

An investigation of the learning processes that take place
during practical work activities when using electrical circuit
boards in grade 8: A case study

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By

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DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.

Signature: Date:

ABSTRACT

Since the introduction of Outcomes Based Education (OBE) as a preferred method of teaching and learning with Curriculum 2005 in 1997, its existence has come under continuous threat for the past thirteen years. Its teething experiences included a revision in 2004 which saw the introduction of the Revised National Curriculum Statements (RNCS) and most recently, we are now standing on the threshold of the implementation of the Curriculum Assessment Policy Statements (CAPS) in 2012.

Throughout the turbulent educational milieu, social constructivism has always been upheld as the preferred teaching and learning methodology and millions of rands have been invested in this regard. This study is thus premised on the concern that now after all the years of actively promoting social constructivist methodologies, the implementation of the CAPS could seriously negate reasonable strides made in this regard.

Triggered by these curricular issues, a qualitative case study was conducted at a school in Grahamstown in the Eastern Cape, South Africa, investigating the learning processes occurring in group work sessions during lessons involving practical work in electricity using circuit boards in grade 8. Underpinned by an interpretivist paradigm, the study took place in two phases. The data was mainly generated through audio and video recording of two focus groups. An open coding system was employed to derive analytical categories and frequency tables were used to establish trends. In order to validate the data, two observer teachers were involved throughout the research process and this was followed up with semi-structured interviews after the second phase. The two case studies, involving learners fitting a similar profile in respect of mother –tongue and age group, were engaged in a similar activity for almost a year apart.

This study anticipated the revelation of the extent to which group practical activities in electricity promoted learning, how knowledge is constructed in group-settings and whether practical activities involving electrical circuit boards in grade 8 enhance learning? The main

findings of my study revealed that these practical activities can promote learning and therefore should remain a preferred method of teaching.

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LIST OF ABBREVIATIONS AND ACRONYMS

ANC – African National Congress

C2005 – Curriculum 2005

CAPS – Curriculum and Assessment Policy Statements

CS – Curriculum Statement

DoE – Department of Education

GET – General Education and Training Band

IPA – Interpretive phenomenological analysis (IPA)

KZN – Kwa Zulu Natal

LoLT – Language of Learning and Teaching

LTSMs – Learning and Teaching Support Materials

OBE – Outcomes Based Education

PEEOE – Predict, Explain, Explore, Observe, Explain

POE – Predict, Observe Explain

R-12 – Grade Reception to Grade 12

RNCS – Revised National Curriculum Statement

ZPD – Zone of Proximal Development

CHAPTER ONE

SITUATING THE STUDY

1.1 Introduction

This chapter introduces my study which is an investigation of the learning processes that take place during practical work activities when using electrical circuit boards in grade 8. I position myself as a researcher, introduce the research question and give a brief overview of each chapter.

The past eight years of my 36 year-long teaching career have been spent in grade 8 Technology classrooms. The school where I teach is a dual medium, (Afrikaans/English) high school covering grades 8 to 12. It is co-educational and has an enrollment of more than 1100 learners. I teach technology to two Afrikaans medium and three English medium classes. It is a township school with limited resources and a rather unique language profile. It is this unique nature of its language profile that motivated me to conduct my investigation in the Afrikaans medium classes.

1.2 Language Profile

As my intention was to discover what learning processes take place during practical activities, I believed that this would be best observed while learners were operating in their mother tongue. The only cases where children would be taught as well as learn in their mother tongue were in the Afrikaans medium classes. A breakdown of the language profile of our learners in my school follows:

- 1.2.1 Approximately 70 % of our learners are *isiXhosa* home language speakers and they are taught in English. Therefore they are being taught in their second language.
- 1.2.2 Roughly 3% of the school's *isiXhosa* home language speakers are taught in Afrikaans. At my school this implies that they are being taught in their third language.
- 1.2.3 Approximately 12% of the school's Afrikaans home language speakers are being taught in English, revealing that they are being taught in their second language.

1.2.4 Finally, we have a group of approximately 15% Afrikaans home language speakers who are taught in Afrikaans. They are the only learners at our school who are taught in their mother tongue and also the only group where the conversations in groups are most likely to be conducted in a language that coincides with their Language of Learning and Teaching (LoLT).

My selection of the learners for my focus groups therefore was guided by the fact that I hoped to derive maximum benefit from the discussions during group sessions. It was an attempt to obviate what Bot (1993) described as, "...the use of what is to many children a foreign language, is one of the main barriers to teaching and learning" (Bot, 1993 as cited by Czerniewicz, Murray & Probyn; 2000:7).

1.3 Learner Profiles

1.3.1 Phase One

The group of six learners in my focus group was made up of five girls and one boy (see Appendices 8.1 and 8.2). These learners ranged between the ages of 13 and 15 and they had attended three different primary schools before they came to my school. This fact partially accounts for the varying levels of their prior understanding/knowledge of basic concepts in electricity (See section 2.5.2).

All six learners were being taught in Afrikaans but five of them were Afrikaans first language speakers. The sixth was an *isiXhosa* home language speaker, but had an exceptionally good command of Afrikaans and was able to participate fluently in the group discussions. One of the six learners dropped out of the focus group and was not replaced because the rest of the class were reluctant to leave the groups they were settled in.

Of the remaining learners in the focus group, one lost his notebook and I was not able to factor his written comments into the data gathered. He is, however, part of the analysis gained from the audio and video material.

1.3.2 Phase Two

The group of learners in Phase 2 was made up of three boys and three girls all aged fourteen (Appendix 8.3). They also attended three different primary schools the previous year and like the learners in the first phase of this study had different levels of prior understanding of electricity as prescribed in the syllabus for grade 7 in the General Education and Training Band (GET) of the Revised National Curriculum Statements (RNCS). They were all Afrikaans first language speakers and were taught in their mother tongue.

1.4 Case Study

The data for my research question was gathered during two case studies conducted at my school over two sessions, one in October 2010 and the other in September 2011. I found that using the case study method as my main data generating technique allowed for reasonable in-depth research as well as the utilization of other data generation tools such as questionnaires, semi-structured interviews, journal writing and audio and video recording. In both instances I used learners from the same grade, who fitted the same language profile and I used the same lesson materials.

The first phase of my investigation proved most valuable in the sense that it taught me a number of useful lessons that I could apply in Phase Two. More is said in this regard in Chapter Four of this thesis. I will also shed more light on my reasons for opting for the case study method in Chapter Three of this study (See section 3.5).

1.5 Motivation for this area of research

In a document entitled, Curriculum News, May 2010 the honourable Minister of Basic Education, Mrs Angie Motshekga announced the establishment of three committees to enable the streamlining of the current curriculum in South Africa. One of these, the Curriculum and Assessment Policy Statements (CAPS) Ministerial Projects Committee was tasked to develop a single, comprehensive and concise curriculum and assessment policy statement for each grade, R-12, as recommended by the report of a ministerial committee. These curriculum and assessments

should provide, “clear guidelines on what you ought to teach and assess on a grade-by-grade and subject basis” (Curriculum News, May 2010).

I am of the opinion that a real chance exists that teachers will be tempted to revert to earlier positivist (traditional) teaching methods and for that matter negate the use of constructivist methodologies. It is with this notion in mind that I set out to investigate the type of learning that takes place during practical work activities when using the example of grade 8 learners working together on electrical boards as a case study. I believe that if I am able to provide some insights into this scenario, it may serve as a motivation for continued support for constructivist teaching methods (Section 2.3.1).

1.6 Research goal and questions

1.6.1 The main goal of this research study is to investigate the learning processes occurring during group work sessions in lessons involving practical work activities in electricity using circuit boards in grade 8. In the process of investigating my main question I will also be investigating the following questions:

- Does engaging learners in well-structured group practical work activities in electricity present a premise for meaningful learner talk?
- How is knowledge constructed in group-settings?
- Do practical work activities involving electrical circuit boards enhance the learners’ understanding of electricity concepts in grade 8?

1.7 An overview of the thesis chapters

Chapter One is titled, ‘situating the study’. It introduces my research topic and seeks to locate my position as researcher in the study. I also give a brief description of my research site and a profile of the learners constituting my focus groups in both phases of the study. I make special reference to the unique nature of the language situation at my research site in an attempt to highlight its

significance in the context of the data I gathered as well as allude to the motivation for my study. Finally, this chapter briefly outlines the essence of each of the chapters making up the study.

Chapter Two is called a Literature Review and it examines the theoretical premise for my investigation of the learning processes taking place during practical work activities when using electrical circuit boards in grade 8. I have consulted literature in respect of the theory that underpins the curriculum (constructivism) and also the knowledge content requirements for grade 8 learners in respect of the topic on electricity. I have also looked at literature regarding practical work and possible problems encountered in the teaching and learning of electricity in the General Education and Training (GET) Band. Finally, I consulted material on learner talk (Lemke, 2001) in an attempt to familiarize myself with what has been written in this regard.

Chapter Three describes the methodological framework that guided the research process. It describes the reasons for selecting my approach to address the research goals and questions and it explains my own role as a researcher in the research process. It also describes the research process as well as explains how data was generated and analyzed. It concludes with a discussion of research trustworthiness, validity and ethical considerations.

In **Chapter Four**, I present and discuss the data I gathered. The first section of this chapter deals with Phase One of the study and the second section is based on Phase Two. In the analysis of the data gathered, I used Haig's (1995:2) 'grounded theory' (Section 4.1) and for coding purposes I used an open coding approach (Section 4.2.1).

Chapter Five contains concluding recommendations and critical reflections. It starts with a summary of the research process and then highlights a few critical remarks in respect of my study. It briefly contextualizes my research goal within the rationale for embarking on this investigation and then alludes to a few recommendations for future research.

1.8 Concluding remarks

This first chapter primarily attempts to situate my study in respect of locale and participants. It also seeks to provide a motivation for this area of research by listing its goals and rationale and

then outlines a brief overview of the thesis chapters. The next chapter will deal with the literature I consulted to support my investigation as well as my findings.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter examines the theoretical premise for my investigation of the learning processes taking place during practical work activities when using electrical circuit boards in grade 8. Essentially, the study of electricity is a requirement of the Technology and Natural Sciences Learning Areas syllabi in the General Education and Training (GET) band. Technology is a relatively new learning area and was introduced in 1997 as part of Curriculum 2005 (C2005). This curriculum was based on outcomes based education (OBE), a methodology that was perceived as the foundation for a transformation from traditional content-based and teacher-centred education to one that is learner-centred in character.

The new curriculum had three design features. Firstly, it was *outcomes-based*, and this feature was positioned so centrally that outcomes-based education (OBE) became synonymous with C2005. An *integrated knowledge* system was the second design feature. School 'subjects' were jettisoned, and eight 'learning areas' introduced for Grades 1 to 9. The third dimension of curriculum reform was the promotion of *learner-centred pedagogy* (Harley & Wedekind, 2005:197).

According to Moll, the Department of Education in South Africa has "looked explicitly towards constructivism to provide the teaching and learning solutions called for by OBE in South African schools" (2002:5) at the time when South Africa was emerging from a segregated past and needed a change from the former apartheid education to something new and transformational. Unfortunately, the haste with which OBE was embraced and implemented by previously marginalised stakeholders led to a number of misconceptions. Jansen (1999:154) wrote that,

Not a single official interviewed in the National Department of Education believed that OBE should be introduced so soon; yet they all worked feverishly towards implementation at all costs in 1998. There is no other way of understanding such behaviour outside of a political analysis of state and curriculum in the South African transition.

Since 1997, our new curriculum has been under constant scrutiny and one could single out Jansen's (1997) argument "why OBE will fail in South Africa", as perhaps the most serious wake-up

call against its hasty implementation. The so-called father of OBE in South Africa, Bill Spady (1999) also referred to a need to end the confusion in OBE in South Africa.

These arguments support the fact that all was not well with OBE and as a result, in the year 2000, C2005 was revised to become the Revised National Curriculum Statement (RNCS). However, the South African National Department of Education (DoE) made it clear that outcomes-based education was still the preferred style of teaching and learning and that the Critical and Developmental outcomes envisaged in the C2005 remained.

Despite serious misgivings from various sources in the country, the DoE remained committed to outcomes-based education. However, towards the end of 2008 certain highly placed individuals and government officials made public statements suggesting that OBE may not have brought about the originally anticipated goals for transformation in South Africa.

On page 4 of The Mercury of October 29, 2008 Mamphela Ramphele was quoted as suggesting that, "We must do away with outcomes-based education. It has failed our children."

In The Witness of 11 December 2008, ANC KZN chairman Dr Zweli Mkhize is reported as saying, "The country's controversial Outcomes Based Education (OBE) system will stay and the ANC plans to focus on it being correctly implemented."

The Cape Argus of 12 May 2009 quoted Angie Motshekga and Dr. Blade Nzimande as follows: "We need to ensure that (we) have the resources to support the (OBE) curriculum. But the basics were not being done, so there might be a review to strengthen the system."

On 06 July 2010, the current Minister of Basic Education, Mrs Angie Motshekga announced the steps to be taken in order to effect recommendations made by the ministerial committee in 2009. Three committees were established to enable the streamlining of the current curriculum. They are the Curriculum and Assessment Policy Statements (CAPS) Ministerial Projects Committee; the Committee for the Reduction of Learning Areas in the Intermediate Phase in the GET band; and the Learning and Teaching Support Committee (Curriculum News, May 2010).

It is possible that unless implemented with circumspection, the new Curriculum and Assessment Policy Statements may have the most profound effect on constructivist teaching methods in South

Africa. The committee responsible for its development was tasked to “develop a single, comprehensive and concise curriculum and assessment policy statement for each grade, R-12, as recommended by the report of a ministerial committee. These curricula and policy statements should provide **clear guidelines on what you ought to teach and assess** on a grade-by-grade and subject basis” (Curriculum News, May 2010, Emphasis mine).

In my view, it is quite possible that these clear guidelines on what to teach and what to assess may lead to teaching strategies that would negatively impact on the objectives of constructivist approaches to teaching and learning. This in turn may lead to the possible devaluation of practical work in the classroom through attempts to accommodate content – based teaching and assessment methods.

Through my study I hope to highlight the possibility that, whilst this latest course would serve to streamline education in the country, it is quite possible that teachers will revert to old-style teaching methods and seriously compromise the reasonable strides made in respect of teaching and learning methods based on understanding as opposed to mere repetition of facts. It is with this possibility in mind that I wished to investigate the value of learner participation in the learning processes in an attempt to expose both the advantages and disadvantages of involving learners in practical tasks using electrical circuit boards in grade 8.

My theoretical framework (Section 2.3) hence seeks to highlight salient aspects of the role of the teacher, constructivism, the value of practical tasks, and the teaching of electricity in the GET band. I looked at aspects of ‘learner talk’ and ‘teacher talk’ in an attempt to analyse the level of meaning that learners make during practical work activities. With regard to ‘learner talk’, Lemke (2001) refers to language as a resource for making ‘social meaning’ whereas Bencze (2000) emphasises the leading role teachers should play during teaching and learning repertoires. In the analysis of the social interaction between the learners whilst working on their respective circuit boards I was hoping to gain some insight in the way they processed knowledge and as a result be in a position to make some inferences in respect of their understanding of the subject matter.

2.2 The role of the teacher

I am fully cognisant of the importance of the role of the teacher in the classroom and I believe that there is space for traditional 'teacher talk' in the classroom. In essence, there is a need in my view to strike the balance between 'teacher talk' and 'learner talk'. However, Bencze (2000:857) cautions that, "Inevitably...teachers may need to provide insights...otherwise students may arrive at unexpected conclusions."

My concern, though, is more about whether learning occurs and the role of the teacher as a mediator. Potenza (2002:1) argues that being a mediator "requires you to be sensitive to the diverse needs of your learners, construct appropriate learning environments, demonstrate sound knowledge of your learning area or subject". Lending further support to this argument, Nxawe and Waghid (2003) perceive the role of an educator as not merely transferring knowledge to learners, but one of creating conditions in the classroom where learners can construct different understandings of the concepts being taught.

Part of the problem of relegating teachers to a lesser role was the emergence of a flawed concept of 'facilitator', a term utilised to describe the OBE teacher. This seemingly simple change had its own ramifications. It impacted on what teachers perceived as their role in the classroom. Part of the confusion was the emergence of a notion that OBE, as Moll (2002:6) puts it, "envisages a learner who is a solitary, free-ranging problem-solver and, thus, a teacher who is simply a facilitator of learning experience." This statement warrants caution. In a sense, it is quite possible to misinterpret Piaget's views about learning as recommending leaving children to their own destiny.

However, according to Moll (2002:18), "Piaget chides those who interpret his ideas about learning as a suggestion that success would depend on leaving the students entirely free to work or play as they will. It is obvious that the teacher or organiser remains indispensable in order to create the situations and construct the initial devices which present useful problems to the child."

Vygotsky also emphasizes the role of a knowledgeable other or teacher in the sense that he argues that learning is co-constructed. Herein lies Vygotsky's (1978) notion of the zone of proximal development (ZPD). Vygotsky situated instruction "at the heart of cognitive development" and emphasized "the central role of the teacher or mediator in 'leading' development through

“collaborative activity” (Lunt, 1993:156). This leading role of the teacher can be interpreted as a mutual construction of meaning and qualifies to be labelled social constructivism or constructionism.

2.3 Theoretical Framework

2.3.1 Constructivism

2.3.1.1 Introduction

According to Moll (2002:5), the DoE was explicitly looking “towards constructivism to provide the teaching and learning solutions called for by OBE in South African schools”.

Moll (2002:24) speaks of three construals of constructivism: “(1) the cognitive developmental construction of new knowledge in learners, (2) the social construction of our experience, ideas, beliefs, meanings and sensibilities within the context of certain natural constraints and possibilities, and (3) the social construction of everything all the way down.” According to him, South Africa “is moving closer to a constructivist view of learning”.

Moll (2002:17) argues that both Piaget and Vygotsky, “... conceive an active construction of knowledge on the part of the learner...” In the case of Piaget the process of “making sense or meaning” is an individual activity and Millar (2004:8) alludes to this as, “Through action on the world, we generate sensory data which can either be *assimilated* into existing schemas or require that these be changed to *accommodate* the new data, in order to re-establish *equilibrium* between the internal and external realities.” Millar’s comment that, “In practice, the representations we construct are tested out not only through action, but also through interpersonal interaction”, reveals in part elements of Vygotskyian thinking.

