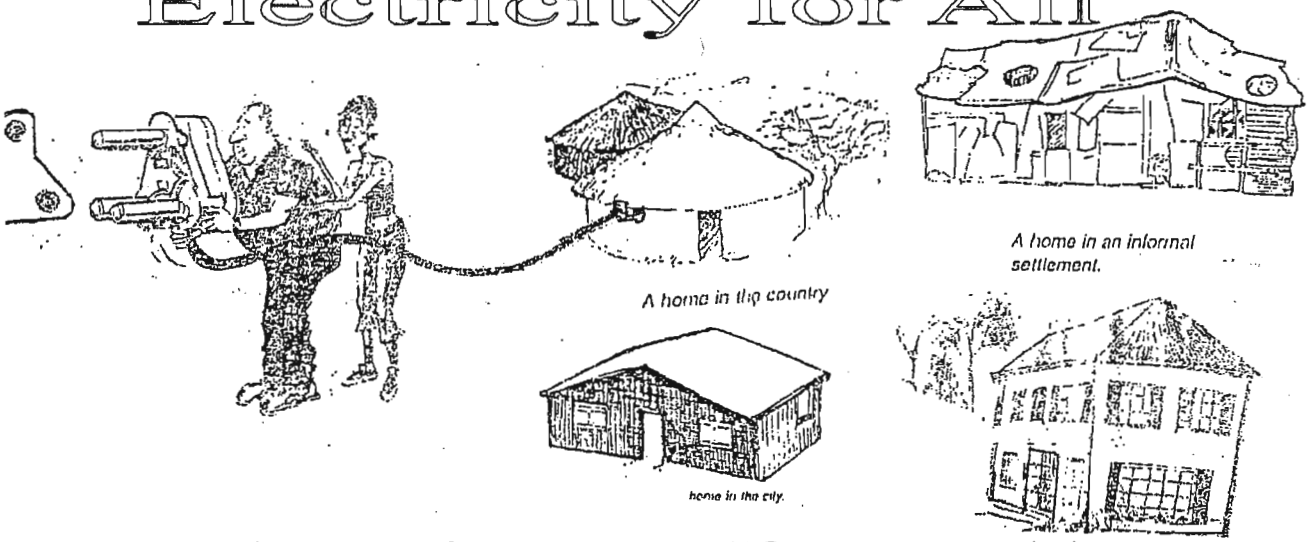
Working in your workgroups of 4 to 6 learners (Home Group), practice working with your group by first reading, discussing and then answering the *background knowledge* questions together as best as you can. Think of the 'things' that you have seen or heard before, or call on your own past experiences gained from where you live.

Questions:

1..Where do we get the electricity in our school or home from? .....
2. How is electricity transported to your school or home? .....
3. What is the name of the switch in your home that controls all the other switches in the house? .....
3. Name the local authority that supplies your school or home with electricity. .....
4. Which item uses the highest amount of electricity in your home: refrigerator, television set, microwave oven, stove or radio ? .....
5. Name one thing that may happen to a person if he or she gets electrocuted? .....
6. Electricity is a form of energy. What does the term 'energy' mean? .....
.....
7. Name two other forms of energy. .....
8. If your electric kettle suddenly stops working, and you think that you could fix it, what would you or your parent do first, before you or your parent try to fix it? .....
.....
9. What is an electric circuit?. .....
.....
10.Name a type of metal that allows electric current to flow through it very easily. .....
11.What is a power station? .....
12.Name an electric appliance in school or home, that converts electric energy to heat energy. .....
13.An atom is the smallest part of all substances (learnt from previous lesson), it is made up of charged particles called protons and electrons. Which one of the two types of charged particles in an atom moves or, is in constant motion? ....
14.What must be attached to a new electric kettle before it can work properly? .....
15.How does electricity affect the environment? .....
.....
16.What could go horribly wrong - as far as people and electricity is concerned? Explain in one concise sentence. .....
.....
.....(Did you here this from someone, **or** did you actually see or experience this in your own life, or where you live?) .....
With regard to number 16's answer above, HOW do you think this happened, or what was the cause? .....

Electricity for All

Electricity for All



Here are the members of your WORKING and LEARNING GROUP who have been approached by your **Local Government Ward Councilor**, in the area where you live. He would like you to help him in your community, in helping the residents in a newly developed housing section of your community. New homes have just been built, and most of the people lived in informal dwellings there. Most of these new home owners know very little or nothing about electricity, how it works, where it comes from, or the dangers it may bring to their lives. (See **Culminating Task** on last page)

The Task at hand for you and your team:

1. Find out as much information as you can on the topic.
2. Collect and prepare the appropriate information in order to make a presentation t o the new homeowners in your community suburb of Sizanani.
3. Follow the set of guided tasks set out as Part 1 to 5 below.

Each member of the team may now **write down** your name and (in the speech bubble) a statement regarding what your interest, need, query, vision or some thing that still confuses you about electricity. You may even state what you like or don't like about electricity, or an unanswered question that you still have about it.

Electricity is a form of energy. This energy ,including other types of energy, may be generated in different ways. Your group has the task of finding out and naming the different ways or sources of generating electrical energy -

1. In general and
2. The main sources of generating electrical energy in South Africa.

TASK 1:

Use pictures to indicate the different possible ways of generating electrical energy. Find pictures from magazines, newspapers or photo copy from books, and then, also name the appropriate method of generating electricity, and state whether each source is renewable or non-renewable - (use Task 4.1 below to tabulate the renewable and non-renewable sources). Information sheet No.1 may also be useful(obtainable from the facilitator)

TASK 2:

From the above types of sources, identify the main sources of generating electrical energy in South Africa. (Information sheet No.2 may assist those who need help)

TASK 3:

Use a pie-chart or bar graph to represent the data listed in TASK 2 in graphical form, stating the percentage of each source next to the diagram. (You may seek help if this is needed to draw a pie chart).

TASK 4:

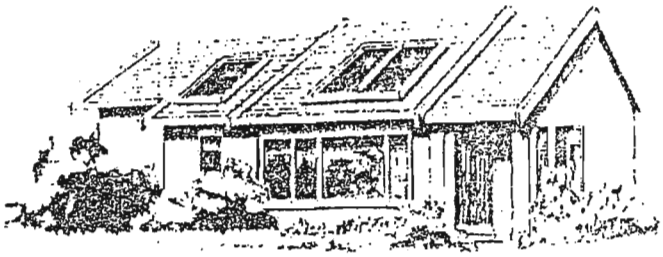
In summarising the above accessed information, supply the following information:

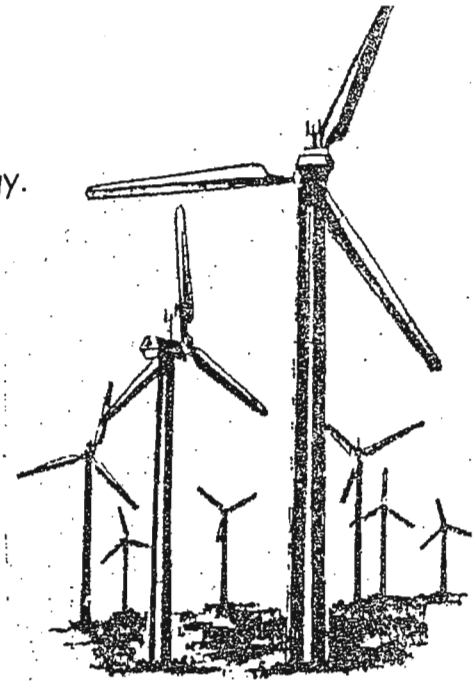
4.1. Definition for the term 'energy' .....

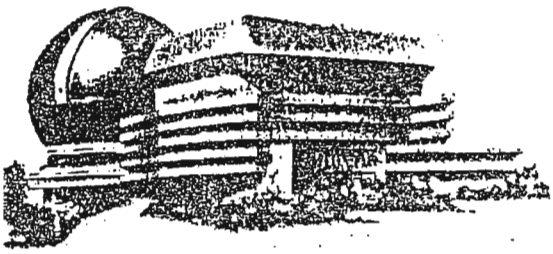
.....

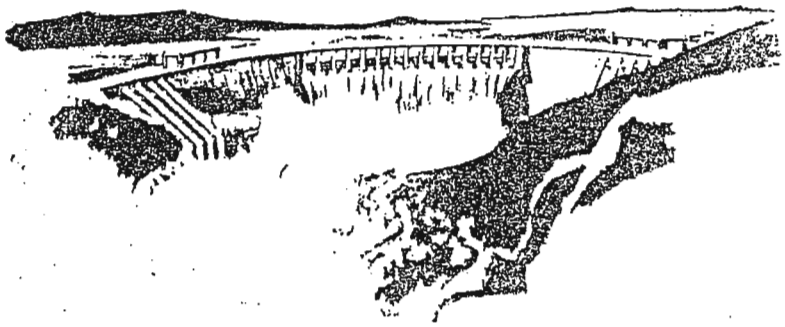
4.2. Tabulate from TASK 1, the energy sources for generating electrical energy into renewable and non-renewable, and stating the meaning of each term as well.

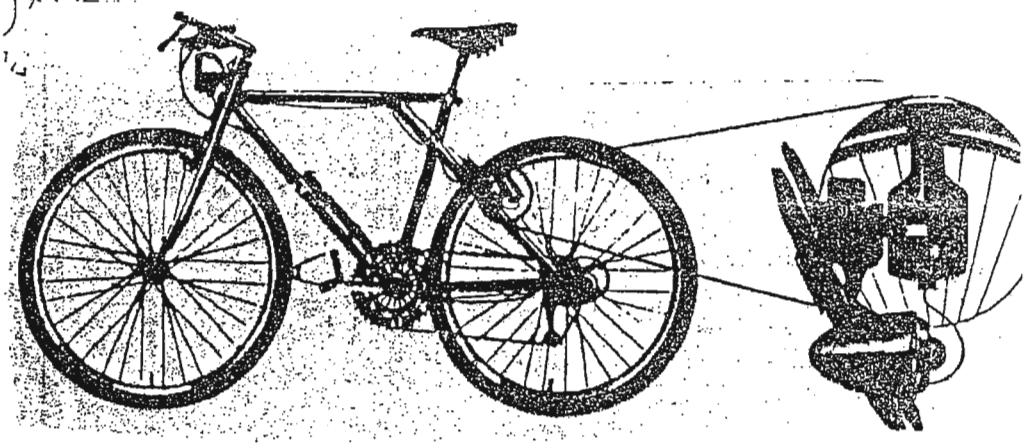
Information Sheet No.1
Sources for generating electrical energy.

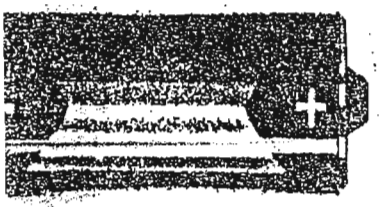












Cell

lydroelectric Dam

Dynamo

Solar

Wind

Burning Coal

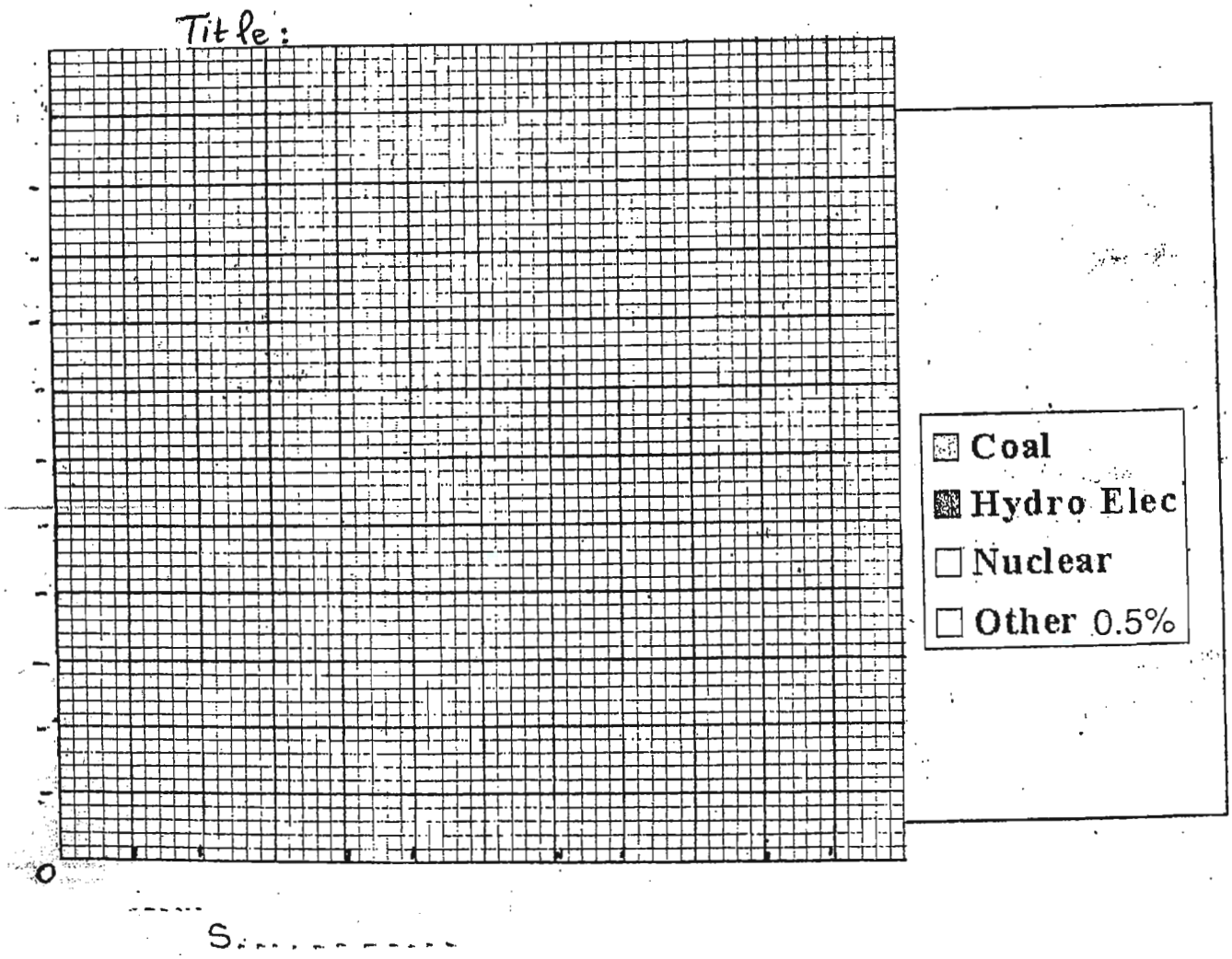
Nuclear

Information Sheet No.2

Task : Drawing a bar graph to represent the sources of generating electricity in South Africa, From the information supplied below:

"The biggest slice, for example shows how much electricity was generated by coal-fired power stations. 91% of the electricity generated by Eskom comes from coal-fired power stations. Hydroelectricity is 1.5%. That is because South Africa is a water scarce country. We do not have enough water to generate enough electricity from hydro power. Some of the other countries, like New Zealand, have a lot of water, so that most of the electricity is generated through hydro power. The electricity generated through nuclear power makes up a 7% of the pie. But that will probably change." Other sources used in South Africa amount to 0.5%.

Draw a bar graph on the sources of sources used to generate electricity in SA		
Criteria	mark	score
1.axes labeled correctly	2	
2.Appropriate scale used	2	
3.Bars shaded evenly	2	
4.points plotted correctly	4	
Total	10	



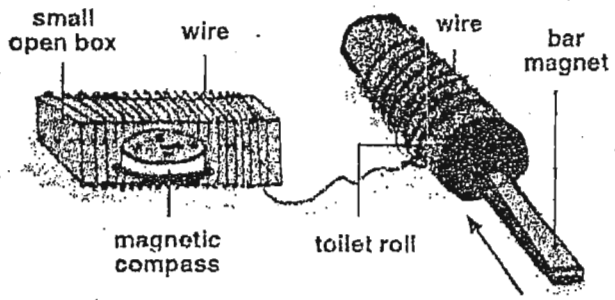
Information Sheet No.3

Task 5: Generating Electricity: How is electricity produced?