Having already alluded to possible misunderstandings of constructivism I am going to briefly explain my interpretation of constructivism in general and social constructivism in particular. Moll (2002:11) argues that “Constructivism or constructionism or indeed, any notion of the construction of knowledge does not have, nor should it have, only one particular meaning.

Atherton (2009) describes constructivism as a set of assumptions about the way human beings learn. In essence, it suggests a move away from the notion that knowledge is given to passive

learners to the idea that active learners invent or co – construct knowledge as they engage with it. Piaget (1978) was one of the earliest philosophers to give voice to this shift from passive learning to active participation in learning. As early as 1978 he said that,

...the basic principle of active education methods...may be expressed as follows: to understand is to discover, or to reconstruct by discovery, and such conditions must be complied with if in future individuals are to be formed who are capable of production and creativity and not simply repetition (Piaget, 1978:20).

The origins of social constructivism can be traced to the Russian psychologist, Lev Vygotsky. He believed that children are at their highest peak of learning when they are collaborating with more skilled partners (Vygotsky, 1978). He said that the more knowledgeable other helps the learner by intellectually scaffolding them, and this allows the learner to carry out more intricate assignments when they are on their own (Wertsch, 1985). He believed that what children do with the help of others today, they are able to do alone tomorrow.

When learners are given the opportunity to discover the connection between what they learn in the classroom and real life they can apply the knowledge they gain and adapt it to their everyday lives, which then suggests that learning is taking place (Vygotsky, 1978). Furthermore, Vygotsky believed that when a child takes part in hands- on activities, they perform above their average age and above their everyday ability.

Social constructivism can thus be said to be the act of acquiring knowledge or making meaning in the course of social relationships. Learners taking part in collective activity in which new knowledge is mediated to them.

Vygotsky identified two levels of development that exist simultaneously in the learner. At the first level he speaks of what the learner can do on his/her own and then he refers to the potential for development that becomes possible with optimal help and guidance from a knowledgeable other. In this context he referred to the gap between the two levels as the zone of proximal development (ZPD).

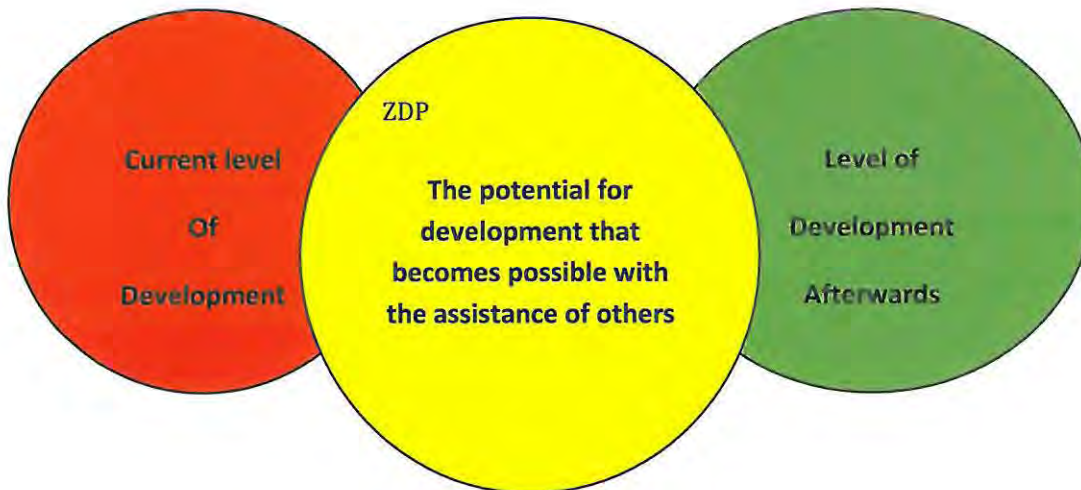


Figure 1 Vygotsky's ZDP (1978)

At the current level of development learners are presumed to be at a stage where they can rely on their understanding of something at that particular point in time. This understanding is often guided by their prior knowledge (Roschelle, 1995). When presented with a problem in a group scenario, these learners are able to broaden their understanding with the help of other learners.

This interaction becomes even more meaningful with the assistance and guidance of somebody who has a better understanding of the phenomenon or problem under investigation. Despite this being an extremely sound premise for learning, the manner in which it was introduced in South Africa was far from ideal (see Section 2.1).

2.3.1.3 The real deal

To the majority of its citizens, Apartheid South Africa was founded on ideologies based on social inequalities. The dawning of a new era and the advent of a new education philosophy excited previously disadvantaged people and it made sense to put past inequities to test. Challenging unjust laws and an education system that operated according to the rules of segregation fitted well with the whole notion of liberal thinking and social constructivist methods of teaching and learning.

It has to be conceded however, that in the teaching and learning of science, learners cannot simply be allowed to arrive at their own conclusions, even though they have been working on their

own. Bencze (2000:847) argues that, "...students' prior conceptions are denigrated, their experiences regulated, their investigations shepherded, and their conclusions restricted." Leach and Scott (1995:48) speak of science as an existing body of knowledge arrived at through years of thorough investigation. Millar (2004:6) too refers to science as, "quintessentially, a body of consensually accepted knowledge about the natural world, so teaching science is inevitably a goal-directed activity."

I thus find the whole idea of learners being involved in a process of enculturation into a community of scientists, as espoused by Hodson and Hodson (1998), most appropriate in this study. Millar (2004) proffers that, "Learning science is an induction into a particular view of the world. As a consequence, 'at school level ... the acquisition of scientific knowledge is inescapably tinged with dogmatism'".

2.3.1.4 How dogmatic or how constructivist?

The outcome of a lesson is dependent on how one teaches the subject. According to Millar (2004:13), "A common criticism of practical work in the teaching laboratory is that it becomes 'recipe following' ...". One can easily end up creating situations for learners to follow recipes without any cognitive exercise or you can deploy strategies that will ensure that learners are not only hands-on but also minds-on and even words-on as proposed by Maselwa and Ngcoza (2003). For instance in the second phase, although I was seriously tempted to intervene when I noted how the learners struggled to make the desired connections on the circuit boards, I remained mindful of what Maselwa and Ngcoza did in respect of allowing more time and therefore more opportunity for observation and reflection. The learners finally managed to arrive at solutions through their own efforts. More will be said in this regard in Chapter Four of this study.

In respect to Vygotsky, there can be no doubt of the role of the teacher in teaching and learning and despite his serious misgivings about the teaching of science, even Bencze (2000:857), admits that teachers need to lead the process. I agree with the latter that the major question to be addressed, "deals with how best to help students develop egalitarian literacy, while simultaneously dealing with the problematic 'marriage' of instruction to inquiry in many constructivism-informed educational schemata" (Bencze, 2000:856).

It is thus my conviction that the Predict, Explore and Explain (POE) (Gunstone, 1990; White & Gunstone, 1992) or Predict, Explain, Explore, Observe and Explain (PEEOE) approach (Maselwa & Ngcoza, 2003) referred to in section 2.4.2 come very close to what I consider a constructivist approach.

The salient elements I have identified in these methods are highlighted by the extracts from Millar (2004:8) presented in the following table:

Table 1 *Highlighted extracts from Millar (2004:8)*

Extract	Salient Element
<p>“Through acting on the world, we generate sensory data which can either be <i>assimilated</i> into existing schemas or require that these be changed to <i>accommodate</i> new data, in order to re-establish <i>equilibrium</i> between the internal and external realities”.</p>	<p>Learner making sense on his/her own as proposed by Piaget</p>
<p>“In practice, the representations we construct are tested out not only through action, but also through interpersonal reaction.”</p>	<p>Knowledge is co-constructed as proposed by Vygotsky</p>
<p>“The processes by which these ideas are first arrived at, and by which they are subsequently supported, are most specialised and particular – and depend not only on practical experience but also culturally mediated interpretations of that experience”(Emphasis mine)</p>	<p>This suggests building on prior knowledge</p>
<p>“...much of the learning associated with a practical activity takes place through the process of talking about the observations and measurements...”</p>	<p>This practice allows for actually following the thinking of the learner/s. Thinking aloud present wonderful opportunities for formative assessment</p>

These are but a few of the requirements for the construction of knowledge as anticipated in C2005 and the RNCS. To me this does not suggest a matter of simply setting up a scenario for recipe following but rather a meticulously planned activity. Hodson and Hodson (1998:18) cite Rogoff who speaks of guided participation depending “on communication and negotiation between teacher and learner about what new knowledge or skill is needed and how it can be made compatible with existing understanding and capability.” I found their paper extremely helpful in terms of enhancing my understanding with regard to scaffolding and aspects of language versus science and this could be a possible area for future research.

2.4 Practical Tasks

2.4.1 Introduction

In order to get a reasonable understanding of the value of practical work activities in the case studies I investigated, I tried to find out what other researchers had to say in this regard. The article by Hodson and Hodson (1998:17) comes closest to my personal experience as a teacher. The sub-heading dealing with, “learning science through apprenticeship” in particular intrigued me (Hodson & Hodson, 1998:17).

When I read it, I was immediately reminded of ex-learners who did ‘appallingly’ at school but who later excelled in their places of employment. I am in a position to identify learners who were practically ‘written off’ as not being able to achieve satisfactorily at school who are currently employed as experts in their fields of employment, assumed ‘non-achievers’ who are now electricians, artisans, mechanics and managers of repute. I therefore agree with Lave (1988:22), that “Apprentices learn to think, argue, act, and interact in increasingly knowledgeable ways with people who do something well, by doing it with them as legitimate, peripheral participants”.

It is my personal experience that ex-learners are able to ‘talk the talk’ and ‘walk the walk’ at their places of employment irrespective of their scholastic performance at school. I have little doubt that practical experience has a major role to play in cultivating conceptual understanding especially when practical activities are carefully planned.

There appears to be general consensus that practical work enhances learning and it has been utilised since the mid-1850s (Gee & Clackson, 1992 as cited by Gott & Duggan, 1996:791). In its

early stages it was mainly used by teachers to practically illustrate certain concepts that they would ordinarily teach via textual resources. Although practical work in the sense of learners actually engaging in experiments themselves later became an integral part of the science curriculum, we still find experiments or demonstrations conducted by teachers in poorly resourced schools invaluable (Hodson, 1990). It would be extremely difficult to argue that experiments, albeit conducted by learners themselves or demonstrated by teachers either physically or through relevant media, do not enhance learning or understanding. The danger though is equating activity with learning.

Gott and Duggan (1996: 791) wrote that, "...there has been an assumption that practical work carried out by the pupils themselves is a 'good thing' and apart from occasional criticisms, its inclusion in science education has been, and to some extent still is, accepted without serious question". Hodson (1990:33), however remarks that, "... practical work, as conducted in many schools, is ill-conceived, confused and unproductive."

Practical work, ideally, "hands-on, minds-on and words-on" practical activities, "... helps learners to acquire skills such as manipulating equipment: making predictions; observing; recording, and analysing data; and drawing conclusions" (Wilkinson & Ward, 1997 as cited by Maselwa & Ngcoza, 2003:649). In a pilot research project in respect of teaching an electrostatics lesson unit to a grade 9 class in Grahamstown, South Africa in a "hands-on, minds-on and words-on" manner, Maselwa and Ngcoza (2003) concluded that practical work in the science classroom has definite advantages in promoting conceptual development and hence conceptual understanding.

Millar (2004:3) too suggests that, "Finding things out for yourself, through your own efforts, seems natural and developmental, rather than coercive, and may also help you to remember them better." Hodson (1990:33) cites the Australian Academy of Science stating, that, "laboratory work allows development from concrete situations to abstract ideas and can be the vehicle for arousal of curiosity... (and) appreciation of aesthetic aspects of the subject."

2.4.2 Possible reasons for this "problem"

In an attempt to understand where the problem regarding practical work in science classrooms may possibly arise from it would be helpful to look at what could be considered to be the main

aims of teaching science. Millar (2004:2) suggests that in most countries, "... science has two distinct purposes. First, it aims to provide every young person with sufficient understanding of science...- scientific literacy... (and) ... second...a steady supply of new recruits to jobs requiring more detailed scientific knowledge and expertise..."

Gott and Duggan (1996:792) also distinguish between what they term "substantive knowledge" and "the development of experimental skills." It is with the latter objective that most critics appear to take issue with. Gott and Duggan (1996:792) argue that "...skills ... have a *distinct knowledge base* which is connected directly and necessarily with the understanding of scientific evidence" and has to be consciously taught.

To explain this phenomenon I cite Millar's (2004:14) example of using an ammeter to measure current in an electrical circuit. In this example he shows that even though the objective of the lesson may not be to teach learners how to use an ammeter, it cannot be taken for granted that learners know how to use the equipment and correctly interpret readings. This may require a separate session on learning how to use relevant equipment in order that the students do not get lost in the 'noise' of the bench.

Hodson (1990:35) divides this acquisition of skills into two sections; that is those that are "content-free, generalizable and transferable skills that are of value to children and those that claim the development of the basic craft skills considered essential for future scientists and technicians." Of the first one he says that it "border(s) on the absurd!" In respect of the latter he appears to concede that, "Complex skills that are considered necessary for further learning should, perhaps, be pre-taught in skills training sessions" (Hodson, 1990:36).

I am comfortable with Millar's (2004:15) observation that whether school science is intended to develop their scientific literacy...as preparation for active citizenship...(or)...to provide the foundation for further study for those students who may wish to follow careers that may require this...developing students' scientific knowledge is a necessary aim."

If there is reasonable consensus in respect of the aim of school science the next question begging an answer would be, how best to do it? Enough evidence seems to suggest that practical work is the route to take and I have alluded to this earlier. The problem, however, appears to lie in the methods that respective teachers deploy when doing practical work and the reasons for doing it.

Gott and Duggan 1996:791) suggest that, "...practical work has a key role in the teaching of evidence provided that the type of practical work is selected carefully with a clear purpose in mind".

Another criticism levelled at science teachers is more of a theoretical nature. Having adopted Outcomes Based Education (OBE) in South Africa as our preferred method of teaching, a method, which according to Moll (2002:5), was founded in social constructivism, teachers are often accused of stifling learner creativity when it comes to teaching science. The dilemma being that according to Leach and Scott (1995:48) science can be considered a body of knowledge arrived at through a process of thorough investigation and according to Bencze (2000:848), "Although students may believe they are freely constructing knowledge, coercion may be under way."

Leach and Scott (1995:48) describe learning science as, "a process of enculturation into a particular way of knowing, rather than the individual making sense of the natural world in their own terms." Bencze (2000:848) is even more outspoken in this regard and he states that, "This practise is paradoxical – while students are engaged in activities they may construe as opportunities to *freely* construct knowledge, educators attempt to engineer their constructions in directions conforming to canons of Western Science and technology." Lending support to this argument, Millar (2004:13) maintains that, "(a) common criticism of practical work in the teaching laboratory is that it becomes 'recipe following', with students often not thinking about *why* they are doing what they are doing." This makes the expression 'constructivist teaching' seem oxymoronic (Watts & Jofili, 1998).

I believe that part of the answer to the question of how teachers can contribute towards developing students' scientific knowledge would be adequately addressed if we investigated some of the methods of doing practical work in science classrooms discussed in 2.4.3 below. It is precisely for those reasons that I have decided to engage in this research project.

2.4.3 Some suggested methods of teaching science

Millar (2004:12) suggests that, "Strategies for improving practical work intended to develop students' scientific knowledge have a common aim – to make students *think* as well as *act*" (Emphasis mine).

Teachers need to design tasks that will serve as a cognitive challenge to students and not merely the act of following a recipe. Millar (2004) talks about “The predict-observe-explain (POE) structure” espoused by White and Gunstone (1992). What I like about the POE approach is that in their prediction the students are given the opportunity to draw on their prior knowledge as well as apply their minds to possible hypotheses of their own. The further advantage is of a linguistic nature and herein lies the notion of ‘words-on’ practical activities as espoused by Maselwa and Ngcoza (2003).

Maselwa and Ngcoza (2003:650) added another dimension to this approach in their research, referring to their approach as Predict-Explain-Explore-Observe-Explain (PEEOE). Maselwa and Ngcoza added more opportunity for explanation and observation during practical activities. This in turn allows for the chance of reflection and thinking aloud.

According to Millar (2004:8), “... much of the learning associated with practical activity takes place through the process of talking about the observations and measurements that they have made, and what they might mean, both with other learners in the class and with the teacher.” They are thinking aloud. Hodson and Hodson (1998:22) argue that, “What is at issue here is the shifting of emphasis from language as an instrument of teaching to language as a means of learning, and a tool of thinking.”

In essence this could prove of even greater value to the students if considered in a cognitive sense. It is my considered opinion that practical activities involving electrical circuit boards are ideal for eliciting observation and explanation opportunities.

What follows is a comparative diagram of the two approaches:

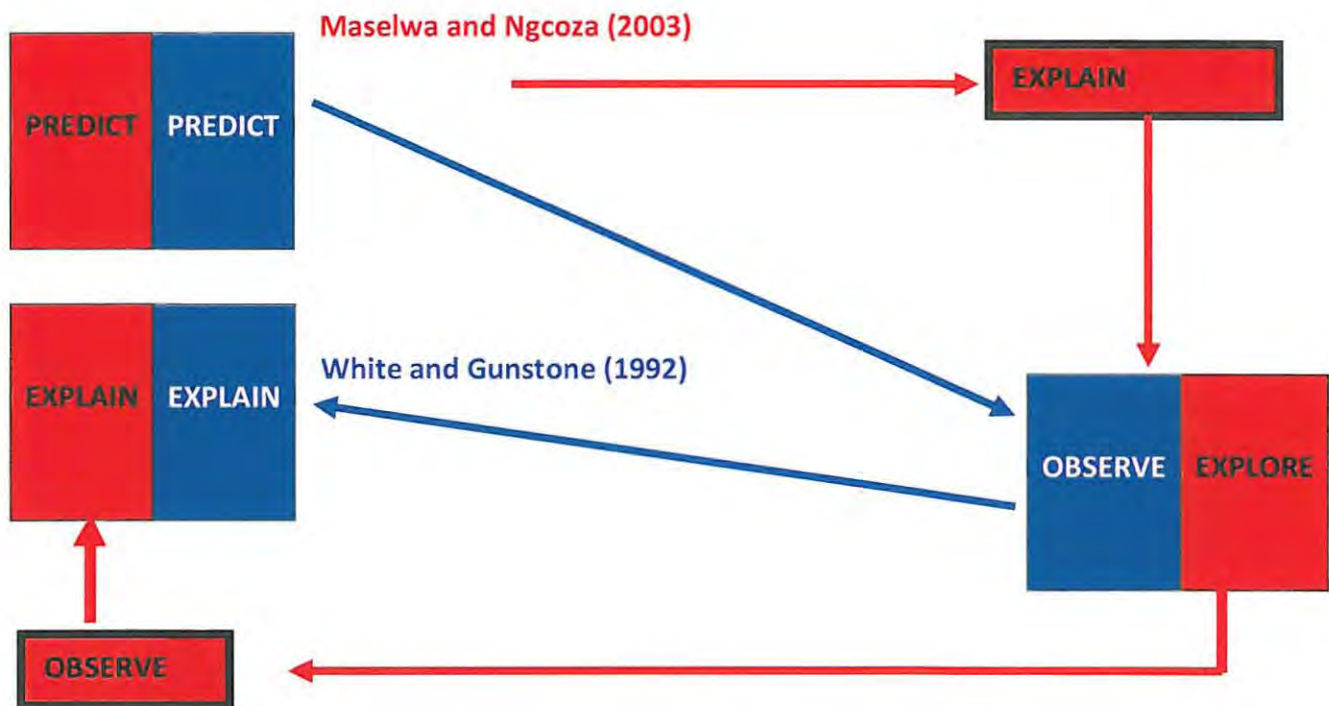


Figure 2 Comparative diagram of POE and PEEOE

The advantage of this method is that the learners will be more circumspect when making predictions. Close scrutiny of these predictions may also reveal thinking patterns, reasons for predicting why something will happen in a certain manner and even the extent of the use of prior knowledge.

In the discussion in 4.3.3 below a number of excerpts are quoted verbatim and the interaction between the learners clearly illustrates a process of consultation and prediction of possible as well as probable outcomes of anticipated actions.

2.5 Teaching electricity in the GET band

2.5.1 Introduction

Learning Outcome 2 of the Technology Curriculum Statement deals with electricity. It reads as follows:

Technological Knowledge and Understanding

The learner will be able to understand and apply relevant technological knowledge ethically and responsibly. (CS, p. 8)

The three core content areas in this Learning Outcome are Structures, Processing and Systems and Control. Electricity captured under Systems and Control entails the following:

The study of electrical systems focuses on the practical use of electrical energy in circuits to satisfy specific needs. Electronics, covered at higher levels, is seen as closely related to electrical circuits but deals more closely with low current signaling and sensing.” (CS, p. 5)

More specifically in the Senior Phase, grades 7-9, learners are expected to explore electrical systems with more than one output in series and parallel. “By practical experimentation, the learner should develop understanding of the operational difference of the outputs when connected differently”. (CS, p. 32)

The assessment standards accompanying the Learning Outcomes spell out the minimum requirements expected at the respective grades. For my case study the assessment standards state that learners in grade 8 should demonstrate knowledge and understanding of how electrical circuits with more than one input or control device will work based on different logic conditions ('AND' and 'OR' logic), and represent them using circuit diagrams, systems diagrams and truth tables.

It is evident that the following statement suggests a constructivist approach:

Learners in Technology classrooms work in groups to analyse the given information in order to create practical solutions. Learners co-operate and communicate with each other, often combining verbal and graphic modes of communication. Discussing and reporting techniques and the use of appropriate terminology are encouraged during technological activities. (CS, p. 5)

Against the background of what is expected in terms of content it became prudent to look at what other researchers have to say about teaching the electricity component in junior classes.

2.5.2 Problems encountered in teaching basic electricity

Beaty (1996:1) has the following to say about the teaching of electricity in schools:

The complex and abstract nature of Science makes the subject difficult to understand. But complexity is not the only reason that Science is hard. The subject is made much more difficult by the presence of numerous misleading "Science Myths" which circulate in the popular culture, which are handed down from parents to children, and which have become

so common and widespread that they even appear in science textbooks and are taught as facts in elementary school.

Beaty (1995) argues that these 'science myths' present a "major barrier to students because the children must unlearn the incorrect myths before they can make further progress in their understanding. Unfortunately, this process of UNLEARNING happens rarely because the myths are supported by so many teachers, and they appear in so many textbooks. Most people never suspect their presence.

Beaty (1995:1) further maintains that electricity becomes almost impossible to understand because of,

... wide misuse of the word "electricity." Using Electricity as the single name for several completely different substance-like quantities, while at the same time expecting students to extract each differing meaning of the "electricity" from the way we use it in explanations. Unfortunately, students instead become permanently confused because they don't realize that the word has several definitions. They hear one word and assume we're talking about one single entity. As a result, they hear us describe a single "electricity-stuff" having contradictory, confusing, totally impossible behavior.

Psillos (1998:1) argues that,

The teaching and learning of electricity, a topic often included in primary and secondary curricula, has been the object of many investigations, books and conferences (Duit et al, 1985; Calliot, 1992). The emerging picture world-wide is not promising given that an adequate knowledge of, for example, electrical circuits has rarely been acquired by students by the end of secondary education.

The fact that electricity is invisible and highly conceptual makes it difficult for learners to understand. This implies that for teachers to offer any meaningful guidance it is vital that they demonstrate sound knowledge of the subject. It is also of major importance that the resources at their disposal are adequate as well as appropriate. Textbooks, unfortunately, are not always accurate.

2.6 Circuit Boards

Considering Beaty's argument that electricity is not easy to understand, teachers are almost obliged to rely on the practical engagement of learners when attempts are made to teach it. The

use of circuit boards is ideal in this sense and the particular board I have selected for this research is readily available, affordable and specifically designed for teaching electricity in grades 7, 8 and 9.

The Senior Phase Easy Electrical Board is a unique learning support tool that enables learners to learn about electrical systems in a practical and hands-on way. It includes everything needed to connect the basic circuits used to introduce electrical systems in grade 7, as well as the more complex electronics circuits dealt with in grades 8 and 9. Meet the requirements for electrical systems in Technology for the National Curriculum for grades 7, 8 and 9. No additional equipment is needed. It is quick and easy to assemble circuits on the board, enabling learners to work through the activities more quickly. The electronic circuit board is ready to use. Learners are not required to solder the circuit together. Two AA (penlite) cells power all circuit assemblies. Most other boards require a more expensive 9V battery. The board is strong, so can be used by classes year after year, and boards can be stacked for storage.

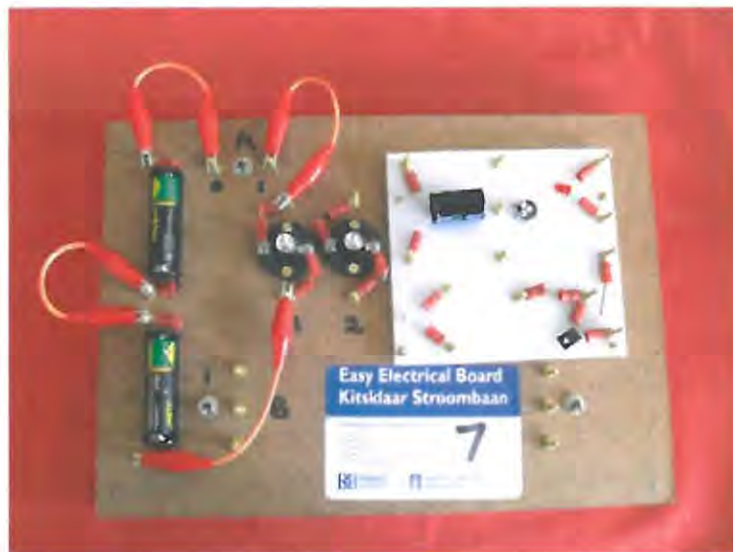


Figure 3 Senior Phase Easy Electrical Board

2.7 *Learner talk*

Based on my assumption that one cannot rely solely on text-based tests to support claims about the extent of learning that is happening within group settings, I thus consulted the relevant literature that would provide insight into the matter. My research topic aims to investigate the learning that happens when learners engage with electrical circuit boards in grade 8 and the work done by Lemke in this regard was most enlightening.

According to Lemke, taking a socio-cultural perspective on science education means, " ... viewing science, science education and research on science education as human social activities within institutional and cultural frameworks" (Lemke, 2001:296). He continues, " ... people who were studying the *functions* of language in social interaction (for example, Halliday, 1978; Martin, 1992; Schegloff, 1991; Mishler, 1984; Lemke, 1990; Bazerman, 1988) began to see language as a culturally transmitted resource for making meaning socially (Gee, 1990; Lemke, 1995) that was also useful for talking oneself through science problems" (Lemke, 1995:298).

In this study, I tried to discover how learners were talking themselves through the problem of connecting the circuits on the circuit board and in my recording of their conversation; I tried to expose the extent of learning and thinking that occurred.

2.8 *Concluding remarks*

In this literature review chapter I attempted to provide theoretical support for my study. The literature consulted gave me a better understanding of social constructivism, the use of practical tasks as a method of teaching science in general and the teaching of electricity in grade 8 in particular. Sources were also consulted concerning the use of electrical circuit boards and the notion of learner talk as espoused by Lemke (2001). The next chapter is a discussion of the methodology employed in conducting this study.

CHAPTER THREE

RESEARCH DESIGN

3.1. Introduction

This chapter describes the methodological framework that guided the research process in this study. I present the reasons for selecting an interpretive paradigm and qualitative case-study approach to address the research goals and questions of this study. It explains my own role as a researcher during the research process. It also describes the research process as well as explains how data was generated and analyzed. It concludes with a discussion of research trustworthiness, validity and ethical considerations.

3.2. Research design and methodology

3.2.1. Research goal and questions

The main goal of this research study was to investigate what learning processes occurred during group work sessions in lessons involving practical work activities in electricity, using circuit boards in grade 8.

In order to achieve this goal I tried to answer the following questions:

- **Does engaging learners in group practical work activities in electricity present a premise for meaningful learner talk?**

To answer this question I used audio and video recordings as well as notes kept by participant observers. The data accumulated in this fashion was transcribed and interpreted as objectively as possible.

- **What type of knowledge was constructed from learner talk during the practical activities in electricity?**

To answer this question I relied on evidence produced from the audio and video transcripts. For instance, I looked at what had transpired in the groups and located this evidence within the social constructivist epistemology. I also analysed the data gathered from semi-structured interviews with both the learners in my focus group as well as the

teachers who helped with observation. In addition, I analysed the journals kept by the learners in the focus group as well as the reflections of the teachers.

- **Do practical work activities involving electrical circuit boards enhance learning in grade 8?**

To answer this question I relied on evidence gained from observing my focus groups audio and video recordings; the responses to semi-structured interviews focussing on this particular aspect as well as relevant sections from the reflections of the teacher observers.

3.3 Methodology

3.3.1 Introduction

This study is premised on the assumption that properly planned practical work activities with specific aims in mind have the potential to improve learners' understanding. I tried to construct the practical tasks in such a manner that encouraged learners to *think* as well as *act*. The tasks not only required the learners to simply connect the wires in a trial and error fashion. They were required to anticipate the result of every next step through consultation with the group members by making predictions. After consensus the step was taken and the result was compared to the predicted outcome. An attempt was made to engage the learners not only on 'hands-on' but also 'minds-on' activities as proposed by Millar (2004:12). By restricting my involvement to a minimum, the tasks also served as cognitive challenges to learners.

During the transcription and analysis of the video and audio recordings I was accorded an opportunity to investigate the level of thinking within the group contexts. The experience I gained from Phase One of my study allowed me to restructure my approach to this aspect of the research. I followed the cues suggested by Millar (2004) where he alluded to the notion of designing practical tasks that encourage learners to think as well as act.

3.3.2 Paradigm

The study is situated within an interpretive paradigm. According to Cohen, Manion and Morrison (2000, p. 36), "the aim of interpretive research is to provide a rich description of the phenomenon and, if possible, to develop some explanation for it." Within this paradigm, I used qualitative case studies as my main source of information.

According to Stake (1995), case studies suggest the in- depth exploration of an activity, gathering detailed information using different data gathering methods over a period of time. In this instance the information was gathered over two separate periods of three weeks each.

3.4 Research sites and participants

3.4.1 Rationale

I decided to confine my study to grade 8 learners as I am currently teaching Technology in this grade. I am also reasonably familiar with the subject content and believe that I am competent at mediating development through “*collaborative activity*” (Lunt, 1993:156). Grade 8 is also the starting grade at my High School and plays a crucial role in developing the learners’ understanding of concepts that will be taken to grade 9. That is, a sound understanding of electricity in grade 8 not only serves as a stepping stone for understanding electricity in both Natural Sciences and Technology, but also in Physical Sciences in the higher grades.

I opted to conduct this study at my own school because of its convenience in respect of proximity and the availability of the necessary resources for my research. The further advantage of conducting this study at my school was that my two colleagues who share the subject in this phase were willing to assist me. They were available on short notice at regular intervals and we were in a position to discuss proceedings at regular intervals.

3.4.2 Participants

3.4.2.1 Researcher

My role during the research process was both one of facilitating the research process as well as teaching during the case study sessions. In essence, I was engaged in reflexive research by researching my own practice. Apart from obtaining the necessary consent from the respective research participants and institutions, I taught the content at the research site as well as familiarised the participating teachers with the materials utilised. In the process I also solicited their involvement as co-researchers. In the final analysis, I attempted to interpret and present the findings of my research in a meaningful way.

3.4.2.2 Teachers

The two teachers involved in my research project assumed the role of participant observers during the teaching sessions. They were invited to move among the groups and advise where necessary. Their main responsibility, however, was that of observation. Each one of them was given a note book in which to record their observations.

3.4.2.3 Learners

I asked the two observer teachers to identify a focus group of six learners as well as at least three extra groups to make up a class that we could work with in the first phase of my study. This focus group of six learners served as my main research unit of analysis. Besides being active participants in the group practical work activities, the learners in the focus group were expected to keep journals in which they had to record their experience of each session.

3.4.3 Process of identification of participating groups

- As this study was conducted outside school hours, learners were granted the opportunity to volunteer participation in the programme.
- I involved four groups of six learners in the first phase of my study. The rationale for this option was partly to extend the reach of the extra exposure these learners enjoyed as well as to cushion the effect of concentrated attention on the focus group. The latter group was monitored through audio and video recording.
- A further advantage of having had at least four groups committed to the programme was that it facilitated possible substitutions should any of the focus group members withdraw. However, when this opportunity presented itself, the learners preferred not to change their groups (Section 1.3.1).
- Care was taken that members of the focus group were able to write as well as articulate their thinking proficiently.

- The identification of the learners for the case study was done in collaboration with the relevant teachers of the subject, based on the assumption that they were in the best position to identify groups that would fit the necessary profile.
- Based on my experience in Phase One, I only used a focus group in Phase Two. I found that having more than one group encouraged competition as well as caused distraction.

3.5 Case Study

I chose to gather the data for my research question through conducting two case studies (see Section 1.4). These case studies were conducted over two sessions which served as Phase One and Phase Two respectively. I found that doing the two case studies best suited my objectives in the sense that it allowed me an opportunity to investigate my research questions for a defined period of time.

Furthermore, in doing so, I was hoping that my findings would “promote understanding for similar situations” (Leedy & Ormrod, 2010:137). This option also enabled me to gather data on my research questions and I could apply data gathering techniques such as questionnaires, semi-structured interviews and audio and video recording with reasonable effect.

3.6 Data Generation

3.6.1 Introduction

This being a study of a qualitative nature, I mainly attempted to “construct interpretive narratives from the data gathered and tried to capture the complexity of the phenomenon under study” (Leedy & Ormrod, 2010:97). However, in order to profile the participants I made use of questionnaires. The questionnaires given to the learners as well as the teachers served to profile them in order to give readers a general idea of the participants in respect of age and gender.

The responses of the participants during the semi – structured interviews were analysed and presented in narrative form. The questions for these interviews were directly related to the research topic and provided useful insights. Careful analysis was made of the written observations of the teachers as well as the journals kept by the learners.

A concerted effort was made to interpret the findings gained from this source as accurately as possible without losing sight of the research topic. I viewed the video footage of the group sessions with my observer teachers (in hindsight this also facilitated validation of data) and issues relevant to the research topic were used in relation to the research topic. Besides the transcription of the video and audio tapes attached as appendices, information related to the research topic was elicited and presented in narrative form.

3.6.2 Data gathering techniques

3.6.2.1 Questionnaires

Questionnaires were primarily used to document the profile of the learners participating in the study as well as to situate the selected class group within the relevant school's context. The responses to these questionnaires allowed me to compare the learners according to their language orientation, their age group and scholastic situation at the time of the study. It assisted the study in the sense that it provided some evidence of the homogeneity of the two groups thus allowing a reasonable premise for consistency between the two case studies.

3.6.2.2 Semi-structured interviews

I used the semi-structured interviews in Phase Two of my study and they entailed "standard questions with one or more individually tailored questions to get clarification or probe a person's reasoning" (Leedy & Ormrod, 2010:188). I used my study goals to formulate the questions for these interviews and although the questions were pre-formulated, they allowed for open-ended responses. I also used some of the data gathered through the course of my research to formulate questions for further semi-structured interviews. Kvale (1996:1) describes qualitative interviews as "attempts to understand the world from the participant's point of view, to unfold the meaning of people's experiences, and to uncover their lived world prior to scientific explanations."

The interviews were conducted one-on-one and were recorded with an audio tape. I was of the opinion that I would be creating a less intimidating environment than one where the interview is video-taped as well as a better opportunity to elicit more unique answers in the sense that the

learners were not aware of each other's responses. To allow for further freedom in their responses, the interviews were conducted in Afrikaans and thereafter I translated the material relevant to my study into English.

3.6.2.3 Observation

During the course of my research I was both an outsider as well as a participant observer. In the contact sessions with the learners I did the teaching and the teachers involved in the study observed the process. Observations of the focus groups were strengthened through the utilisation of audio and video recordings. I tried to be objective in the records I kept as well as bearing in mind that my interpretations of what I have seen or heard were "apt to change over the course of the study" (Leedy & Ormrod, 2010:147).