Electric currents are charges that are continuously on the move. Conductors are things like metals which contain lots of free charges. Normally, the charges or electrons inside a metal bar will drift from atom to atom in a random way. But if you join electric conductors to each other and there are more electrons at one end than at the other, then the electrons will move towards the end with fewer electrons. This movement of electrons in a particular direction is an electrical current.

How is electricity produced?

Activity 1



You will need:

- strong bar magnet
- magnetic compass
- 5m reel of insulated wire
- small open box
- toilet rol or cardboard cylinder.

Place the compass in the small open box. Wind one end of the wire 20 times around the box (make sure you are able to see the compass).

Wind the other end of the wire around the toilet roll at least 50 times to make a second coil.

Connect the two ends of the wire together. Keep the coil on the toilet roll away from the compass.

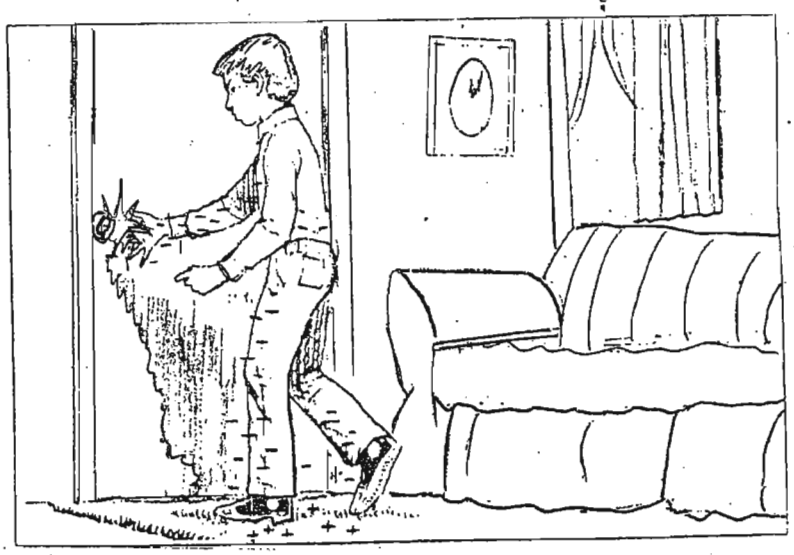
Slowly push the magnet into the opening of the toilet roll. What happens to the compass needle? Any change is due to the electric current in the wire.

Move the magnet faster into the cylinder. What happens to the needle now? How can you make a bigger current in the wire?

Passing an electric current through a wire can produce a magnetic current. The opposite is also true if a wire moves through a magnetic field and current is produced in the wire. The size of the current depends how quickly you move the wire. This principle is used in power stations to generate electricity, but instead of moving a wire through a magnetic field, the magnet turns inside a wire coil. Steam turns turbines, which are connected to electromagnets in generators.

If you touch a metal doorknob after walking across a rug, you might receive a slight electrical shock. Why?

Scientific model
A kind of mental picture used by scientists to describe something that cannot be seen directly.



often use a **scientific model.** A *scientific model* is a sort of mental picture of something that cannot be seen directly.

Conducting an Investigation: Learner Name:..... Grade: ....

Group work. Questions for the investigation. These are based on the information sheet on the previous page.

1. How is electricity produced?

2. List the apparatus used to conduct the above investigation.

3.How is the above listed apparatus connected? Explain clearly.

4. Conclusion/Observation. List your group's observations below.

South Africa produced 224 million tons of marketable coal in 1998, making it the fifth largest coal producing country in the world. 25% of our coal was exported internationally. The remainder of South Africa's coal production feeds the various local industries, with 45% being used for industrial use, and 3% for domestic heating and cooking. Eskom is one of the largest electricity generators, and Sasol is the largest coal-to-chemicals producer in the world. Technologies are in place to ensure that the production, processing, transportation and utilisation of coal is done in an environmentally responsible manner (Source: EnviroTeach Vol.8, May 2001)

You or your group are required to investigate and explain the process of power generation from coal as a source. **First:** Investigate how electricity may be produced, by setting up a simple experiment in class to demonstrate this. Follow the instructions provided in Information Sheet No.3. After this demonstration, and having read the Information Sheet No.3. see how best you and your group can answer the following questions:

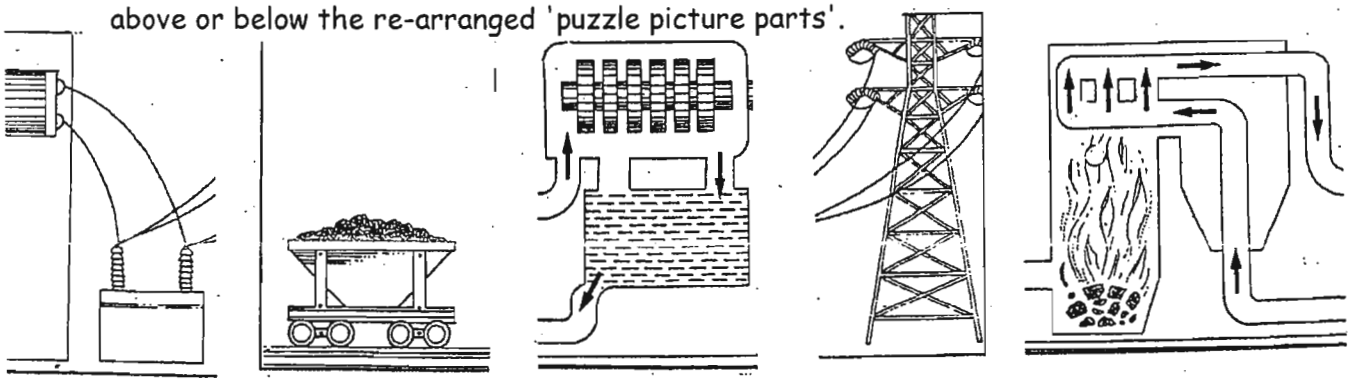
1. You have learnt in a prior lesson, that all matter is made up of tiny invisible atoms, where each atom contains protons (with a positive charge or (+) and electrons (with a negative charge (-), which one of the two can actually move inside a conductor? .....
2. Underline the correct word in the brackets. The conductor (copper/plastic) allows the electrons to flow through it.
3. Scientists use a scientific model based on the electron (-) to explain how electricity flows from one object to another, because electricity cannot be seen while it is flowing through a conductor. What is a scientific model? .....
.....
4. What causes the electrons in a conductor to begin flowing from one end of a conductor to the other end? .....
.....
5. What would you then say, is an electric current? .....
.....
6. Why does the electric current in this demonstration not shock or electrocute you or me? .....
7. How, do you think, we could increase the strength of the electric current in a demonstration such as this one, to have a deadly shock? ...

Second

Use the scrambled 'puzzle picture parts' of the electricity generating process at a coal burning power station, contained in Information Sheet No.4 to re-arrange the 'puzzle picture-parts' to fit together in such a way that you and your group think is best for the process of generating electricity. Write key words for each stage of the process, e.g. begin with - coal burning. (You may use the space below to do the re-arranging of the 'puzzle picture parts', name the energy conversions, and state the Law of Conservation of Energy, or you may use a new sheet)

Third: Electricity is the movement of charged particles through a conductor When these charged particles (electrons) move, they can transfer energy into different useful forms- e.g. in a globe electric energy is converted into light energy. Identify the various energy conversions that occur from the time coal is still a type of material containing *chemical energy* - up until *electrical energy* is produced. Note, this step must be done on the diagram, next to the appropriate section of the electricity generating process.

Lastly: State the LAW of Conservation of Energy. Note, this Law may be written above or below the re-arranged 'puzzle picture parts'.



Examine and study the diagram in the Information Sheet No. 5 very carefully, and then:-

TASK 1.

Trace the pathway of electricity transportation from the generating power station (which is situated far from your home, in Mpumalanga Province), up until it reaches the outside of your home. This picture represents or shows the way electricity reaches most of the homes in South Africa - including your home.

TASK 2.

Compile a report indicating Step 1, Step 2, etc. so that anyone reading it can understand and follow you clearly, when you explain to them - how electricity reaches their home from the power station at the source of the generation process. (You may write the report below, or on a separate sheet)

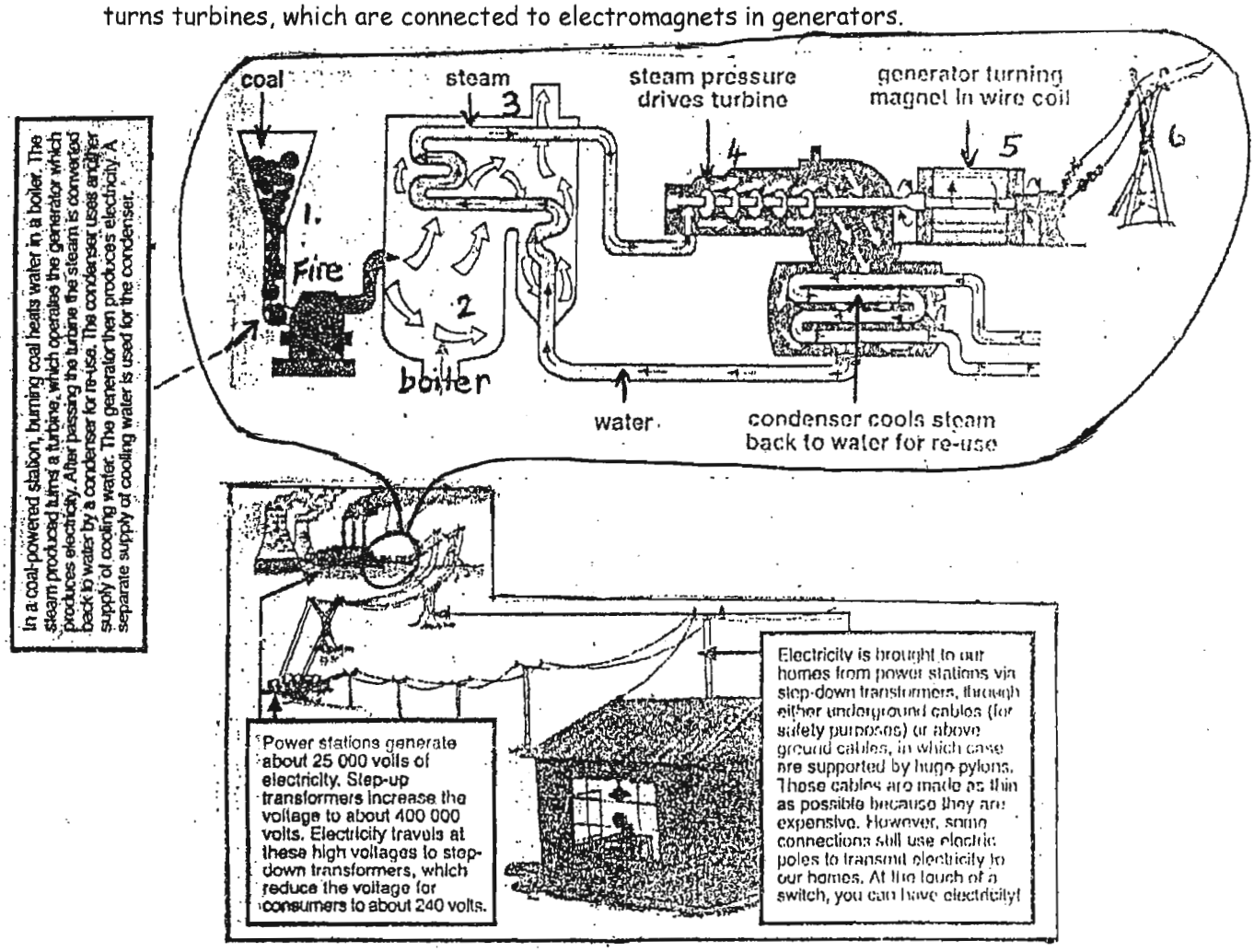
TASK 3.

State what the unit is for the measurement of the strength of an electric current, and then use this information to explain how much the electric current strength is at the source, and how it changed to a lower electric current strength before it is connected to your home. Please also state why the strength of the electric current is reduced before it enters the home, and what safety measure is in place to prevent a very strong electric current from entering a home).

Information Sheet No.5

Generation Electricity in a Power Station. How is electricity produced in a power station?

Passing an electric current through a wire can produce a magnetic current. The opposite is also true if a wire moves through a magnetic field and a current is produced in the wire. The size of the current depends how quickly you move the wire. This principle is used in power stations to generate electricity, but instead of moving a wire through a magnetic field, the magnet turns inside a wire coil. Steam turns turbines, which are connected to electromagnets in generators.



Insulators and Conductors

Our bodies can conduct electricity, especially when they are wet. Never touch plugs, points, or light switches with wet hands. A conductor will allow electricity to pass through it. We use conductors to take electricity to where it is needed. We use insulators to prevent it from reaching places where it could be dangerous. Electricians like the one pictured here, wear rubber boots to protect themselves from electric shocks. Metal wires conducting electricity are insulated with rubber or plastic to make them safe.

PART FOUR	Uses of Electricity in the home	Energy & Change (incl. M&M)

In the previous task we have seen how conductors take electricity to where it is needed. We use insulators to prevent it from reaching places where it could be dangerous. Electricians war rubber boots to protect themselves from electric shocks. Metal wires conducting electricity are insulated with rubber or plastic to make them safe for people and other animals.

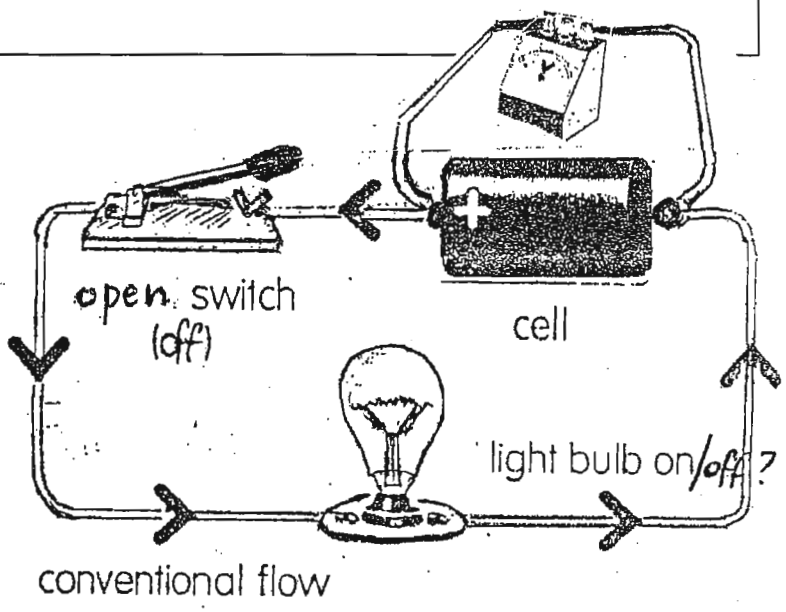
TASK 1

Setting up a **simple electric circuit** in the classroom

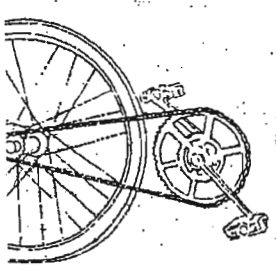
You and your group will use the diagram in pictures below which shows how the different components/parts are connected together in order to make a light bulb or globe shine. The torch battery or cell is used as a portable form of stored electricity, ready to be used when ever you need it. The names of the different components/parts and their symbols are also given in one of the pictures given below.

Redraw the picture drawing of the electric circuit using the symbols in the place of the pictures in the diagram below.