Gillham (2000:46) describes observation as the "most direct way of obtaining data." He argues that it is, "... not what people have written on the topic (what they intend to do, or should do). It is not what they say they do. It is what they actually do ..." After reviewing the reports of the observer teachers for Phase One I was tempted to guide them towards describing what it was that I was specifically looking for.

In retrospect, I am glad that I did not intervene and in the second phase I got an almost running commentary of what transpired. This fitted neatly with the notion that their observations were a reasonably accurate account of what actually transpired. I was able to extract the phenomena that I was looking for from a real context.

3.7 Data analysis

The first step was to code the data gathered. After transcribing the video recordings, my two observers were invited to view the material with me in an attempt to check its veracity.

The next step was to read through the transcriptions in an effort to form broad analytical categories. This exercise produced about thirteen broad categories from which I proceeded to assemble a guide for analysis and coding. My first step in this regard was to check if some of the categories identified could be grouped together.

The next step in the process was to assign a code to the categories and check the transcriptions for frequency. This frequency table was then applied to highlight a few interesting aspects for consideration in my research question.

In an attempt to facilitate some semblance of consistency, the same codes identified in Phase One were applied in Phase Two of this study.

3.8 *Validity*

In an attempt to triangulate my findings, I compared "... multiple data sources in search of common themes" (Leedy & Ormrod, 2010:100). The data sources in this instance being questionnaires, semi-structured interviews, observation (audio and video recordings), notes and journals kept by participants.

The transcription of audio and video material afforded me the opportunity to reflect on what transpired within the focus group in reasonable detail. In a sense, I tried to describe the situation in such detail that readers could "draw their own conclusions from the data presented" (Leedy & Ormrod, 2010:100).

I also sought the opinion, "of colleagues in the field to determine whether they agree or disagree that I made appropriate interpretations and drawn valid conclusions from the data" (Leedy & Ormrod, 2010:101). I interacted with the teachers involved in the study at regular intervals and this exercise was of great value. Leedy and Ormrod suggest that, "The researcher takes his or her conclusions back to the participants in the study and asks quite simple questions such as, do you agree with my conclusions? Do they make sense based on your experiences? How did this work for you?" (Leedy & Ormrod, 2010:101).

3.9 *Ethical considerations*

I was aware of the ethical considerations that needed to be followed when I embarked on this study. Johnson and Christenson (2004:96) define research ethics as a set of guidelines that assist researchers to conduct ethical research. In view of this I made concerted efforts to guarantee the following:

- Protection of participants from harm;
- Informed consent from all relevant instances;
 - The participants
 - The parents of the participants
 - The teacher responsible for the subject in the school
 - The principal of the school
 - The District Manager of the Grahamstown Education District
- The right to privacy of all the participants; and
- Honesty with professional colleagues (Leedy & Ormrod, 2010:101).

3.10 Concluding remarks

The method selected for gathering data probably lies at the heart of what can be deduced from any study. At the outset, my approach was reasonably mechanical. I looked at previous models for research and tailored my journey accordingly. However, to read about research methods and then decide on a particular approach turned out quite differently in reality.

It is relatively easy to speak of qualitative research versus quantitative research, but when presented with data from the actual research, interpretation becomes quite daunting. So much is written about analysing data that it could become confusing. In retrospect, I believe that if I had spent more time in thoroughly thinking through my options for analysing data, in all probability, I would have redesigned my research method. I would for example have opted for at least two case studies for each of the two phases. This probably would have facilitated the comparative conclusions that I needed to draw.

The problem I had with the qualitative nature of my research was my personal quantitative nature. I am used to comparing numbers and possibly some of the conclusions would have read better if there were test marks to compare. I say this not because I am in support of text-based testing, but because in my opinion test marks are a more tangible measure and it is nationally acceptable as a benchmark for assessment. In the Annual National Assessment conducted in

February 2011, the scores that the learners got in the respective tests were converted to percentages and used in the in the analysis (ANA report:19).

The task of transcribing the data was a bit overwhelming and at some point I considered soliciting assistance. Fortunately, I decided against the idea and this decision allowed me to interact with my study in a much closer fashion. The coding process was tedious and the whole idea of not homing in on the data that I was looking for from the start was reasonably discouraging (Section 4.2 below). Everything worked out reasonably neatly in the end and I am convinced that I would in all probability follow more or less the same method in future research. I have alluded to some changes in my approach in section 6.2 of this thesis.

In the next chapter I present the data gathered in the process and discuss it in the context of the theoretical framework and research design detailed in Chapters Two and Three above. Where appropriate, further literature sources will be quoted to either explain a particular course of action or substantiate observations made.

CHAPTER FOUR

DATA PRESENTATION AND DISCUSSION

4.1 *Introduction*

This chapter deals with the interpretation of the two sets of data gathered during my research. The first section alludes to Phase One of the study and the second section is based on Phase Two.

In the analysis of the data gathered, I selected Haig's (1995:2) interpretation of 'grounded theory' "...a general theory of scientific method concerned with the detection and explanation of social phenomena" as the most appropriate method. For coding purposes, therefore, I used an open coding approach in which, according to Böhm, "researchers use their background knowledge about the context of the textual passage being investigated and, in general terms, their knowledge about the area of investigation" (Böhm, 2004:271).

However, mindful of Haig's (1995) review of this method, I aligned my analysis to the notion that I am not engaged in a process of developing a theory, but rather using it as "a general theory of scientific method concerned with the detection and explanation of social phenomena". So, the data gathered in this research was approached according to Haig's argument that, "The importance of data lies in the fact that they serve as evidence for the phenomena under investigation," (Haig, 1995:3) and for its interpretation I was guided by deductive reasoning and interpretive phenomenological analysis (IPA) as espoused by Davies (2007:235)

Deductive reasoning

The philosophical idea that underpins the style of research in which the investigator begins from a theoretical position and sets out to test it by gathering and analysing data. It is sometimes called the hypothetico –deductive method because, in experimental research, the researcher normally outlines a hypothesis based on the theory, and then uses empirical methods to see whether it is confirmed or not. (Davies, 2007:235)

Interpretive phenomenological analysis (IPA)

A broad term that describes the standard approach to data analysis in qualitative research: looking for themes in the early emergent data; making connections between them; seeking further evidence (confirmatory or conflicting) through second-stage interviews or observations; the elucidation of confirmed patterns; and an attempt to infer meanings from the completed analysis. (Davies, 2007:238)

4.2 Phase One

4.2.1 Coding

Phase One of my study proved a valuable learning experience for the approach I used in Phase Two. My main data gathering tools were profiling questionnaires (Appendix 8), audio and video recordings (Appendix 10), notebooks kept by learners in the focus group (Appendix 11) and observation notes (Appendix 12) kept by the two observer teachers.

One of the first lessons I learnt from this phase was that I should not take anything for granted. I discovered that it should not be assumed that learners are familiar with scientific or technological terms. The upshot of this was that I needed to do more talking in order to explain the various terms during the sessions which were supposed to reveal how learners think. This in turn resulted in a considerable amount of unusable data. In order to filter the information gathered I used the analytical strategy described by Schmidt (2004:253) as a guide.

This entailed firstly a stage of forming analytical categories, a second stage of assembling the analytical categories into a guide for analysis and coding and a third phase of coding the material in which the material was classified into the analytic categories. In the fourth stage, I tried to draw up a table of frequency in respect of the data and in the fifth stage to interpret the data as best as I could. According to Schmidt:

The goals of this stage of analysis might be: to discover new hypotheses, to test a hypothesis on a single case, to distinguish between conceptual terms, to arrive at new theoretical considerations or to revise existing theoretical frameworks. Using the constellations derived from the codings, a motivated selection of cases may be made for more detailed analysis. (2004:257)

Throughout the analytical process I remained mindful of Schmidt's encouragement of, "Readers to develop their own appropriate modes of analysis" (2004:253).

I opted to follow this systematic analysis of the content in an attempt to minimise the possibility of examining only material that supported my hypothesis. In my analytical categories I included material other than that which was relevant to my study. According to Holsti et al.

Inclusion or exclusion of content is done according to consistently applied criteria of selection; this requirement eliminates analysis in which only materials supporting the investigator's hypotheses are examined. (Holsti; Nachmias & Nachmias, cited in Nachmias and Frankfort-Nachmias, 1996:324-325)

4.2.2 Results of Stage 1(Formulation of Analytical Categories): Phase 1

After the transcription of the video and audio recordings I numbered the data according to discernible sub –divisions. For example, I tried to separate entries on a table according to speech turns or explanations of actions (Appendices 10A- 10C). I then invited my two colleagues to watch the video footage and listen to the audio tapes to check the accuracy of my transcriptions. Their input was most valuable especially in helping to identify the learners who were talking. This step was necessary in order to respond to authenticity claims on the basis of member checking (Section 3.8).

The next step was to read through the transcriptions in an effort to form analytical categories. Based on my personal experience and the theories encountered in my literature review I was able to identify thirteen broad categories from this exercise. They were:

Table 2 *Broad analytical categories –phase1*

No	Category	Theory
1	Using board as reference and interacting with board	Teacher Talk, Practical Tasks
2	Use of OHP to supplement Easy Electrical Board	Teacher Talk, LTSM
3	Interaction between learners, correction, consultation	Cooperative Learning, Constructivism

4	Explain answer, verbalise thought, writing reflections	POEE, Constructivism,
5	Teacher a 'know- all'. A source of information	Positivism
6	Use of chalk board	Teacher Talk, LTSM
7	Thinking aloud, Learner Talk	Constructivism
8	Teacher wait time, time to solve problem	Teacher Talk, Constructivism
9	Argumentation	Learner Talk, Constructivism
10	When to intervene and how?	Teacher Talk, Constructivism
11	Group dominance	Group work
12	Critical thinking. Is learning really taking place?	Critical thinking, Constructivism
13	Learning can be an enjoyable experience	Cooperative Learning

4.2.3 Results of Stage 2 (Analytical guide for analysis and coding.): Phase 1

From these broad categories I proceeded to assemble a guide for analysis and coding. My first step in this process was to check if some of the categories identified above could be grouped together. This resulted in the following new groupings:

Table 3 *Grouped categories into codes*

CODE	Grouped	Category	Theory
1	1 +2 +6	Using board as reference and interacting with board/Use of OHP to supplement Easy Electrical Board/Use of chalk board/ Learning can be an enjoyable experience	Practical Tasks/ LTSM

2	3+12+7+ 9	Interaction between learners, correction, consultation/ Critical thinking. Is learning really taking place?/ Thinking aloud, Learner Talk/ Argumentation	Cooperative Learning/Critical thinking/Constructivism/
3	4	Explain answer, verbalise thought, writing reflections	POEE/Constructivism/
4	8+10	Teacher not 'a know- all'/ Teacher wait time, time to solve problem/ When to intervene and how?/ Group dominance	Constructivism/ Group work
5	1 + 5	Teacher actively teaching/directing activities	Teacher Talk/ Positivism

The next step in the process was to assign a code to the categories and check the transcriptions for frequency. The coding used is reflected in Table 3 above.

4.2.4 Frequency Table (Phase 1)

In order to calculate the frequency of the occurrence of the code investigated, the total number of separate entries on the table representing the speech turns or explanations of actions were used as denominator (Appendices 10.1- 10.3). For example, Appendix 10.1 suggests a total of 112 separate speech turns. Day 1 on Table 4 below reflects that 44 of these speech turns are related to code 1 and $44/112$ translates into a frequency 39.3%. Appendix 10.2 shows 53 speech turns of which 17 could be ascribed to code 1. This translates into 32.1%. The interesting significant jump in the frequency of code 1 on day three can be ascribed to the experience I gained over the first two days.

As a result, on the third day I allowed the learners to do a lot more on their own in order for me to get a reasonable idea of what was really happening whilst they were trying to find a solution to the problem. Code 4 is almost a direct antithesis to code 5. The argument being that if the teacher was not actively engaged in teaching or directing activities, it could be deduced that the teacher allowed the learners more time to solve the problem on their own.

This in a sense suggests that on those occasions where the teacher direction decreased, there was an increase in the interaction between the learners and more opportunity for the social construction of meaning. This conscious decision by the teacher was founded in the ideas around “collaborative activity” as espoused by Lunt (1993) in Chapter Two, section 2.2 above. However, it could not be surmised that learning took place.

Table 4 **Frequency Table Phase 1**

CODE	Broad Category	Frequency		
		DAY 1	DAY 2	DAY 3
1	Using board as reference and interacting with board/Use of OHP to supplement Easy Electrical Board/Use of chalk board/ Learning can be an enjoyable experience	DAY 1	44/112	39,3 %
		DAY 2	17/53	32,1 %
		DAY 3	35/41	85,4 %
2	Interaction between learners, correction, consultation/ Critical thinking. Is learning really taking place?/ Thinking aloud, Learner Talk/ Argumentation	DAY 1	64/112	57,1 %
		DAY 2	41/53	77,4 %
		DAY 3	32/41	78,0 %
3	Explain answer, verbalise thought, writing reflections	DAY 1	45/112	40,2 %
		DAY 2	41/53	77,4 %
		DAY 3	31/41	75,6 %
4	Teacher not ‘a know – all’/ Teacher wait time, time to solve problem/ When to intervene and how?/ Group dominance	DAY 1	71/112	63,4 %
		DAY 2	38/53	71,2 %
		DAY 3	27/41	65,9 %
5	Teacher actively teaching/directing activities	DAY 1	41/112	36,6 %
		DAY 2	15/53	28,3 %
		DAY 3	14/41	34,1 %

4.2.4 Preliminary Conclusions

Based on the findings up to this point I was able to reflect on my research questions. I tried to corroborate these with what the learners wrote in their notebooks as well as what the two observer teachers wrote in their observation notes. The goal being to arrive at an understanding of the learning processes that occur during group work sessions in a lesson involving practical work in electricity using circuit boards in grade 8. The research questions addressed were: Does engaging learners in well-structured group practical activities in electricity present a premise for meaningful learner talk? How knowledge is constructed in group-settings and do practical activities involving electrical circuit boards in grade 8 enhance learning?

Code 2 above broadly categorized the interaction between learners, correction, consultation by peers, critical thinking and argumentation as the main ways in which learners tried to make sense of the challenges they were presented with. Should one consider the frequency of these phenomena as suggested by the frequency table in section 4.2.4 above, it appears that the social construction of knowledge as alluded to in Chapter Two, sub-section 2.3.1 was the dominant means of processing knowledge whilst using easy electrical circuit boards.

This is an excerpt from the transcription of day 1 of Phase One. The learners in the group were experiencing problems in connecting the electrical circuit.

Please refer to speech turns 60 - 65 of [Appendix 10.1](#)

Girl 2: Hie is 'n lang een. (Here is a long one). The learners in focus group experience problems connecting their circuit. Teacher 1 approaches. They manage to get it right without his intervention.

Girl 1: Ons moet die ene daar sit. *Freely translated, "We must put this one there."*

Girl 2: Nee nog nie. Ons moet eers van hier af hiernatoe gaan. *Freely translated, "No, not yet. We must first move from here to there."* (Pointing on circuit board)

Girl1: O, OK sien jy? *Freely translated, "Oh, OK, do you see?"*

Girl 2: Is dit nie te kort nie. Vat die ene. Dan vat ons hom hievanaantaf tot hieso. *Freely translated, "Is that not too short? Take this one. Then we take from here to here."*

Girl 1: Issie. Kyk hie. Die krag gaan mos deur die een dan gaan dit op in die draad en dan na die een. (Pointing at the CB as she's talking) ...en as dit hieso kom gaan dit in die skakelaar af hiernatoe. *Freely translated, "It's not. Look here. The current flows through the one and then it goes up through the wire and then to the other one. And when it comes here it goes into the switch down here."*

A lot of discussion and consultation was taking place in the group. Learners differed in opinion and made suggestions that were tried out. This kind of negotiation was evident throughout the three sessions. Such interactive type of learning is corroborated by what the learners and teachers wrote in their notes and observations (Section 2.3.1.1 above).

On day one, Learner One (L1) wrote that she learnt to help members in the group and to listen to one another's proposals ([Appendix 11.1](#)). On day two, she wrote that she learnt how to work with people and how to help people when they needed help. On day three, she wrote that she learnt how to work with people and how to respect other people's proposals.

On day one, Learner Two (L2) wrote that she really enjoyed working with learners from another class group ([Appendix 11.2](#)). On day three, she commented on the pleasure of working with the three teachers involved, that is, the researcher and the two observer teachers.

On day one, Learner Three (L3) wrote that she learnt how to work with other people and to listen to other people's opinions ([Appendix 11.3](#)). On day two, she wrote that she learnt how to help, understand and respect one another.

On day one, Learner Four (L4) wrote that she learnt to help her classmates and to listen to their proposals ([Appendix 11.4](#)). On day two, she wrote that she learnt how to work with people and to help them where needed. On day three, she wrote that she learnt to listen to other people's ideas and to give people a chance to voice their opinions.

On day two, Observer Teacher Three (T3) wrote that the, "Learners got a chance of expressing themselves, they help each other, correct each other and they understand better than when the

teacher talks alone and just write on the board” (Appendix 12.2). On day three, she wrote that, “Learners who understand show those who struggle.”

On day two, T3 wrote that the learners were eager and they corrected one another whilst working with the circuit boards (Appendix 12.2). Discussions were happening amongst them and co-operation amongst the learners was good. On day three, she commented that group work was excellent and that the learners were comfortable interacting with one another.

Code 1 above refers to instances where the easy electrical board was used as reference or where the teacher or learners interacted with the board. The frequency of this occurrence suggests that the board became a major instrument in the teaching and the consequent understanding that emerged. An argument could therefore be made that by engaging learners in working with easy electrical boards, and for that matter, involving them in practical tasks using easy electrical boards, enhances learning as proposed by Maselwa and Ngcoza (2003).

Most of the lesson sessions involved the learners actively engaging with the easy electrical board and it could be argued that most of the learning resulted from this active engagement. I have, however, elicited a few instances where this phenomenon could be substantiated beyond mere speculation.

On day two, L2 wrote that it is much better to work with something that you see than to hear of that something (Appendix 11.2). L4’s comment on day one was that she found this way of learning most enjoyable (Appendix 11.4). T1 wrote, “In this way of teaching and learning learners understand better because they see and touch. They are able to apply what is taught practically” (Appendix 12.1). T3 commented that the learners were eager to work with the easy electrical boards (Appendix 12.2).

Codes 4 and 5 shed some light on the issue of well-constructed group activities and its resultant role in the efficiency of learning. There are indications of the role of the teacher during practical activities. Great care was taken regarding thorough preparation for the lesson but the challenges surfaced primarily during the actual management of the activity. I was somewhat derailed by the realization that I had to do a lot more talking, something that is discouraged by Lemke (2001) than I had anticipated because of the lack of prior knowledge of the learners (Section 2.2 above).

It is recognized, however, that since these learners came from different primary schools they had different levels of exposure to basic electricity. This implied that I had to explain a lot more than I had intended. However, this did not have a negative impact on my findings. What these codes highlighted was more the extent to which the teacher was tempted to intervene.

For instance, how long was the teacher willing to allow the learners to work the problem out for themselves? It was quite a challenge to allow trial and error without intervention but patience in this regard was abundantly rewarded by the satisfaction of achievement seen on the faces of the learners after their success. This can be argued as indicative of the extent to which well-structured group practical activities in electricity promote learning. Both observer teachers made positive comments with regard to the structure of the lesson, the group work and the use of the circuit boards.

Code 3 attempted to identify the instances where the learners were allowed the opportunity to explain their answers, verbalise their thoughts and write reflections. All the learners were able to write comprehensively on what they had learnt during the three sessions. This accounts for content knowledge, the actual facts and information shared during the course of the session. (Appendices 11.1 to 11.4). The fact that they were able to write about what they learned concurs with Hinchey's (1998:52) argument that, "In most cases, individual student writing and talk, rather than tests, signal to the teacher whether learning has occurred".

It is evident from the notes kept by the learners that they had a satisfactory grasp of the knowledge content of the lessons and both the observer teachers were reasonably convinced that the learners had captured the knowledge content of the sessions adequately (Appendices 11 and 12).

4.3 Phase two

4.3.1 Analytical guide for analysis and coding

During the video and audio recording sessions of Phase Two, I explicitly asked learners to verbalise their thinking aloud. This was as a result of my experience in Phase One. I took a leaf from the work done by Barnard, Sandberg and van Someren (1994:1) who argue that, "This is a very direct

method to gain insight in the knowledge and methods of human problem-solving. The speech and writings are called spoken and written protocols”.

For this session I used a focus group without the other groups because I found that having more than one group encouraged competition among the children and resulted in some of the learners just connecting wires to see a result without having thought through their actions. Using one group also assisted in concentrating the focus of the observers.

After the transcription of the video and audio recordings I once again numbered them according to discernible sub-divisions by separating entries on a table according to speech turns or explanations of actions. My colleagues were then invited to watch the video footage and listen to the audio tapes to check the accuracy of my transcriptions.

I used the same analytical categories and codes derived in Phase One to apply to this set of data (See [Table 2](#) and [Table 3](#)). The reasoning being that I needed to be consistent in the criteria I applied over the two phases.

I then proceeded to check the latest transcriptions for frequency using the codes reflected in [Table 3](#).

4.3.2 Frequency Table (Phase 2)

Table 5 **Frequency Table Phase 2**

CODE	Broad Category	Frequency		
		DAY 1	DAY 2	DAY 3
1	Using board as reference and interacting with board/Use of OHP to supplement Easy Electrical Board/Use of chalk board/ Learning can be an enjoyable experience	107/157	81/130	68.2%
		63,1%	138/223	61,9%
		75.8%	98/130	75,4%
2	Explain answer, verbalise thought, writing reflections	119/157	164/223	73,5%
		75,4%		

3	Explain answer, verbalise thought, writing reflections	DAY 1	117/157	74.5%
		DAY 2	103/130	97,2%
		DAY 3	184/223	82,5%
4	Teacher not a know - all/ Teacher wait time, time to solve problem/ When to intervene and how?/ Group dominance	DAY 1	122/157	77.7%
		DAY2	95/130	73,1
		DAY 3	183/223	82,1%
5	Teacher actively teaching/directing activities	DAY 1	35/157	22.3%
		DAY 2	35/130	26.9%
		DAY 3	40/223	17.9%

4.3.3 Discussion

4.3.3.1 Introduction

It was now possible to use some of the findings from both phases to provide reasonable suggestions in response to the investigation of the learning processes occurring during group work sessions in lessons involving practical work in electricity using circuit boards in grade 8. Both phases reveal substantial evidence of interaction between learners, correction, consultation, critical thinking and argumentation as the main ways in which learners approached the challenges they were presented with.

4.3.3.2 Frequency Tables

The frequency Tables 4 and 5 suggest that the social construction of knowledge was the main means of processing knowledge whilst using the easy electrical circuit board. According to O'Donoghue et al., (2007:435),

It is difficult to conceive of any human learning interactions that are not social processes of engaged meaning making either by learners as social agents in context or from the point of view of what is learned relating to social life in a world of interdependent living-things.

Learner 1 in Phase Two repeatedly mentioned the fact that she enjoyed working in a group. Of note is her reference to the fact that she believes that it is better to work as a group as opposed to struggling on one's own. "Dit sal baie beter wees om met ander te werk asom alleen te sukkel om Dit reg te kry" (Appendix 13). *Freely translated, "It will be much better to work with others than to struggle to get it right on your own."* This notion of co-operative learning was echoed by Learner 2 In Phase Two who wrote that, ...*"baie koppe werk beter as een"* (Appendix 14). *Freely translated, "...many heads work better than one."*

Quite clearly all the learners who participated in the programme in both phases indicated that they enjoyed working in a group except for learner 6 in Phase Two who wrote that he preferred to work in a pair. "...ek dink dit sal beter wees as daar daar twee saam werk want ek hou nie om met 'n klomp mense te werk nie" (Appendix 18). *Freely translated, "...I think it will be better when two work together because I do not like working with a lot of people."*

Vygotsky (1978) argued that children are at their highest peak of learning when they are collaborating with more skilled partners. These responses by the learners suggest opportunities for more 'knowledgeable' learners to help their peers through intellectual scaffolding. Millar (2004) also suggests that, "... in practice, the representations we construct are tested out not only through action, but also through interpersonal interaction" (Section 2.3.1.1 above).

A closer look at the actual conversations taking place in the group proved quite interesting. This is an excerpt from day 1 Phase 2 Speech turns 2 to 9 (See Appendix 22.1).

L2: Eerste die selle insit. *Freely translated, "First put the cells in."*

L4: Ons moet die geleidingsterminaal hier by die sel laat inkom. *Freely translated, We have to get the wire to come into this cell."*

L2: Wag eers. *Freely translated, "Wait first."*

L4: Jy moet die een hier by die sel insit. *Freely translated, "You must put this one in here at the cell."*

L2: Waar? Hierso? (All the learners are pointing to where terminals should be placed) *Freely translated, "Where? Here?"*

L5: Ja. En ene hier. Hier bo. *Freely translated, "Yes. And one here. Here at the top."*

L2: Ja. En ene hier. (Pointing to the next terminal) daar moet nog 'n geleidingsterminaal... *Freely translated, Yes. And one here. There should be another wire..."*

L2: (Doing the wiring) Moet daar nie nog een hier kom nie. Na die bulb toe nie? *Freely translated, "Shouldn't another one come here? To the bulb?"*

This tendency was prevalent throughout the three sessions. The learners were asking each other questions and consulted with one another before they made a connection on the board. When they encountered a problem, there was a pensive pause and an intense scrutiny of the board. On more than one occasion, they retraced their actions up to the point where they reached a problem and would analyse the situation. Roschelle (1995:2) argues that, "... constructivism depends on continuity, because new knowledge is constructed from old."

This discussion is taken from day 2, speech turns 55 to 63 (See Appendix 22.2). It follows after they could not make progress and decided to start from scratch.

L2: Ons maak soos ons met die eerste een gemaak het. (L3 starts by connecting the short wire between the cells.) *Freely translated, let us do what we did with the first one."*

L2: (L3 picks up a wire) Ja vat 'n lange. Sit hom aan daarso...en dan na die skakelaar. *Freely translated, "Yes, take a long one. Put it on there...and then to the switch."*

L4: Nee. (L5 put a wire at a wrong terminal and changes it) Ja. *Freely translated, "No, yes."*

L2: Dan gaan ek die ene probeer. En dan van hier af... *Freely translated, "Then I am going to try this one. And then from here..."*

L4: Hier in. *Freely translated, "In here?"*

L2: Hierso ne? Freely translated, "Here hey?"

L4: Hy moet hier in. (Pointing) *Freely translated, "It must go in here."*

L2: Wag, wag...kom ons kyk of dit werk. (He tries switch 2.) Ah ah. (He tries switch 1. Doesn't work. There is silence. All the learners are looking at the board, trying to figure out where they went wrong.) *Freely translated, "Wait, wait...let us see if it works. Ah ah."*

Somehow it appeared that the nature of the exercise never really allowed anyone to play a leading role. Although it was mostly one or two learners who did the wiring, this was primarily done in consultation with the group. The following excerpt is taken from day 3 of Phase Two, speech turns 32 to 51 (See Appendix 22.3). This conversation shows how involved the learners became.

Four of the six are actively engaged in discussion. Offering advice and even admonishing each other at times. All the learners appeared to be making strong input. Once again it provided a glimpse of the potential practical activity holds for cognitive exercise and could be interpreted as supporting Haig's (1995:3) argument that, "The importance of data lies in the fact that they serve as evidence for the phenomena under investigation" (Section 4.1 above).

L1: Al twee moet aan wees sodat hy kan lig. *Freely translated, "Both should be on for it to can shine."*

L2: Uh?

L1: Wag. (She takes off two wires) *Freely translated, "Wait."*

L4: Haal alles af. *Freely translated, "Take everything off."*

L3: Los die twee. *Freely translated, "Leave those two."*

L2: Los daai twee. *Freely translated, "Leave those two."*

L1: Moet ons nie miskien die een gebruik nie? *Freely translated, "Shouldn't we maybe use this one?"*

L2: Jy moet al twee gebruik mos. (He starts wiring) *Freely translated, "You should use both."*

L1: Van die skakelaar na die ander skakelaar. *Freely translated, "From the switch to the other switch."*

L2: Gister was hy so ne? Kyk net hierso. *Freely translated, "Yesterday it was like this. Just look here."*

L1: Maar die is die gloeilamp nie die skakelaar nie Lloyd. *Freely translated, "But this is the bulb and not the switch Lloyd."*

L2: Wag. Gou iets kyk. (He tries switch 2, it works) *Freely translated, "Wait, I just want to see something."*

L2: Gister was hy so. *Freely translated, "Yesterday it was like this."*

L4: Moet ons nie die ene gebruik nie? *Freely translated, "Shouldn't we use this one?"*

L2: Uuh. Ons moet net twee gebruik want daai is ook net twee. *Freely translated, "No, we must only use two because those are also two."*

L1: Kan ons nie daai ene vat tot hier. En hierso tot hierso. (Pointing) *Freely translated, "Can't we take that one up to here and from here to here."*

L4: En dan vat ons een oor hierso. Try. *Freely translated, And then we take one over here. Try it."*

L2: Hoe? Hierso? *Freely translated, "How? Here?"*

L1: Nee Lloyd. Haal af daai draad. (L2 removes the wire) *Freely translated, "No Lloyd. Take off that wire."*

L3: Die ene hierso. *Freely translated, "This one here."*

As with Phase One, learners in Phase Two were unequivocal in their support of working with the electrical easy boards. The logical conclusion is that doing practical activities involving electrical circuit boards in grade 8 enhances learning. These are some of the comments made by some of the learners in Phase Two:

Learner 2, “ ...ek verstaan beter die werk wanneer ons prakties werk”(Appendix 14). *Freely translated, “...I understand the work better when we work practically.”*

Learner 3, “Ek voel dit is beter om dit te doen as praktiese werk. ‘n Mens kan dit beter verstaan.” (Appendix 15) *Freely translated, “I feel it is better to do it as practical work. A person can understand it better.”*

Learner 4, “Ek dink dis beter as kinders self die werk doen, van op so manier sal hul kreatief is en die werk verstaan.” (Appendix 16) *Freely translated, I feel it is better if children do the work themselves because in that manner they will be more creative and understand the work.”*

Learner 5, “Dit is baie lekker om met praktiese werk te doen. Dit is baie intersanter om met stroombaan te werk.” (Appendix 17) *Freely translated, “It is very nice to do practical work. It is very interesting to work with a circuit (board).”*

Learner 6, “Ek dink dit sal beeter wees as ons praktiese werk doen want dit is makliker. En al die skryfwerk is baie en die kinders sal gou leer en die dit sal intresanter wees en hulle sal dit kan ondhaw.” (Appendix 18) *Freely translated, “I think it will be better if we do practical work because it is easier. And all the writing work is a lot and the children will learn quicker and it will be more interesting and they will be able to remember it.”*

These comments resonate with the conclusions of Maselwa and Ngcoza (2003) that practical work in the science classroom promotes conceptual understanding. The comments also give further credence to Millar’s (2004) theory that, “Finding things out for yourself, through your own efforts, seems natural and developmental, rather than coercive, and may also help you to remember them better” (Section 2.4.1 above).

Both observer teachers also commented on the use of the circuit board as a means for the learners to apply their knowledge practically. Teacher 3 wrote, “In conclusion learners were better off in understanding given a chance to apply the information they had into practice” (Appendix 20).

It has to be said though, that engaging learners in practical activities, for example, in this case study, around a circuit board, does not necessarily translate into learning. The comment by Hodson (1990) in respect of, “...ill-conceived, confused and unproductive” practical tasks is a very

real concern. I have during the course of my research learnt that strategic intervention and patience was crucial in ensuring that learners were enabled to make meaning by themselves.

One of the first considerations when introducing new information should be the establishment of prior knowledge (Roschelle, 1995). This is said with particular reference to the fact that the learners in my case study focus groups came from three different schools and they were all at different levels of understanding with regards to what they were supposed to have learnt in grade 7.

This aspect became apparent in Phase One and I had to discard a lot of unusable data due to its irrelevance to my study. A huge amount of recorded time was lost in my attempts to bring the group to the required level of introducing the new task, something which defeated the social constructivist (McRobbie & Tobin, 1997) ideals as espoused in this study.

The same happened in Phase Two, but my previous experience afforded me the opportunity to treat the matter differently. Instead of moving directly into the new work, I conducted a separate session where the learners were acquainted with the terminology and equipment they were going to work with. This insight was gained from the example made by Millar (2004) in respect of the use of an ammeter (Section 2.4.2 above).

Lending support, Johnstone (2010:26) argues that the, “vast bulk of our teaching and learning is done through the medium of language...” and “...it “plays a major role in filtering incoming information.” It therefore stands to reason that not much learning will happen if learners are taught new concepts whilst at the time trying to make sense of unfamiliar terminology. The same argument holds true when learners have to use unfamiliar equipment at the same time as learning new concepts.

Unless teachers ensure that learners are at the most conducive stage for interpreting new information, it would become a more taxing exercise for them to make sense of all the different pieces of information they need to process simultaneously. Johnstone (2010:23) further argues that learners,

Are looking for linkages between old and new knowledge (i.e., making sense of the new) and getting prepared for storage in long – term memory. Sometimes the linkages are faulty

and give rise to alternative frameworks; sometimes no linkages could be made (i.e., no understanding was achieved) and the information was rejected or rote learned.

An idea of the level of prior knowledge regarding electricity can be gained from the comments of Learner 2 ([Appendix 14](#)). These words run throughout her comments on all three days and are resonated in the comments of some of the other learners.

L2, "Ek het baie nuwe woorde geleer en baie dinge verstaan wat ek nie van geweet het nie." *Freely translated, "I have learnt many new words and understood many things that I did not know of."* These many new words and many things she is referring to are things that are contained in the grade 7 syllabus. At grade 8 level it was supposed to have been revision.

It is therefore extremely important that the teacher who engages learners in practical tasks should ensure that the learners are familiar with at least the terminology that will be used in the exercise as well as reasonable familiarity of the equipment that they will need to manipulate during the exercise. If not, then these need to be taught actively as a preparatory exercise (Section 2.4.2 above).

L2 reminded the group members that the board was now wired the same way it was wired the previous day. Quite significantly, the same learner suggested that they use the knowledge they gained on the first day to assist them on the second day. On day two of Phase Two he said, "Ons maak soos ons met die eerste een gemaak het." *Freely translated, "Let us do what we did with the first one"* ([Appendix 22.2](#)).

Another aspect meriting mention is the whole notion of teacher wait-time and strategic intervention. It is probably the most challenging concept in respect of time constraints placed on syllabus coverage and the level of learner understanding. Vygotsky (1978) argues that, "A child's greatest achievements are possible when exploring on their own, achievements that tomorrow will become his/her basic level of real action."

There appears to be general consensus that learners are unique and Levine (2002:1) has the following to say in this regard,

Planet earth is inhabited by all kinds of people who have all kinds of minds. The brain of each human is unique. Some minds are wired to create symphonies and sonnets, while

others are fitted out to build bridges, highways, and computers; design airplanes and road systems; drive trucks and taxicabs.

Over and above this uniqueness, we also have to contend with learners who come from different geographical and socio-economic locations and who were exposed to learning and teaching environments mediated by teachers of varying competences. Learners who have progressed through a GET phase in an environment referred to by Lunt (1993) as where, "...a large majority of those children whose backgrounds (linguistic, ethnic, class) and life experience are different from a 'norm' and in particular children from ethnic minority backgrounds." It is this very real situation in our schools that needs to be considered when we seek to provide learning experiences that are not 'ill-conceived and unproductive'.

Based on this premise, teachers need to seriously consider the aspect of the time discrepancies in the learning processes of learners. Teacher-wait-time becomes crucial when one considers what might happen when teachers are given set time-frames in which to cover syllabus content as anticipated in CAPS. Warning signals should certainly flare when a scenario is created where, a "danger of viewing the standards and benchmarks as inert content to 'cover'", exists (McTighe & O'Connor, 2005:12).