You or your group may be ready to state what an **electric circuit** is - write it in the box



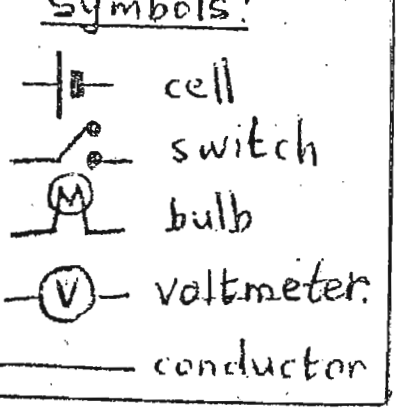
; to think about
s moving all round a circuit are
aks in a bicycle chain which
n the pedals are pushed.



Skill- Drawing circuit diagram using symbols

Criteria	Achieved beyond 3	Achieved 2	Needs Help 1
1.Components connected in a closed circuit formation			
2.Appropriate symbols are used			
3.Components properly connected			
4.Neat & clear symbols			
5.Circuit works when switch is on			

Symbols:

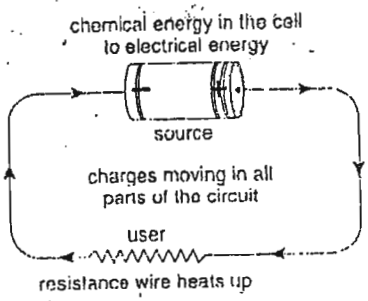


TASK 2

Electric Circuits - energy and moving charges

In electric circuits a **transfer of energy** occurs with the **movement of electric charges.** In Std 6 you learned that every electric circuit must have a **source** of electrical energy, a **user** of electrical energy and **connectors** to join the user to the source. The **circuit** will **transfer the energy** while **electric charges are moving** all round the circuit.

The study of circuits helps us to understand how the movement of charge and the transfer of energy occur together.



Take Note: The connectors, source and user (e.g. a light bulb) together form a **path** along which the electric charges move. What name would you give to this almost circular path formed by the connectors, source and user? an .....

Task 2 (begins here)

Use the following components to set up en electric circuit in the classroom: Connectors, a cell, a user (e.g. light bulb), open switch, and a voltmeter across the ends of the cell (to measure the energy that the cell can give).

Then, find out what the symbols are for each of the components used in the above electric circuit. Lastly, draw a circuit diagram below, using the symbols you found for each of the components.

Energy changes and movement of charges

When a circuit is completed by closing the switch (switching it on):

1. The charges along the path will begin to move. What makes the electric charges move? .....
2. The source then changes the available energy (called .....) into electrical energy.
3. The charges in the user (bulb) move. In the user, electrical energy changes to the wanted energy. In a light bulb, what is the wanted energy? .....In another user such as a electric kettle, what is the wanted energy? ..... and in a fan? .....

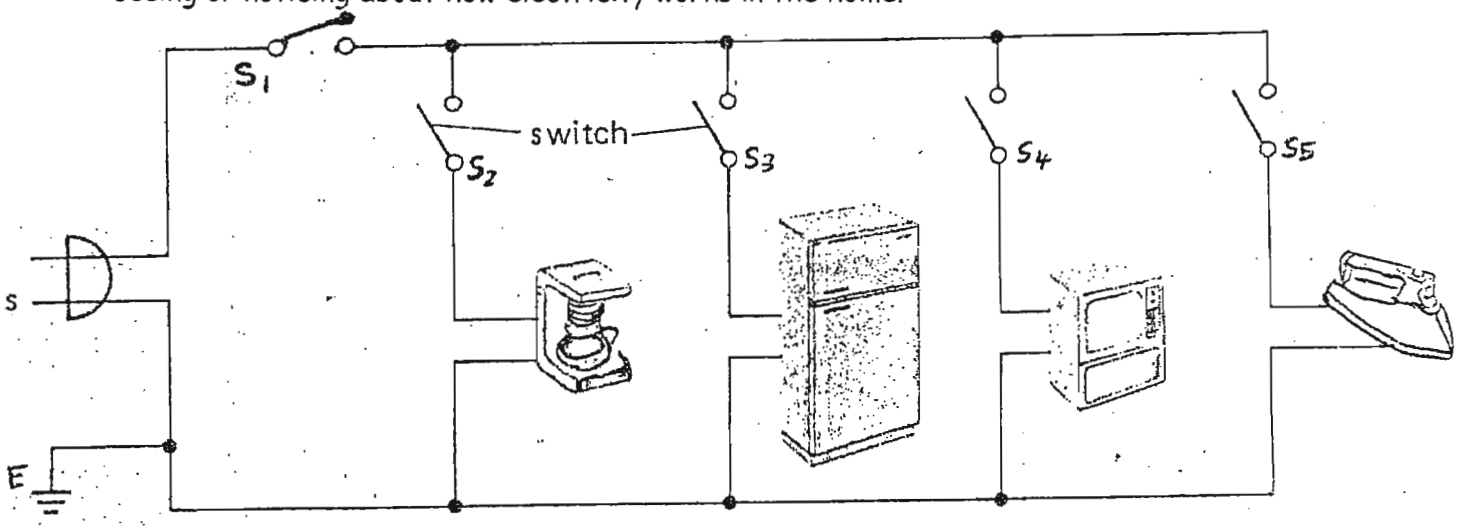
Note: The volts (V) or voltage of a source of electrical energy, is the measure of the ability of a source (e.g. cell, battery, power station) to give electrical energy.

TASK 3

Electric circuits in the home

We have seen how electricity travels in a simple electric circuit, from the source, round along a few conductors and electrical components, and back to the source again, for as long as the switch is ON.

Take a careful look at the following diagram of an electrical circuit found in most homes, and then write down your own comments on what you or your group are seeing or noticing about how electricity works in the home.



Can you explain why this type of circuit is called a parallel circuit?

.....

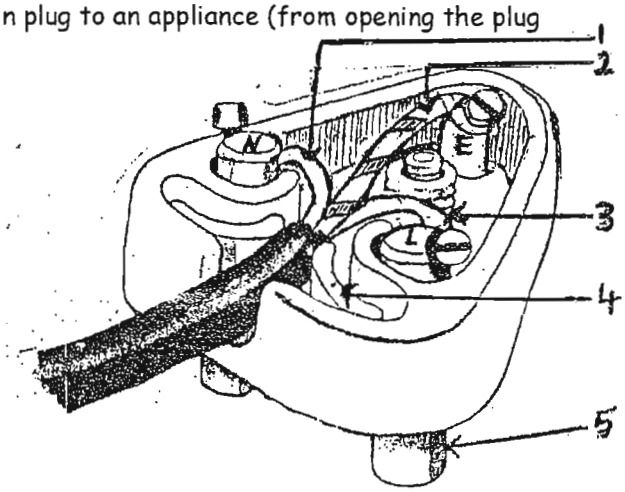
.....

.....

TASK 4

For each of the different electrical appliances shown in the above diagram, a plug is needed. Most appliances come with a fitted plug, but some need a plug to be connected first. Use the diagram provided below to:

1. Shade in the correct colours for each wire in the 3-core flex wire using crayons.
2. Name the different colour codes
3. Explain how you would connect a 3-pin plug to an appliance (from opening the plug to replacing the cover)



Skill & Knowledge: Connecting a 3-pin plug

Performance Measure(s)/Criteria	Mark
1 Use of screw driver to open or close plug screws	1
2. Colour coded wires connected to appropriate pin	1
3. Firm connections to plug pins	1
4. Cord firmly held by chord grip	1
5. Plug cover back in place	1
Total	5

Electricity and the human body

Our nervous system works on small electrical signals sent from the brain to all parts of the body. These signals are carried along nerve pathways. They regulate all our body functions, like making our heart beat regularly, keeping our body temperature controlled and giving us sensations of pain or pleasure.

When electricity flows through a persons body, the electricity can cause the body to be burnt. The nerve pathways can conduct the electricity to all parts of the body and cause damage to vital organs. The results of electric shock can be permanent disability or even death.

Warning !

Electricity can be dangerous if you do not take care. Be safe with electricity, be electrowise!