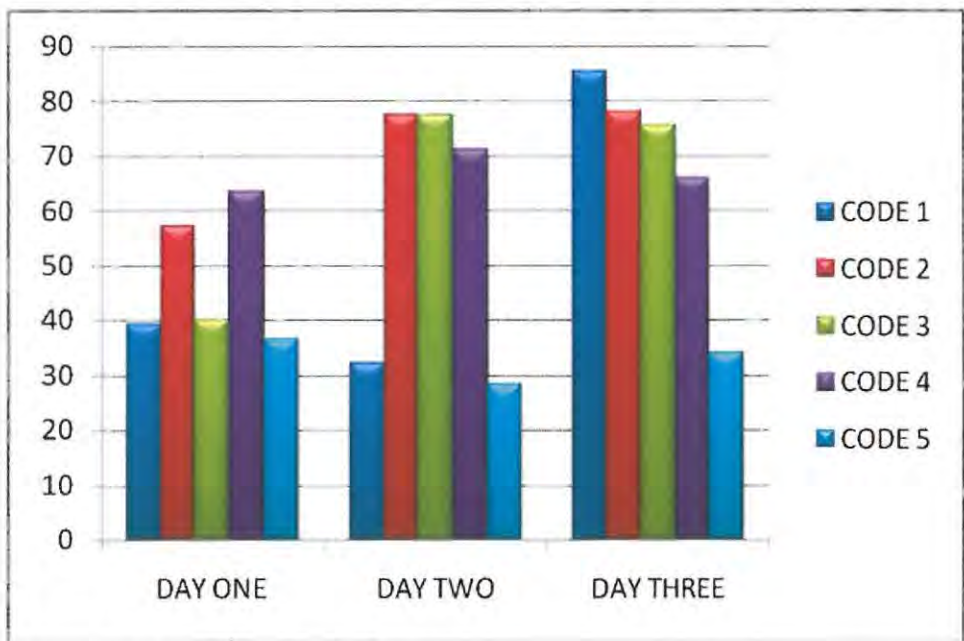
It was with this in mind that I tried to keep my intervention to a minimum. At times I was really stretched to the limit, experiencing a dilemma in the sense of not allowing the learners to become completely disillusioned on the one hand and allowing them room to solve the problem in their time on the other hand. Striking this balance can be a challenge.

It was gratifying though to find that on day 1 Teacher 3 commented on the advantage of the board in allowing learners to find out where they made a mistake on their own, "Leerlinge probeer 'n tweede keer en vind self uit waar hulle fouteer het" ([Appendix 19](#)). *Freely translated, "Learners try a second time and find out for themselves where they had made a mistake."*

A similar comment was made in her observation on day 3, "Leerlinge was 'n bietjie onseker van die Of-Logika. Lank geneem voor hulle dit reggekry het op die stroombord. Uiteindelik het iemand dit reggekry en aan die ander verduidelik hoe dit werk" ([Appendix 19](#)). *Freely translated, "Learners were a little uncertain about the OR-Logic. They took long before they got it right on the circuit board. Eventually somebody got it right and explained to the others how it worked."*

It is important to note that the learner is not “a solitary, free-ranging problem-solver” (Moll, 2002:6). The teacher should always be present to provide the necessary ‘insight’ (Bencze, 2000: 857). That is, care should be taken that proper learning opportunities are created and careful planning is needed. The teacher becomes a facilitator within these learning environments and the level of intervention or guidance becomes a relevant factor too (See 2.2 and 2.3.1.1 above). It is within that zone of proximal development (ZPD) (Vygotsky, 1978) that a fine balancing act is playing out (See [Figure1](#)).

I have included Charts 1 and 2 in order to illustrate a relationship between code 5 which represents teacher involvement and the rest of the codes which signify learner involvement in the process of finding a solution to the problem presented. Careful analysis reveals interesting suggestions in respect of practical involvement of learners using electrical circuit boards in grade 8.



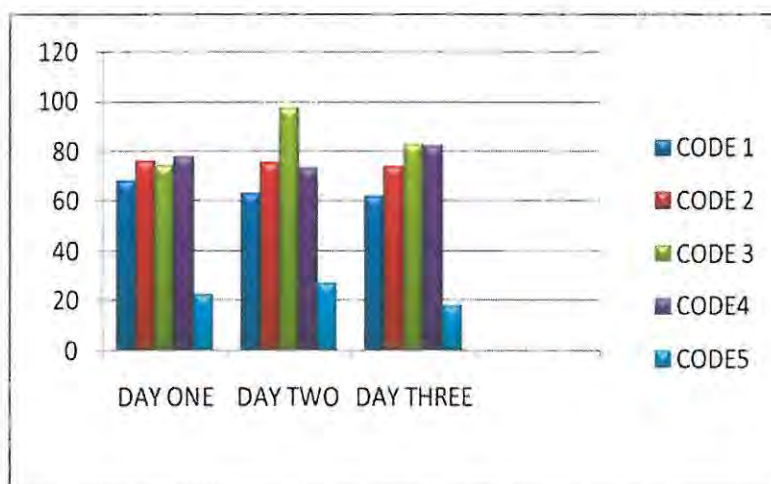
Bar Graph 1 Frequency Table Phase 1

CODE	BROAD CATEGORY
1	Using board as reference and interacting with board/Use of OHP to supplement Easy Electrical Board/Use of chalk board/ Learning can be an enjoyable experience
2	Interaction between learners, correction, consultation/ Critical thinking. Is learning really taking place?/ Thinking aloud, Learner Talk/ Argumentation
3	Explain answer, verbalise thought, writing reflections
4	Teacher not a know - all/ Teacher wait time, time to solve problem/ When to intervene and how?/ Group dominance
5	Teacher actively teaching/directing activities

Chart 1 suggests a direct correlation between teacher-wait-time, that is, less intervention from the teacher (Code 4) and the increase in activity around the board and learner interaction (Codes 1 and 2). The same conclusion is true for Phase Two.

What is most interesting in this chart is the marked increase in codes 2 and 3. This can be ascribed to the lessons I learned in Phase One. A lot more time was allowed for learners to solve the problem. Please note the decrease in percentage in Code 5. This seems to suggest that if the teacher talks less, the learners get more time to engage with the practical activity.

Once again, it should be emphasized that learners are not to be treated as ‘free-ranging problem solvers’ (Moll, 2002:6) (Section 2.2 above). Besides careful planning of practical tasks to facilitate learning, the actual management of that ZPD needs to be carefully managed in order to allow for maximum opportunity for cooperative learning productivity.



Bar Graph 2 Frequency Table Phase 2

A similar trend is noticeable when studying Chart 2. More opportunity for learner interaction is possible when the teacher takes a step back. Reeves (2000) argue, "Improving time on task is not only about teachers and learners spending more time at school in class. Ultimately, it is about how teachers manage time in class so that their learners spend as much time as possible meaningfully engaged with challenging intellectual work." I concur with Reeves.

However, this brings us to yet another dilemma regarding mediating learning. The aspect of allowing learners to explore and arrive at solutions may become quite a challenge to the mediator of a learning situation. Millar (2004) suggests that, "... teaching science is inevitably a goal-directed activity." Bencze (2000) cautions that unless teachers provide insights, "students may arrive at unexpected conclusions" (Section 2.2 above).

It is this possibility of arriving at unexpected conclusions that may constitute a serious challenge to a teacher. A syllabus-driven teacher will be goal-directed and in all probability dismiss routes of arriving at conclusions other than that which is prescribed. This attitude flies in the face of allowing learners to make sense on their own as would be the case during practical tasks.

Presseisen (1992:7) has the following to say in respect of meta-cognition, "A focus on meta-cognition in the classroom emphasizes helping students understand their own responses to thoughtful situations. Quite often, meta-cognition or executive control involves 'hands-on' learning strategies to help the learner represent the information more vividly and to suggest routes to solutions embedded in particular contents."

There exists a very real dilemma that practical activities will be sacrificed because teachers may not be in a position to explain the 'unexpected conclusion' arrived at, and in the process, groundbreaking innovation may be dismissed as wrong conclusions.

This in a sense exposes another weakness in allowing learners to engage in practical activities, that which relates to the competence of the teacher or facilitator. Any teacher or facilitator who is not completely comfortable with the content knowledge (Shulman, 1986) in his/her subject will be reluctant to allow any situation to develop beyond their control.

4.3.3.3 *Semi-Structured Interviews*

Part of my reasoning to use semi-structured interviews was motivated by validity considerations. In this regard it could serve as another data source in search for 'common themes' (Section 3.8 above).

The advantage of this form of data gathering method which Cohen et al. (2000:267) describe as an "Interchange of views between two or more people on a topic of mutual interest" is that any misunderstandings can be corrected immediately. According to Kelly (2010:1),

Face to face interviews have advantages over the other survey methods, according to Biklen (1992) some of these advantages include the opportunity to clarify any misunderstanding of questions by the respondent, and the research coordinator also has the opportunity to gain more information on the subject area. The research coordinator can also assess the understanding of questions by the respondent. More information can be collected in a face to face interview whereby the research coordinator can collect more information than in other methods of research.

For example, it became evident during the interviews that the learners were not sure whether I was referring to the chalk board or the circuit board when I was asking questions. The real-time nature of the semi-structured interview afforded me the opportunity to become more specific immediately.

Here follows one such example: (See Appendix 21.1, speech turns 22-23)

Teacher: Uhm. Nou OK. Se vir my uh. Van die twee lesse wat jy gekry het ne, watter een was die lekkerste? *Freely translated, "Uhm, now OK. Tell me which of the two lessons have you enjoyed the most?"*

Learner: Altwee meneer. *Freely translated, "Both Sir"*.

This was not the response I had expected and realising the ambiguity of my Question I immediately became more specific.

Teacher: Ek praat nou van die ene in die klas van die parallel en die series en die ene wat jy in die middag gekry het na skool wat ons met die stroomborde gewerk het. Watter een dink jy was die beste. *Freely translated, "I am referring to the lesson in class about parallel and series and the one you got in the afternoon after school where you worked with the circuit boards."*

Learner: Die ene wat ons na skool gedoen het meneer. *Freely translated, "The one we did after school sir."*

I have not followed any pattern in analyzing the data gathered in this fashion and primarily used the learners' comments to elucidate common themes that emerged up to that point in the process.

Learners' responses in respect of the semi-structured interviews also revealed that practical activities involving electrical circuit boards in grade 8 had the potential in respect of enhancing learning. According to Johnstone (2010:23),

The only way a teacher can be reasonably sure that a student has received and understood exactly what was intended is for the teacher and student to discuss and exchange the understanding face to face.

I decided to interview each of the focus group members individually so that I could solicit unique responses as well as avoid a situation where learners simply agreed to what a previous speaker had said. I was wary of creating a situation for cumulative talk as described by Mercer (2008:1), "Everyone simply accepts and agrees with what other people say. Children do use talk to share knowledge, but they do so in an uncritical way. Children repeat and elaborate each other's ideas, but they don't evaluate them carefully".

The following table contextualizes the questions put to the learners:

Table 6 Questions and rationale for semi-structured interview

No	Question	Rationale
1	Content questions on Parallel and Series Connections	This lesson was conducted in class on Tuesday 01 November 2011 and was taught in a Positivist manner where the teacher stood in front of the class and provided the information. The interview was conducted on 08 December 2011. This means that the interview followed approximately 37 days after the lesson. It was hoped to establish how much the learners could

		remember since the lesson was taught.
2	Content questions were asked in respect of the work done during the practical lessons conducted on 06, 07 and 08 September 2011.	During these sessions the learners were busy with easy electrical circuit boards. These sessions occurred approximately 3 months before the interviews. It was hoped to establish how much the learners could remember since the session.
3	The learners were asked which sessions they enjoyed most, the teacher teach type or the one where they worked on the circuit boards. They were requested to substantiate their responses.	It was anticipated that the learners would say they enjoyed the practical work more and for that reason they were asked to explain their answer.
4	The learners were then asked which sessions they understood the best the teacher teach type or the one where they worked on the circuit boards.	The responses to this question were compared to their responses to the content questions in 1 and 2 above.

All the learners in session two indicated that they enjoyed the lesson involving the easy electrical board the most.

Learner 6 said, "Is beter om soos daai te werk met die goete meneer. As jy dit verkeerd het kan jy dit weer oor doen" ([Appendix 21.6](#)). *Freely translated, "If you get it wrong, you can do it over again."* Learner 4 said, "Want ons het dit self gedoen" ([Appendix 21.4](#)). *Freely translated, "because we did it ourselves."* In his notes for day 2, Learner Five wrote, "Dit is baie lekker om met stroombaan te werk. Maar om ook nie alleen te werk nie om saam vriende te werk" ([Appendix 17](#)). *Freely translated, "It is very nice to work with the circuit (board). But also not work alone and to work with friends."*

These responses are complementing what the learners said in Phase One. On day 1 of Phase One, L2 wrote, "Ek het gesien hoe dit werk en dit was heerlik om oor elektisiteit te leer..." ([Appendix 11.2](#)). *Freely translated, I have seen how it works and it was nice to learn about electricity.*" On the same day T2 wrote, "Leerdere is gretig om met stroombord te werk." ([Appendix 12.1](#)) *Freely translated, "Learners are eager to work on the circuit board."*

All the learners said that they understood the content better when they engaged practically with the circuit boards. Here are some of their responses:

L1, "Daar aan meneer het ons baie gedoen wat ons al nooit van geleer het nie. Daar kon ons aan die stroombaan werk. En ons kon verstaan. Ons het verstaan wat ons mee besig was " ([Appendix 21.1](#)).

Free translation, "On that Sir, we did a lot that we never learnt of before. There we could work on the circuit. We could understand. We understood what we were busy with."

L2, "Ek het beter verstaan oor elektrisiteit want ons het dit self prakties gedoen. Ek het beter verstaan oor wat gaan dit eintlik" ([Appendix 21.2](#)).

Free translation, I understood electricity better because we did it ourselves practically. I understand what it is about better."

L3, "Want jy weet as die ene nie kan werk kan die ander ene lig by die parallele" ([Appendix 21.3](#)).

Free translation, "Because if the one does not work, then the other one will work in parallel."

L4, "Want ons het dit self gedoen" ([Appendix 21.4](#)).

Free translation, Because we did it ourselves."

L5, "Dit was maklik meneer" ([Appendix 21.5](#)).

Free translation, Because it is easy sir. Like, uhmm...do not know what to say now.'

L6, "Want meneer is makliker net meneer. Soos uhm. ..weet ook nie hoe kan ek nou se nie" (Appendix 21.6).

Free translation, "Because it is just easier sir. Like...do not know how I can say now."

The majority of the learners said that they understood better because they were able to do the work practically.

These observations concur with what Piaget (1978) had to say in respect of 'active educational methods' (Section 2.3.2.1 above).

Practical tasks therefore seem ideal in the sense that if they are designed as well as administered properly, they will succeed in making students think as well as act (Millar, 2004:12). I deliberately add the dimension of proper administration or facilitation because even a well-prepared practical activity can become unproductive if the teacher is not able to manage the task well (Section 2.4.3 above).

The individual responses of the learners resonate well with what T3 observed in Phase One, "In this way of teaching and learning learners understand better because they see and touch. They are able to apply what is taught practically" (Appendix 12.2).

Similar suggestions of enhanced understanding can be deduced from the comments of T2, Phase Two when she wrote, "Dit het tyd geneem en aan die laaste probeerslag het hulle die stroombaan laat vloei. Die gloeilamp het gebrand. Leerlinge vind dit dat hulle anders ook sal kan wys hoe 'n stroombaan werk" (Appendix 19). *Freely translated, "It took time and at the last attempt they got the circuit to flow. The bulb was on. The learners felt that they would be able to show others how a circuit works."*

T3, Phase 2 wrote the following:

In conclusion learners were better off in understanding given a chance to apply the information they had into practice. Secondly they were better off to do tasks as groups because if one learner understands/can remember he/she can remind the others of what was said before. Learners can also remember what the other learner was saying in the group discussion than working alone. (Appendix 20)

These comments fit well with the comment of the same teacher in Phase One which implied that the learners understood working with the circuit boards better than when the teacher talked alone and just wrote on the board (Appendix 12.2).

4.3.3.4 *Do practical activities involving electrical circuit boards in grade 8 enhance learning?*

This is a difficult question to answer and one can only surmise in the light of the evidence generated that involving learners in practical activities with electrical circuit boards does enhance learning.

Much of what has been written in this chapter is premised on observation documented through written, audio and video recording. To further validate the possible conclusions that could be arrived at was the involvement of two different focus groups observed during two separate sessions approximately one year apart. The engagement of the second focus group in individual one-on-one semi-structured interviews was a further attempt to seek a reasonable answer to the question. The content-based questions of the semi-structured interview provide a likely conclusion that the enhancement of learning occurred.

It should be noted that this interview was designed to provide for further clarity in respect of the research questions and the questions therefore were deliberate in soliciting a reasonably clear response. I have alluded to the responses to questions 3 and 4 of the interview in section 4.3.3.3 above (See Table 6). Questions 1 and 2 were content or knowledge-based and in particular anticipated a test of memory.

Two presentation methodologies were employed to teach subject matter involving electricity concepts in the syllabus for grade 8. The one lesson, which for the purpose of this thesis I will call Lesson A was conducted during school hours and taught to a whole class in a 'positivist' fashion. The information was taught in a traditional lecture type manner where the learners had to listen and take notes. The second lesson, which I call Lesson B was the practical involvement of a group of learners using an easy electrical circuit board. These sessions were conducted outside school hours and served as Phase Two for this research.

Particular note should be taken of the time-lapse between the two sessions, Lesson A and Lesson B and the time when the semi-structured interview was conducted. Lesson A was conducted on Tuesday 01 November 2011 which translates to approximately 37 days before the interview which happened on 08 December 2011. Lesson B was conducted over three sessions, that is, 06, 07 and 08 September 2011. This was approximately 3 months before the interview.

This table represents some of the responses to the content questions.

Table 7 *Some of the responses to the content questions.*

LEARNER	Response to Lesson A	Response to lesson B	Reference
1	Ek onthou meneer	Daar ook van...ons het die stroombaan. Ons het daar aan gewerk. Uhm die eerste een. Ons het die twee selle aangesit. Een by die negatiewe kante en een by die positiewe kante. Toe sit ons die geleidingsterminale aan van die battery af na die skakelaar toe van die skakelaar af na die gloeilamp toe dan af na die sel toe.	<u>Appendix 21.1</u>
Free Translation	I remember sir	Also of that...we did the circuit. We worked thereon. Uhm, the first one. We put the two cells in. One at the negative side and one at the positive side. Then we connected the terminals from the battery to the switch and from the switch to the bulb and then to the cell.	