TASK 1

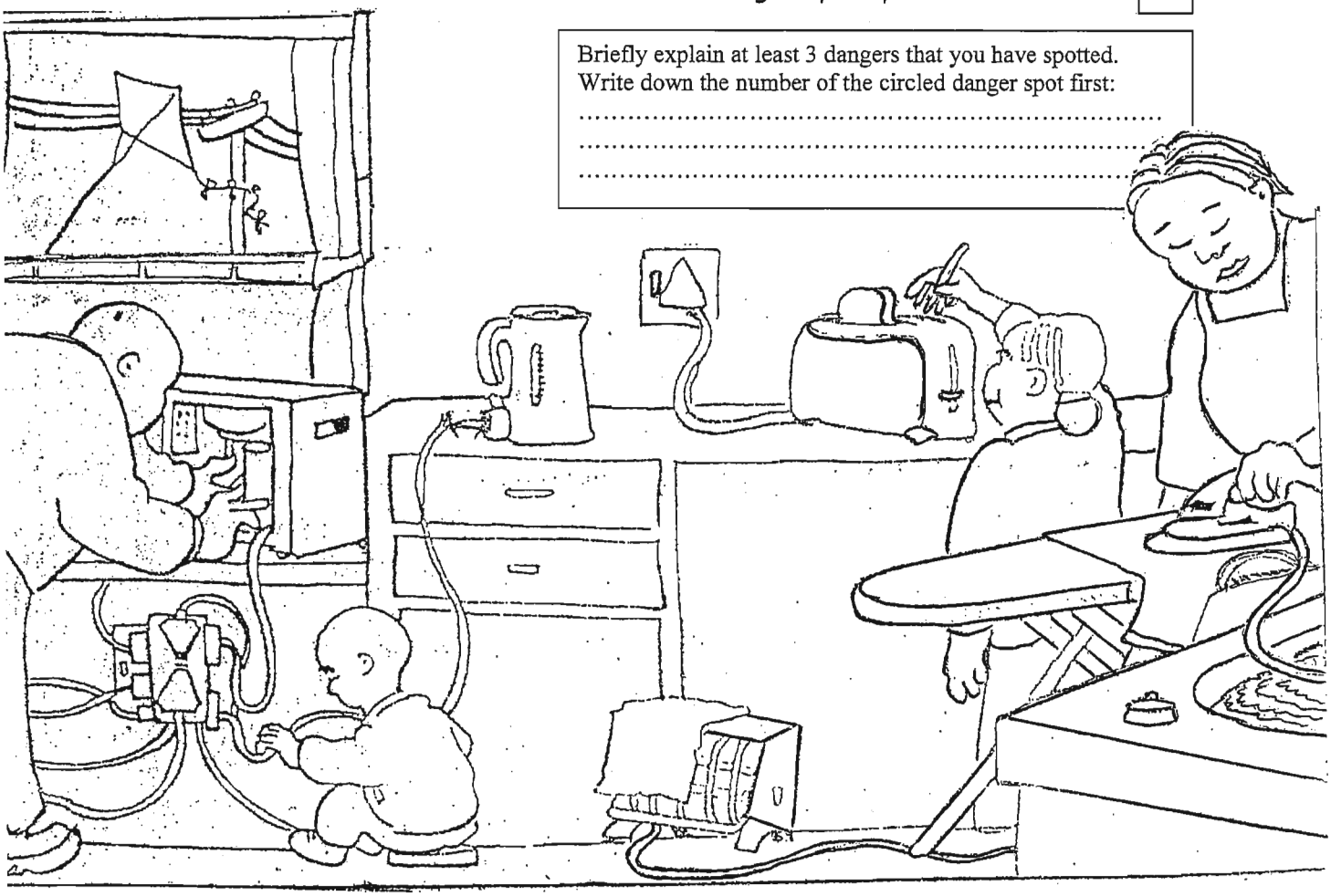
"Spot the danger" activity. Draw a circle around each danger you spotted, write a number next to the circle. Fill in the number of dangers you spotted in this box: ☐

Briefly explain at least 3 dangers that you have spotted.
Write down the number of the circled danger spot first:

.....

.....

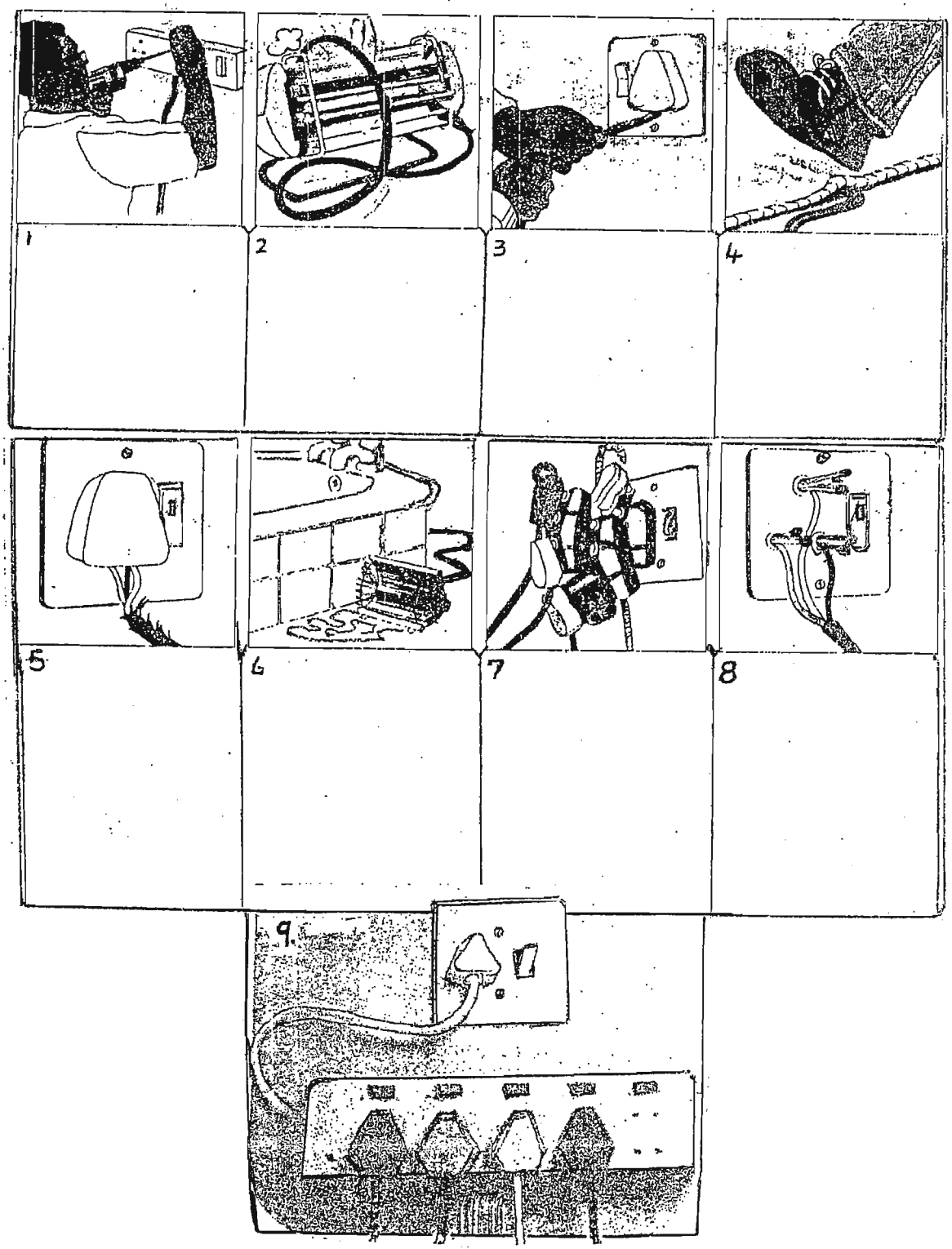
.....



TASK 2

The following pictures show situations in the home where electricity can be dangerous to people. Choose those pictures where you have observed the kind of danger situation seen in the pictures below, then write in the box what the danger is, and how it can be prevented.

Electricity can be dangerous :



Culminating Performance Task

You and the members of your WORKING and LEARNING GROUP have been approached by your Local Government Ward Councilor, in the area where you live.