This learner could remember content from both lessons but clearly could respond in much more detail to Lesson 2. I noted that in general that the learner had a reasonably retentive memory. I also noted that the learner could relate to the lesson in class and remember what was said in that context only. For example, she said that the parallel connection had three separate circuits.

This was an example that I used on the chalkboard. She could only apply her understanding to this example and for that matter did not understand the concept of parallel connections. When asked about the work she did in the practical lesson, she was able to vividly explain how to wire a circuit. The overall impression gained was that she understood the practical lesson better than Lesson A.

LEARNER	Response to Lesson A	Response to lesson B	Reference
2	Nee meneer.	Die of skakelaars. As jy die een skakelaar afsit is die gloeilamp af en die ander een aan.	<u>Appendix 21.2</u>
Free Translation	No sir.	The OR-switch. If you switch off the switch the bulb will be off and the other one still on.	

L2 could not remember content of Lesson 1. I had asked probing questions to stimulate recall to little avail. Her responses to Lesson 2 were more accurate. I was reasonably impressed with her responses to probing questions in respect of Lesson B. My overall impression was that she understood Lesson B better because according to her, "We did it practically."

LEARNER	Response to Lesson A	Response to lesson B	Reference
3	Ja meneer Dat die by die paprallel daar is drie verskillende goete. Elkeen het sy eie	Dat daar drie soorte logikas is.	<u>Appendix 21.3</u>

	stroombaan.		
Free Translation		There are three types of Logic	

This learner could remember both lessons reasonably well. He was also one of those who could recall information and he responded extremely well to content questions related to Lesson A. Despite this, he indicated that he preferred Lesson B because they were allowed to do things for themselves. He advised that teachers should use practical activities to teach because it was better in his opinion.

LEARNER	Response to Lesson A	Response to lesson B	Reference
4	Ja meneer Parallel het twee stroombane en series het drie stroombane.	Ons het geleer hoe om 'n ...hoe twee terminale, twee skakelaars te gebruik om 'n gloeilamp aan te sit en ons het nuwe woorde geleer. Ons het ook geleer van geleidingsterminale en van en logika en of logika.	<u>Appendix 21.4</u>
Free Translation		We have learnt how to...how two terminals, to use two switches to get a bulb to work and we learnt new words. We have also learnt of terminals and of AND-Logic and OR-Logic.	

Although this learner was comfortable with Lesson A, there were a few misunderstandings. What she could remember of Lesson B was most impressive. As in the case of Learner 1, this learner understood the examples I drew on the chalkboard. To her those were the only examples of parallel and series connections she could remember. She did not really understand what it meant but could respond to questions based on the examples given.

With Lesson B, however, she exposed a better conceptual understanding of the circuits we worked with. She was able to express herself in the new terminology they claimed they were not familiar with and she attributed this to the fact that they were afforded an opportunity to work on the boards practically.

LEARNER	Response to Lesson A	Response to lesson B	Reference
5	Nee meneer.	Ons het die draad na die bulb toe gevat meneer en na die skakelaar toe. En van die skakelaar af toets ons dit na die sel toe meneer en toe toets ons hom uit.	<u>Appendix 21.5</u>
Free Translation		We took the wire to the bulb sir and to the switch. And from the switch we tested it to the cell sir. And then we tested it out.	

This learner could not remember content of Lesson A well. He was, however, in a position to respond adequately to questions in respect of Lesson B. The response to questions related to Lesson A were treated with an uncomfortable silence. After some prodding the learner responded. When asked questions about the second lesson his eyes lit up. What was of significance to me was his reference to 'testing the circuit'. This boy experienced the whole exercise as one of testing whether things would work.

This in a sense lies at the centre of the activity. Trying out scenarios, coming to conclusions and predicting what could or would happen if a certain course was taken. This comes very close to the concept espoused by Maselwa and Ngcoza (2003:650) of Predict-Explain-Explore-Observe-Explain (Section 2.4.3).

LEARNER	Response to Lesson A	Response to lesson B	Reference

6	Ek het vergeet meneer.	Ja meneer. Ons het van daai stroomborde gepraat meneer. Ons moen die...die uhm ...die terminale en die goeters so vas aan mekaar maak meneer sodat die gloeilampie ken gloei meneer.	<u>Appendix 21.6</u>
Free Translation		Yes sir. We have talked about those circuit boards. We had to...the uhm...the terminals and the things had to be attached to each other so that the bulb could glow sir.	

This learner could not remember Lesson A, but was extremely enthusiastic in his responses to aspects of Lesson B. This learner was very proactive during the practical session. He was the one who actually did the wiring on the cues of the group members. From my personal experience in respect of theoretical knowledge required for class tests, he is not one of the better learners in that respect. Despite this, he really seemed to excel during the practical sessions.

The rest of the group members allowed him to lead the practical activity and on occasions he became so confident that he even tested the knowledge of the group. He is L2 in Appendix 22.2. If the proceedings of this session are followed up to speech turn 17, it becomes clear that he was directing the proceedings. He was the one who refused to give up when they appeared to have reached a stalemate (See Appendix 22.1, speech turns 112 and 113). Teacher1, "Lyk my julle gee nou op." *Freely translated, "It looks to me like you are now giving up."*

Learner 2, "Nog nie meneer." *Freely translated, "Not yet sir."*

Of all the learners in the study group he comes closest to what Lave (1988:22) has to say about apprentices, "(they), "...learn to think, argue, act, and interact in increasingly knowledgeable ways with people who do something well, by doing it with them as legitimate, peripheral participants" (Section 2.4.1 above).

The overall impression gained was that the learners were more familiar with the content or knowledge aspects of Lesson B even though this work was done three months earlier. It would be reasonable to suggest that they remembered as well as understood Lesson B better. Most of them

indicated that they would be in a position to share this information with the rest of their peers. Meaning that they would be able to show other learners how to wire an easy electrical board and explain what is meant by AND-LOGIC and OR-LOGIC.

According to Vygotsky (1978), what learners do with the help of other people, they can do alone later. When learners are given the opportunity to discover the connection between what they learn in the classroom and real life and apply the knowledge they gain in a way that they can adapt it to their everyday lives, learning is taking place. Learners involved in practical activities become more advanced than those who are not.

The responses of the learners during the semi-structured interviews as well as in the notes revealed reasonable evidence too of what Hinchey (1998: 52) suggested when she wrote, "In most cases, individual student writing and talk, rather than tests, signal to the teacher whether learning has occurred" (Section 4.2.4 above).

The following extract from the transcription of day 1 of Phase Two is an example of how learners were able to express what they had learnt verbally (Appendix 22.1, speech turns 144 to 156).

Teacher: Nou goed. Haal alles af en kyk kan julle hom van voor af aanmekaar kan sit. En gesels maar. Se vir wie –ever, wie gaan wat doen. Wie gaan die werk doen daarso. *Freely translated, "Well, take everything off. See if you can put this thing back together from scratch. Say who is going to do what. Who is going to do the work?"*

Learner: Lloyd.

Teacher: Wie gaan vir Lloyd se wat hy moet doen? *Freely translated, "Who is going to tell Lloyd what to do?"*

Learner: Liezl

Teacher: Hy moet luister. Liezl se vir Lloyd wat hy moet maak. *Freely translated, He must listen. Liezl, tell Lloyd what he should do."*

L1: Eerstens moet hy die kleintjie vat. Geleidingsdraad. Dan vat jy weer een soontoe. (Pointing) Sit hom by die skakelaar. Dan die ene. *Freely translated, He must first take the small one. A terminal. Then he takes it there to the switch. That one.*

L2: Na die...*Freely translated, "To the..."*

L4: Gloeilamp toe. *Freely translated, "To the bulb."*

L1: Dan vat jy nou weer een van hiervan af. (Pointing)*Freely translated, "Then you take it from here."*

L4: Van die gloeilamp af, terug na die selle toe. (The bulb is on) *Freely translated, "From the bulb back to the cells."*

Teacher: uh um. Nou elkeen van julle soos julle hier staan, sal julle vir iemand in die klas kan verduidelik hoe om dit te doen? *Freely translated, "Now everyone of you standing here, will you be able to explain to somebody in the class how to do this?"*

Learners: Ja meneer. *Freely translated, Yes sir."*

The data generated in this study points to a huge amount of learner interaction which would not have happened in a traditional classroom. A very crucial aspect to note is that this interaction happened primarily in language. This is a phenomenon that Hodson and Hodson (1998:22) refer to as, "... the shifting of emphasis from language as an instrument of teaching to language as a means of learning, and a tool of thinking" (Section 2.4.3 above).

This provides yet another excellent learning opportunity. Generally speaking, learners are only given the opportunity to talk about what they are learning when questions are asked by the teacher. This may suggest that the only time any particular learner talks about academic content would be at the request of the teacher. Hence, engaging learners in practical activities allows them to freely communicate within their groups. This means that learners get the opportunity to engage not only with actual instruments but also with the terminology of the subject and in this sense use language as a 'means of learning and a tool of thinking'.

4.4 Conclusion

This journey proved quite a challenging exercise and throughout the process I had to be mindful of the fact that I was dealing with qualitative data. It was not the intention to derive conclusive evidence from the findings, but rather to give the reader a glimpse of what was happening within the groups busy with practical activities involving electrical circuit boards.

I have thus tried to provide the reader with a lens for viewing the phenomenon under study in the context of my research questions. It is hoped that conclusions or suggestions in respect of the value of practical activities in Science and Technology related lessons have emerged from the exercise and that teachers in general will seriously consider not under-estimating the value of practical tasks in the classroom.

The next chapter contains critical remarks concerning my findings as well as a few recommendations for future research regarding the use of practical tasks as a methodology for teaching and learning.

CHAPTER FIVE

CONCLUDING RECOMMENDATIONS AND CRITICAL REFLECTIONS

5.1. *Summary of the research process*

5.1.1 *Phase 1*

Phase One of my research was conducted over three sessions in 2010. The dates were 20 October, 27 October and 08 November. I solicited the assistance of the two observer teachers to identify a focus group of six learners as well as at least three extra groups to make up a class that we could work with in the first phase of my study.

The group of six learners in my focus group was made up of 5 girls and 1 boy who ranged between the ages of 13 and 15 and they had attended three different primary schools before they came to my school. Five of them were Afrikaans First Language speakers but they all have been taught in Afrikaans since Grade R.

My main data gathering tools were audio and Video recordings, notebooks kept by learners in the focus group and observation notes kept by the two observer teachers. In order to filter the information gathered I used the analytical strategy described by Schmidt (2004:253) as a guide. This entailed a first stage of forming analytical categories, a second stage of assembling the analytical categories into a guide for analysis and coding and a third phase of coding the material in which the material was classified into the analytic categories. In the fourth stage a table of frequency in respect of the data was drawn up and in the fifth stage I tried to interpret the data as best as I could.

After this process I was able to construct a set of preliminary conclusions.

5.1.2 Phase 2

For this session I used a focus group without the other groups because my experience in Phase One revealed a tendency among the children to compete which resulted in some of the learners just connecting wires to see a result without having thought their actions through. Using one group also assisted in concentrating the focus of the observers.

This group was made up of three boys and three girls all aged 14. They had also attended three different primary schools the previous year and like the learners in the first phase of this study had different levels of prior understanding of electricity as prescribed in the syllabus for grade 7 in the GET Phase of the RNCS. They were all Afrikaans First Language speakers taught in their mother tongue.

In both phases I focussed on the Afrikaans language group because I agree with Benson (2004:2) that, “While there are many factors involved in delivering quality basic education, language is clearly the key to communication and understanding in the classroom”. More was said in this regard in section 1.2 above.

After the transcription of the video and audio recordings, I once again numbered the data according to discernible sub-divisions by separating entries on a table according to speech turns or explanations of actions. My colleagues were then invited to watch the video footage and listen to the audio tapes to check the accuracy of my transcriptions.

I then used the same analytical categories and codes derived in Phase One to apply to this set of data. The rationale being that I needed to be consistent in the criteria I applied over the two phases.

The latest transcriptions were then checked for frequency using the codes reflected in Table 3.

In this phase I also used semi-structured interviews which were transcribed and the process resulted in expressing my findings as tangible conclusions.

5.2. *Critical Remarks*

The main goal of this research was to investigate the learning processes that take place during group work sessions involving practical work in electricity using circuit boards in grade 8. This was done in response to an announcement made by the honourable Minister of Basic Education, Mrs Angie Motshekga in which she announced the establishment of three committees to enable the streamlining of the current curriculum in South Africa. The Curriculum and Assessment Policy Statements (CAPS) Ministerial Projects Committee was tasked to develop a single, comprehensive and concise curriculum and assessment policy statement for each grade, R-12. It was anticipated that these curriculum and assessments should provide, "clear guidelines on what you ought to teach and assess on a grade-by-grade and subject basis." (Curriculum News, May 2010). This has in the interim become policy.

My concern is the possible reversion to earlier traditional teaching methods and the negation of constructivist methodologies. I therefore set out to investigate the learning that occurs during practical work activities, using the example of grade 8 learners working together on an electrical easy board as a case study. In the process of investigating my main question I also attempted to provide an opportunity to reflect on the extent to which group practical activities in electricity can improve understanding, what type of knowledge was constructed from learner talk and whether practical activities involving electrical circuit boards in grade 8 enhance the learners' understanding of concepts in electricity. This being a study of a qualitative nature made it difficult to emerge with a set of conclusive empirical evidence. Therefore it seeks to expose a particular instance, the case study, to closer scrutiny and providing thought – provoking material for consideration when engaging with lesson material in the CAPS being introduced in 2012.

One cannot overlook the apparent indicators that the learners in the two focus groups who engaged in practical activities using the easy electrical circuit board revealed. There is little doubt that the knowledge during these sessions was socially constructed (McRobbie & Tobin, 1997) and that practical activities involving electrical circuit boards in grade 8 enhance learning.

It has to be emphasised that the activities with the circuit boards need to be well – constructed and the teacher should have a reasonable understanding of the extent of his/her involvement or guidance during the lesson. My personal experience in this regard was an eye-opener. At times I

was tempted to provide solutions when I found the learners struggling. Patience in this regard was rewarded with the visible joy and pride of success when the learners finally managed to solve the problem with minimum intervention from the teachers.

It is this aspect of time to wait for learners to understand that might be compromised when the tempo and volume of subject content is going to be prescribed as appears to be the intention with the implementation of the CAPS.

It is unlikely that any study can be considered to have covered all possible aspects. There are a few things that I would have done differently should I embark on this topic again.

One of them would be the actual testing of learners for content knowledge, before and after intervention. This could be achieved through a questionnaire. I have alluded to the qualitative nature of this study and the difficulty of ascribing quantitative values to data generated through observation.

A baseline knowledge test would also not be out of place. This is based on my experience of the learners coming from different primary schools with different levels of prior knowledge (Roschelle, 1995). Such a test would have given me an opportunity to establish where the learners were at in respect of the syllabus and indicate aspects needing fine tuning or introduction to the manipulation of equipment that learners may not be familiar with.

5.3. Concluding recommendations

There is no doubt that the CAPS will provide a clear direction to teachers and standardization might improve the quality of our education. There would, however, still be room for constructivist teaching methods and practical work can play a meaningful role in teaching science. Teachers should not neglect practical demonstrations or activities to enhance conceptual understanding as there appears to be ample reason to believe that practical activities can assist in forming future individuals, “who are capable of production and creativity and not simply repetition (Piaget, 1978:20).

Hinchev’s (1998) constructivist view on education suggests that learners are able to interpret information and should be taught in a way where they can apply what they have learnt to

different situations instead of being able to recite facts without really making any sense of them. She supports constructivism and believes that learning takes place when a learner is able to use what they learn to solve problems in a variety of contexts having the freedom to choose their own method to reach a solution instead of memorizing facts. Hinchey is not concerned with what learners learn but rather how they learn as long as they can justify their perceptions.

CAPS will be specific in the 'what' learners need to know on a grade by grade basis. It is, however, the 'how' part of what they will learn that is of concern. The CAPS document is not much more than a syllabus, which can be described as a specific learning programme. It is how we as teachers are going to mediate this document to our learners that matters.

Vygotsky situated instruction "at the heart of cognitive development" and emphasized "the central role of the teacher or mediator in 'leading' development through "collaborative activity" (Lunt, 1993). It is therefore going to be crucial that we do not lose sight of what the DoE was hoping constructivist teaching methods would achieve for South Africa. What Moll (2002:5) describe as, "... the teaching and learning solutions called for by OBE in South African schools".

Teachers should continue to interrogate their teaching practice.

The discourse of education, we want to argue, is more likely to be descriptive and normative, whereas pedagogy invites us to recognize the multiple and various dynamics of scenes of learning and teaching (Leach & Moon, 2008:4).

As far as I am concerned the problem we have is more closely related to the manner in which we teach than what we teach. My case studies seem to confirm that practical work activities could play a major role in facilitating understanding and therefore should continue to be considered a "good thing", Gott and Duggan (1996: 791).

Another area of concern is language. Here I am referring to the language in its widest possible context. For the vast majority of the learners at my school, the language of learning and teaching (LoLT) is not the same as their home language or mother-tongue. This state of affairs has its own ramifications which I have alluded to in section 1.2 above.

The role of language and the learners' ability to meaningfully participate in lessons is also an area of concern. In order for learners to derive maximum benefit from learning situations they need to do so in a language they are most comfortable with.

In my study it became evident that even though I opted to work with a home language group in its truest sense as far as my school is concerned, there were learners at grade 8 level who were still not adequately empowered to reason in their mother-tongue. Here I speak of two types of language. On the one hand, I am referring to adequate vocabulary to articulate the view the learner wishes to convey and on the hand I am referring to subject vocabulary (terminology).

5.4 Conclusion

This thesis confirms that involving learners in practical tasks can have definite advantages provided these tasks are selected carefully and have a clear purpose in mind (Gott and Duggan, 1996:791). It further provides reasonable evidence that practical activities need time for learners to actually engage in group practical work in a meaningful manner.