He would like you to help him in your community, to help the residents in a newly developed housing section of your community. New homes have just been built, and most of the people lived in the informal dwellings that were there before the new houses were built. **Most of these new home owners know very little or nothing about electricity ---**

WHERE it comes from,
HOW it is produced
HOW it works,
HOW it is used in the home
WHAT are the dangers it may bring to their lives.(SAFETY measures)

Most of the new home owners are very scared of connecting electric cables to and inside their homes, because they have heard how a person could get shocked or killed by the incorrect use of electricity. They would first like to get clear and simple answers to these questions before they agree for electricity to be connected to their new homes.

The new home owners and the Local Government Councillor have agreed to meet again in four week's time, at which meeting he would like you and your team to make a presentation on electricity to the concerned new home owners.

The Task at hand for you and your team:

4. **Find as much information as you can on the topic.**
5. **Collect and prepare the appropriate information in order to make a presentation to the new homeowners in your community suburb of Sizanani.**
6. **Work closely under the expert guidance of your teacher or other knowledgeable adult/peer**
7. **Make use of pictures, graphs, models, drama, song or reports to explain some concepts**
8. **Use portfolio boards as a medium of communication, for display and presentation**
9. **Practice and sharpen your public speaking or presentation skills.**

NB:
Your team will share the presentation of the portfolio at the meeting, and also answer some of the questions which may be asked by the new home owners.

Anexture 14. Performance Task-Scoring Rubric

(analytic rubric for assessing the culminating performance task)

Electricity in our home/industry - Portfolio Boards(display/presentation)

Name: ..... Grade: ..... Date: .....

Category	Beginning 1	Developing 2	Accomplished 3	Exemplary 4	Score
Pictorial & Graphic representations	Some pictorial & graphical representations with some captions.	Clear pictorial & graphical representations with captions.	Accurate & clear pictorial & graphical representations with captions.	Accurate, clear & appropriate pictorial & graphical representa-tions with clear captions	
Communica-tion of results	Communication of results is incomplete, unorganized, & difficult to follow	Communicates some important information; not organized well enough to support ideas	Communicates most of important information; well organized to support ideas	Communication of results is very thorough; well organized & shows insight into the workings of electricity	
Quality of work	Provides work that usually needs to be checked by others to ensure quality	Provides work that sometimes needs to be checked by others to ensure quality	Provides high quality work	Provides work of the highest quality	
Science concepts & principles	Lacks insight into scientific ideas, concepts & principles	Shows little insight into scientific ideas, concepts & principles	shows some insight into scientific ideas, concepts and principles	shows insight into the workings of electricity, and science concepts and principles	
Relations & links between Science & Tech.	No attempt made at expressing links or role of Science & Tech.	Attempt made at expressing links or role of Science & Tech.	Links made in role of Science & Technology in the production & use of electricity	Appropriate links made in the role of Science & Technology in the production & use of electricity.	
Total Score: (Note: For each criterion if work is exemplary, learner gets 4 marks)					20

Annexture 15

Learning Unit (Referred to as a Learning Programme in C2005, 1997; and a Lesson Plan in the RNCS, 2003)

Page 1

[Note: The Terminology used here is as per Curriculum 2005, e.g., (Learning Programme), which in the RNCS is a Lesson Plan - developed by T Jafta, June 2004]

Learning Programme: Natural Science (Senior Phase - Grade 8)
Phase Organiser: Economy and Development
Programme Organizer: Industry and Marketing **Focus**: Electricity in Industry/Home

1. **TITLE:** Electricity in our Home or School
2. **LEARNING OUTCOMES**:

Main Outcome: NS SO 9: Demonstrate an understanding of the interaction between the Natural Sciences & socio-economic development.
AC 1: How Science & Technology are used in society
AC 2: Analyze the way in which Science & Technological development have changed the lives of people
AC 4: Explore the link between scientific ideas and technological devices
AC 5: Communicate the roles & consequences of science and technology

Supporting Outcomes: (For integration purposes)
NS SO 1: Use process skills to investigate phenomena related to the Natural Sciences
AC 1: Phenomena are identified
AC 4: Data is collected
AC 6: Findings are communicated

NS SO 3: Apply Scientific knowledge & skills to problems in innovative ways
AC 2: relevant information is selected & gathered
LLC SO 4: Access, process & use information from a variety of sources & situations
AC 2: Aim of the information search is defined
AC 3: Information is located, accessed & selected
AC 6: Organizational skills are applied
TECH SO 1: Understand & apply technological processes to solve problems
AC 1: Problems, wants & needs are identified
AC2: Consider a range of possible & relevant solutions

NB: The aim of this illustrative Learning Programme (ILP) is for learners to learn about electricity as it affects their own & other people's lives. The ILP is linked to the learner's context, and provide to learners and educators a structure in which learning can take place.

3. DESIGN

3.1. SKVA's

SKILLS	KNOWLEDGE	ATTRIBUTES (Values/Attitudes)
1.Problem solving 2.Accessing information 3.Investigation 4.Communication 5.Recording. 6.Drawing graphs 7.Presentation 8.Connecting electrical appliances or devices 9.Following instructions	1.Electricity - phenomenon 2.Electric current - types 3.Conductors & insulators 4.Sources & generation thereof 5.Simple circuits & symbols using torch cell(s) 6.Energy, conversions & uses 7.Safety measures 8.Colour codes for electrical connections	1.Conservation of electrical energy 2.Respect & rules for usage thereof 3.Being electrowise 4.Care for living things 5.Forming own opinion regarding proper utilization of electricity and sources 6.Wise use of natural resources 7.Respect & valuing other's opinions & views

3.2. Teaching, Learning, and Assessment methods/strategies

Learning Outcomes Learners will be able to:	**Structured Learning** and **Assessment** -Educator/learner/Self	**Purpose**	**HOW?** and what **Evidence?**
3.2.1.Share their prior knowledge of electricity (as experienced at home, community, or school)	Learners individually complete the questionnaire for **RPL** *Educator Assessment.*	To gain learner's prior knowledge (to provide a starting point for learning)	• Questionnaire • Questions & answers
3.2.2.Skill: Listen, gather information. Sub-skill: Select relevant scientific information, manipulate data	Educator led **group discussion** on the problem to be addressed as requested by the local community Ward Councillor.	To introduce the topic and set the scene for the challenge put to the learners studying science, and who live in the community as well. To plot the way forward	• Short lecture and clarification seeking session (approx. 8 min) • Ideas on what could be done
3.2.3.Skill: Communicate findings Sub-skill: Share findings and/or conclusions	**Small group work**. Learners access relevant information on ways of generating electricity, i.e., sources. See information sheet 1 in the probe or workbook. *Learner/Educator Assessment.*	Learner/ Educator participation, co-discovery, two-way-rich communication to elicit responses on the task at hand	• Worksheet/poster/table • Questions & answers • Marking rubric

Learning Outcomes Learners will be able to:	**Structured Learning** and **Assessment** -Educator/learner/Self	**Purpose**	**HOW?** and what **Evidence?**
3.2.4.Skill: Gather information Sub-skill: Select relevant scientific information 3.2.5.Skill: Communicate findings Sub-skill: Share findings or conclusions	Teacher input to stimulate **debate** on the need for conservation of natural resources renewable & non-renewable. **Individual reading** of info. sheets in probe followed by **think-pair-share**, to differentiate and then **tabulate** the differences. *Educator Assessment.*	To stimulate discussions, and raise awareness regarding conservation. Consolidation Provide relevant opportunities for co-operative learning	• Short Educator input and presentation of pictorial text • Question and answer • Table of renewable & non-renewable sources
3.2.6.Skill: Accessing information Sub-skill: Identify & list sources used in South Africa, Giving percentage of each. 3.2.7.Skill: Translating data from one form to another Sub-skill: Draw a bar graph and a pie chart from the numerical data on sources above, using marking rubric as a guide.	**Small group work**. Learners access information from the appropriate sources or use information sheets in the probe. Numerical data is obtained related to the sources used in S.A. **Individual activity**. Learners **draw a bar graph** using the graph paper in the probe, and then **draw a pie chart** using Educator mediation. *Educator/self/peer Assessment*	Awareness of local consumption of natural resources. Numerical data is represented graphically Use of data for different purposes Provide relevant opportunities for co-operative learning	• Table of sources used in SA indicating amounts used • Bar graph • Pie chart • Assessment/Marking rubric
3.2.8.Skill: Focus and plan an investigation Sub-skill: Identify and record data 3.2.9.Knowledge: How is electricity produced using magnet and copper coils	**Small group work**. Learners co-operate in conducting an **investigation** and, **demonstration**, on how electricity may be generated when using a magnet, compass, copper wire and cylindrical cardboard roll - guide by info. sheets Learners **individually draw a diagram** and **compile a report** on their observations and apparatus used. Use findings to say what electricity is, and how it is generated. *Educator Assessment.*	To develop learners skills and knowledge in conducting investigations in science. To introduce the importance of accurate observations in preparation for further learning. To stimulate inquiry and to introduce learners to the scientific investigative process To introduce learners to the way electricity is generated in a power station, & to use this setting to address what electricity is, how it works, how its presence can be explained.	• Diagram with labels • Investigation report with steps for conducting scientific investigations -aim, apparatus, how apparatus is connected, observations & conclusion

Learning Outcomes Learners will be able to:	**Structured Learning** and **Assessment** -Educator/learner/Self	**Purpose**	**HOW?** and what **Evidence?**
3.2.10.Skill Manipulating Data Sub-skill: Arrange data in a sequential order to represent the process of generating electricity at a power station. 3.2.11.Knowledge: Process of generating electricity at a power station using coal. Energy conversions along the process. Law of conservation of energy	Educator input on the task. **Small group work**. Learners cut own puzzle pieces on the information sheet in the subject probe. They use **discussion and negotiation** or request Educator mediation if needed, to re-arrange the different puzzle pieces to form a sequence of steps that represent the electricity generation process at a power station. **Group discussion** in identifying the types of energy present in each step, and what the conversions are, if any. *Educator Assessment.*	To set the scene for the task. Application of skills & knowledge gained from the previous or earlier activity. To expand or transcend classroom based learning to real life situations.	• Ordered sequential steps of generating electricity in a power station in S.A. - using coal • List of energy conversions that occur at each step in a process of generating electricity using coal. • Rubric
3.2.12.Skill: Accessing Information Sub-skill: Tracing the path of large scale electricity supply to our homes as it travels form the power station. 3.2.13.Knowledge: Conductors, insulators, transformers, pylons, dangers with electricity, pollution and getting shocked or electrocuted.	**Educator mediation** using infrastructure in the local community - e.g., overhead pylons, street poles, power boxes near the homes, and electricity meter outside on the walls of homes, and the circuit board with electrical switches inside the home or school on the kitchen wall. **Small group discussions** using a colourful poster showing the path of electricity from the power station to the homes. Learners **list the steps** showing the movement of electricity to their homes, and how the current is stepped down before it enters the home or school. *Educator Assessment.*	To acquaint the learners with the large scale supply of electricity in the country. To create opportunities for learners to relate their classroom based science learning to real life situations. To stimulate interest, inquiry and observation when learners work or encounter electricity on their own at home or in the community, so that they can make informed decisions. To help learners use science concepts and laws in order to inform their everyday actions and uses of electricity.	• List showing the steps that trace the path of electricity supply from the source to the home or school, each step indicating the devices used to step down the current, and the appropriate voltage at each step. • Rubric

Learning Outcomes Learners will be able to:	**Structured Learning** and **Assessment** -Educator/learner/Self	**Purpose**	**HOW?** and what **Evidence?**
3.2.14.Skill: Drawing Drawing simple circuit diagram from a picture diagram, using symbols 3.2.15.Knowledge: Exploring fundamental Science principles & concepts that underpin the working of electrical devices.	**Individual activity**. Learners draw a simple circuit diagram from a picture circuit diagram - using symbols. *Educator Assessment.*	To extend learner's understanding of the movement of electricity in conductors from one place to another using simple diagrams, harmless amounts of electricity, and every day objects in the classroom.	• Drawings of simple circuit diagrams using symbols. • Questions and answers • Rubric
3.2.16.Skill: Connecting a three-pin plug. 3.2.17.Knowledge:Electrical devices. Color coding used for connecting electrical wires or appliances to electricity supply Knowledge and awareness of dangers associated with electricity supply in the home, school, or the community	**Small group discussion**, as to the steps to follow when connecting a 3-pin plug to a 3 core flex wire **Small group work** negotiating the proper colour codes and making the connection of a plug to an electric appliance. **Think-pair-share** in spotting the danger of electricity consumption as shown in a picture in the subject probe. **Individual activity** identifying dangerous situations and appropriate usage of electricity in the home, school or community - using the given task sheet in the subject probe. *Educator/peer Assessment.*	To show how science and technology work together for the benefit of man. To show how technological devices can be used to improve the lives of people. Raise awareness of the dangers associated with the wrong or incorrect use of electricity. T acquaint those learners who need electricity, with the advantages of this form of energy in our modern society to-day.	• A properly connected 3-pin plug • A working electrical appliance • Rubric • Table indicating faulty or correct use of electricity in the home, school, or community.

4. DELIVERY

4.1. Teaching, learning, and Assessment methods. The three processes occur concurrently and and are interwoven. The content, pedagogy and outcomes are all captured in the above learning programme. The three are further developed and set out in the probe (or workbook) which each learner receives.
4.2. What the probe will look like. See Annexture 7 for this learning support material that enables the Educator, learner and parent to enter the negotiated space where learning takes place. Each learner is given a copy of the probe.

5. QUALITY ASSURANCE

5.1. Quality assurance is based on learner feedback and evidence of learning (i.e., assessment tasks, tests, reports, etc.) after the completion of the entire learning programme.
5.2. Work done by the learner is reflected in the assessment activities in the probe, or other artifacts produced by the learner.. These serve as evidence of learner performance.

6. REVIEW AND REFINEMENT

My Notes about	My Plans and my Results	Reminders for Next Time
6.1. Teaching Strategy	- Stimulus material in the probe facilitated discussion and co-operation, and lends to greater learner participation. - Some learners from resource-poor backgrounds needed extra mediation and concrete examples	- Plan for more demonstrations with real samples of technological devices. - Provide more challenging tasks for the learners - Relate more, what children learn in the classroom to what happens in real-life - Plan excursions or visits to science fairs
6.2. Use of Time	- Group work activities are often marred by conflicts and childish behaviour by some, and this affects their focus. Assessing group work takes a lot of time. - Individual activity exercises are often copied from others. Hands-on activities also take more time. Homework or take away tasks are often not completed.	- Clear instructions and role-functions must be given for group work and group members. - Develop learner's time-keeping skills. Enlist parental assistance in monitoring take away tasks. - Spread group work assessment over a number of days.
6.3. Resources	- The probe took time to compile and staple. It requires lots of photocopying, photocopying facilities, and plenty of duplicating paper. - The probe is the most effective way of managing teaching, learning and assessment all in one, and for delivering curriculum in the classroom	- Access more reference material for the compilation of the probe, and acknowledge sources. - Probes must be planned and compiled long beforehand. - Align assessment rubics to summative assessment requirements.

My Notes about	My Plans and my Results	Reminders for Next Time
6.4. Assessment	- Learners make use of the assessment criteria in rubrics to guide performance. This also helped them to assess themselves to track own progress. - High absentee rate affects learner's performance and continuity. - Recording of assessment is time consuming. - The Educator's role of mediator of learning and assessor can be conflictual at times for the learner. - Assessment sometimes stands in the way of good teaching and learning. - One often has to spend a lot of time observing group work or a group in order to follow the discussions and exchange of ideas, to then give advice and prompt slow starters.	- Find a way to make recording of learners assessments simpler. Include peer assessment tasks - Inform parent on absenteeism, and provide explanation on the manner in which continuous assessment is calculated.
6.5. Class Motivation	- Most learners found the activities enjoyable and interesting. - Most do not visit libraries because of lack of access. - Some returned to class during intervals to continue with their tasks.	- Build in feedback loops so that learner's work or progress can be monitored before due the date. - Learners must be told about the consequences of not completing classroom or take home tasks.

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