It can therefore be argued that the introduction of the CAPS in an attempt to improve the quality of education in the country may have quite the opposite effect if not approached with circumspection. This assumption is based on the possibility that teachers may revert to teaching methods where covering aspects contained in the syllabus becomes more important than learners' understanding because of set time –frames in which the work has to be done in.

McTighe and O' Connor (2005:11) argue that "emphasis on established content standards has focused teaching on designated knowledge and skills" and therefore teachers need to "avoid the danger of viewing the standards and benchmarks as inert content to 'cover'..." As teachers we need to continue to recognise the value that practical work in the science classroom can add to our teaching practise and not simply engage in covering the syllabus.

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APPENDICES

APPENDIX 1: Copy of letter from supervisor



RHODES UNIVERSITY

Grahamstown • 6140 • South Africa

EDUCATION DEPARTMENT ● Tel: (046) 603 8610 ● Fax: (046) 622 8028 ● e-mail: K.Ngcoza@ru.ac.za

04 October 2010

TO WHOM IT CONCERNS

This serves to confirm that Mr Gerald Accom (Student Number 87A 2448) is a part-time student in the Education Faculty of Rhodes University, Grahamstown. He is currently enrolled for a Masters degree in Science education and is undertaking a research project in the teaching of electricity in the GET phase as prescribed in the National Curriculum Statement Grades R-9 (schools) policy in part fulfillment of the requirements for the degree.

This project is being undertaken under my supervision. Both Mr Accom and I are bound by the code of ethical conduct prescribed by Rhodes University.

I would be happy to answer any queries you may have concerning the research project.

Yours faithfully

Dr. K. N Ngcoza

E-Mail: K.Ngcoza@ru.ac.za

Tel: (046) 603-8383

Fax: (046) 622-8028

APPENDIX 2: Copy of letter of consent to school principal

35 Middle Terrace
Grahamstown
6139
04 October 2010

The Principal
Mr. S. C. Wessels
Mary Waters High School
Lavender Valley
Grahamstown
6139

Dear Sir

I am currently enrolled for a Masters degree in Science education at Rhodes University Grahamstown. My primary area of interest lies in the teaching of electricity in the GET phase as prescribed in the National Curriculum Statement Grades R-9 (schools) policy.

Motivation for researching this topic is born from personal experience and a genuine desire to assist teachers who are also having difficulty in teaching this relatively new and exciting component of both the Natural Science as well as Technology learning areas.

I wish to beg your permission to allow me to conduct this research with selected learners from the Afrikaans Home language classes in grade 8. It is anticipated that all the participants will gain valuable insight and in the process become co-authors of e-lessons for electricity in grade 8.

I will also be seeking the cooperation and support of the two teachers who are teaching technology in grade 8.

During my research which will be conducted over 2010 and 2011 I undertake to ensure the following:

- Protection of participants from harm
- Informed consent from all relevant instances:
 - The participants
 - The parents of the participants
 - The teachers responsible for the subject in the school
- The right to privacy of all the participants and

Thanking you in anticipation

Yours truly

G. C. Accom

APPENDIX 3: Copy of letter of consent from school principal

MARY WATERS H.S

PER SCALUM SCIENTIAE

P.O. BOX 2124
GRAHAMSTOWN
6140



TEL: (046) 636 1690
FAX: (046) 622 7191
06 October 2010

e-mail addresses: samuel.wessels@gmail.com
sam12@ubsamail.co.za

Dear Mr Acoom

It is my pleasure to inform you that you may conduct your proposed research project at the above-mentioned school on condition that you adhere to all the aspects you have highlighted in respect of the safety of the learners as well as the issues listed under informed consent.

I wish you success with your endeavours.

Yours truly

S.C. Wessels
(Principal)

A large, stylized handwritten signature in black ink, written over the typed name and title of the principal.

APPENDIX 4: Copy of letter to colleagues/co-researchers

35 Middle Terrace
Grahamstown
6139
11 October 2010

Dear Colleague

I am currently enrolled for a Masters degree in Science education at Rhodes University Grahamstown. My primary area of interest lies in the teaching of electricity in the GET phase as prescribed in the National Curriculum Statement Grades R-9 (schools) policy.

Motivation for researching this topic is born from personal experience and a genuine desire to assist teachers who are also having difficulty in teaching this relatively new and exciting component of both the Natural Science as well as Technology learning areas.

I wish to beg your assistance and would like to invite you to join me as co-researcher on this project. It is anticipated that all the participants will gain valuable insight and in the process become co-authors of e-lessons for electricity in grade 8.

I will be conducting lessons in electricity on the following afternoons from 14h00 to 15h00 and respectfully wish you to act as observers during the session.

Dates: Wednesday 20 October 2010
Wednesday 27 October 2010
Wednesday 03 November 2010

You will be required to do the following:

- Complete a questionnaire for profiling purposes
- Keep a written record of what you observe during the course of the lesson.
- Avail yourself to participate in semi-structured interviews.

These lesson sessions form a vital component of my research and I am totally dependent on your assistance in providing accurate responses to the questions posed as well as your observations.

All of the information you give me will be treated as completely confidential.

Besides making the results of this survey available to relevant authorities like the Department of Education and the Education Department at Rhodes University, you will be one of the first people to receive a copy.

I am totally committed to making this much more than an academic exercise and can assure you that, based on the results of the research, serious efforts will be made to foster initiatives in the Grahamstown District to enhance the teaching of electricity in grade 8.

Thanking you in anticipation

G. C. Accom
(Gerry)

APPENDIX 5: Copy of letter of consent to parents of learners

35 Middle Terrace
Grahamstown
6139
18 October 2010

Dear Sir/Madam

I am currently enrolled for a Masters degree in Science education at Rhodes University Grahamstown. My primary area of interest lies in the teaching of electricity in the GET phase as prescribed in the National Curriculum Statement Grades R-9 (schools) policy.

My research seeks to highlight the importance of practical activities in class and for that reason I need to observe a group of six learners for three lessons over three weeks. This observation will involve audio and video recording of learners doing practical work with electricity boards. These boards operate from 3v batteries and are completely safe.

Your son/daughter will also be expected to keep a journal of their experience, complete questionnaires and participate in semi-structured interviews as part of my data gathering.

All of the information gathered will be treated as completely confidential.

Kindly be advised that you may withdraw your child from the project at any time for any reason that suits you.

Dates: Wednesday 20 October 2010, Wednesday 27 October 2010 and Wednesday 03 November 2010. (Times: lessons will be after school from 14h00 to 15h00)

Thanking you in anticipation

G. C. Accom

REPLY SLIP (Please detach and return by Tuesday 19 October 2010)

----- Cut here -----

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I _____ as
(Full names of parent/guardian)
parent/legal guardian of _____ have
(Full names of child)

read and understood the contents of the letter dated 12 October 2010 from Mr G. C. Accom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

(Signature of parent/guardian)

Date: _____

Cut here

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I ABECAIL FLEURS as
(Full names of parent/guardian)

parent/legal guardian of LEREEN SZE have
(Full names of child)

read and understood the contents of the letter dated 12 October 2010 from Mr G. C. Acoom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

Fleura
(Signature of parent/guardian)

Date: 12/10/10

Cut here

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I MAGDELENE JORDAN as
(Full names of parent/guardian)

parent/legal guardian of Danielle Denis have
(Full names of child)

read and understood the contents of the letter dated 12 October 2010 from Mr G. C. Acoom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

MJD
(Signature of parent/guardian)

Date: 14/10/10

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I Lucile Davenia Fouse as
(Full names of parent/guardian)

parent/legal guardian of Luchanda Fouse have
(Full names of child)

read and understood the contents of the letter dated 12 October 2010 from Mr G. C. Acoom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

Fouse
(Signature of parent/guardian)

Date: 18/10/2010

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I LINDISA COSA as
(Full names of parent/guardian)

parent/legal guardian of OTHAN DAVINO ACITA COSA have
(Full names of child)

read and understood the contents of the letter dated 12 October 2010 from Mr G. C. Acoom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

Linda
(Signature of parent/guardian)

Date: 20/10/10

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I GERALD MEINTJIES as
(Full names of parent/guardian)

parent/legal guardian of ROWAN MEINTJIES have
(Full names of child)

read and understood the contents of the letter dated 12 October 2010 from Mr G. C. Accorn regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

[Signature]
(Signature of parent/guardian)

Date: 14/10/2010

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I AGERAH HOPSHIRE as
(Full names of parent/guardian)

parent/legal guardian of SAVADENA NICOLE HOPSHIRE have
(Full names of child)

read and understood the contents of the letter dated 12 October 2010 from Mr G. C. Accorn regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

[Signature]
(Signature of parent/guardian)

Date: 14/10/10

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I CHEYL as
(Full names of parent/guardian)

parent/legal guardian of JAMIE LEE have
(Full names of child)

read and understood the contents of the letter dated 31 August 2011 from Mr G. C. Accom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

[Signature]
(Signature of parent/guardian)

Date: 2-9-2011

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I IMROCKLINE DAN HENCKELS as
(Full names of parent/guardian)

parent/legal guardian of NEVERON SIZR have
(Full names of child)

read and understood the contents of the letter dated 31 August 2011 from Mr G. C. Accom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

[Signature]
(Signature of parent/guardian)

Date: 21 08 2011

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I Rosaline Boesak as
(Full names of parent/guardian)

parent/legal guardian of Vinchesto Holster have
(Full names of child)

read and understood the contents of the letter dated 31 August 2011 from Mr G. C. Accom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

Rosaline Boesak
(Signature of parent/guardian)

Date: 31 August 2011

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I LIZZIE JACOBS as
(Full names of parent/guardian)

parent/legal guardian of LIEZEL JACOBS have
(Full names of child)

read and understood the contents of the letter dated 31 August 2011 from Mr G. C. Accom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

L. Jacobs
(Signature of parent/guardian)

Date: 2-09-11

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I AMANDA MEINTJES as
(Full names of parent/guardian)

parent/legal guardian of LLOYD have
(Full names of child)

read and understood the contents of the letter dated 31 August 2011 from Mr G. C. Accom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

[Signature]
(Signature of parent/guardian)

Date: _____

073 5358417

CONSENT FORM

To Whom It May Concern:

Dear Sir/Madam

This serves to confirm that I S. Minboer as
(Full names of parent/guardian)

parent/legal guardian of Janeve Minboer have
(Full names of child)

read and understood the contents of the letter dated 31 August 2011 from Mr G. C. Accom regarding my child's participation in his research project and wish to grant my permission.

Yours truly,

S. Minboer
(Signature of parent/guardian)

Date: 01.09.2011

APPENDIX 8.1: Copies of questionnaires to focus group

QUESTIONNAIRE – Learner Profile

Please respond to all of the following questions by putting a cross (X) in the box provided or by writing your own response.

DATE: _____

PERSONAL DETAILS:

1	GENDER	Male		Female	
----------	---------------	------	--	--------	--

2	Your AGE GROUP	
----------	-----------------------	--

3	What is your home language?	
----------	-----------------------------	--

4	If you can speak more than one language, rank them in the next block by placing the one you use most at the top and the one you speak the least at the bottom	Language I speak the most	RANKING Number
		A	
		B	
		C	
		D	

5	In what language are you taught at school?	
6	In which grade are you?	
7	Is this your first year at this school?	
8	Which school did you attend last year? (2009)	

THANK YOU FOR YOUR TIME AND EFFORT!

APPENDIX 8.2: Summary of questionnaires to focus group Phase 1

QUESTIONNAIRE – Learner Profile (Summary)

Please respond to all of the following questions by putting a cross (X) in the box provided or by writing your own response.

DATE: 20 October 2010

PERSONAL DETAILS:

1	GENDER	Male	1	Female	5
2	Your AGE GROUP	13	14	15	
		1	3	1	
3	What is your home language?	Afrikaans	isiXhosa		
		5	1		
4	If you can speak more than one language, rank them in the next block by placing the one you use most at the top and the one you speak the least at the bottom	Language I speak the most		RANKING Number	
		A	Afrikaans	5	
		B	English		
		C	isiXhosa	1	
5	In what language are you taught at school?	Afrikaans x 6			
6	In which grade are you?	8A	8B	8C	
		2	3	1	
7	Is this your first year at this school?	YES			
8	Which school did you attend last year? (2009)	St Mary's Primary School	George Dickerson Primary school	Grahamstown Primary school	
		1	3	2	

APPENDIX 8.3: Summary of questionnaires to focus group Phase 2

QUESTIONNAIRE – Learner Profile (Summary)

Please respond to all of the following questions by putting a cross (X) in the box provided or by writing your own response.

DATE: 06 September 2011

PERSONAL DETAILS:

1	GENDER	Male	3	Female	3
----------	---------------	------	---	--------	---

2	Your AGE GROUP	14
		6

3	What is your home language?	Afrikaans
		6

4	If you can speak more than one language, rank them in the next block by placing the one you use most at the top and the one you speak the least at the bottom	Language I speak the most	RANKING Number
		A Afrikaans	6
		B English	5
		C isiXhosa	1
		D	

5	In what language are you taught at school?	Afrikaans x 6
----------	--------------------------------------------	---------------

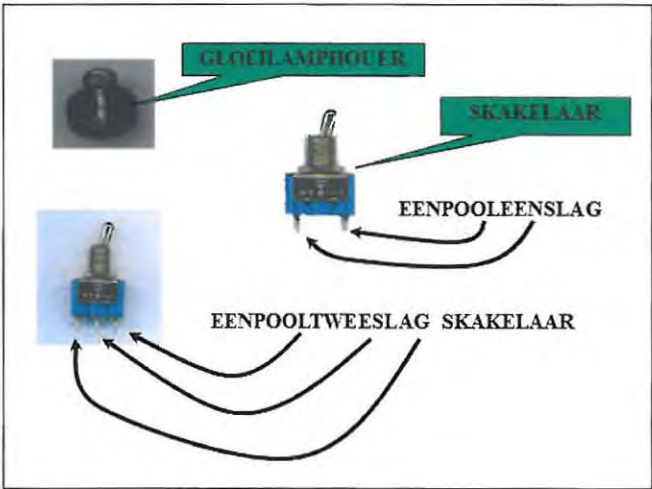
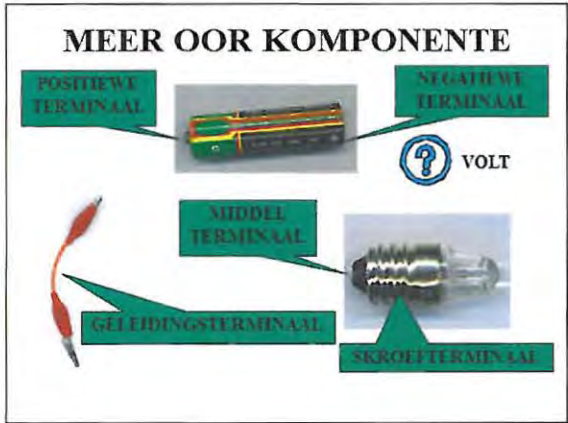
6	In which grade are you?	8A	8B
		3	3

7	Is this your first year at this school?	YES
----------	-----------------------------------------	-----

8	Which school did you attend last year? (2009)	St Mary's Primary School	George Dickerson Primary school	Grahamstown Primary school
		1	3	2

ELEKTRISITEIT

STROOMBANE



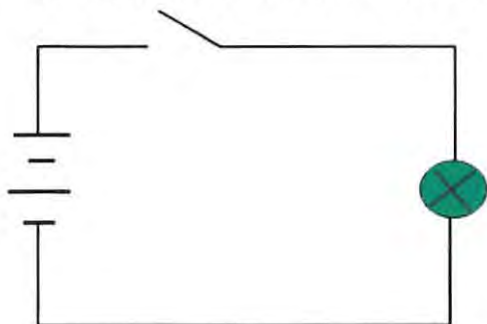
SIMBOLE

Suid-Afrikaanse standaardsimbole

- Tegnoloë in Suid-Afrika gebruik standaardsimbole in plaas van realistiese tekeninge van elektriese stroombane.
- 'n Stroombaandiagram toon elke komponent as 'n simbool.
- Dit kan vinnig geteken word, neem minder ruimte in beslag en is maklik verstaanbaar, selfs vir mense wat verskillende tale praat.

Komponent	Simbool
Gloelamp	
Gonsier	
Elektriese motor	
Skakelaar	
Sel, battery selk	
Terminaal	

STROOMBAANDIAGRAM



Probeer om die stroombaan wat julle in die diagram gesien het op julle stroombaanbord op te stel



TEKEN 'N STROOMBAANDIAGRAM IN JOU EIE WERKBOEK

HELP MEKAAR ASSEBLIEF!

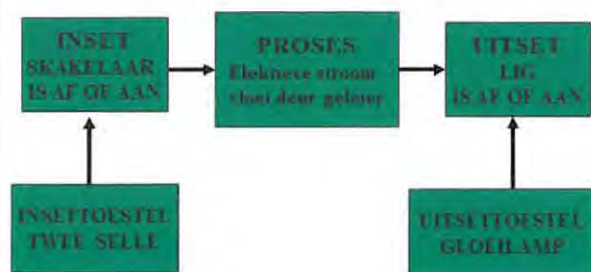


ELEKTRIESE STELSELDIAGRAMME

Soos enige stelsel, bestaan 'n elektriese stroombaan uit DRIE komponente.

1. Die INSET: wat die stelsel ingaan.
2. Die PROSES: hoe die inset na die uitset verander het.
3. Die UITSET: wat uit die stelsel uitkom.

'n STELSELDIAGRAM



WAT IS KONTROLE LOGIKA?

KONTROLE LOGIKA word gebruik om die UITSET te kontroleer of te beheer.

In die voorbeeld wat ons gebruik het, het ons gesien dat die stroombaan of die PROSES deur die skakelaar beheer was.

INSET	UITSET	WAARHEIDSTABELLE	
AF	AF	AF = 0	AAN = 1
AAN	AAN		
		INSET	UITSET
		0	0
		1	1

ELEKTRISITEIT

WAARHEIDSTABELLE

STROOMBORD

STROOMBAANDIAGRAM

'n STELSELDIAGRAM

WAT is KONTROLE LOGIKA?

In die voorbeeld wat ons gebruik het, het ons gesien dat die stroombaan of die PROSES deur die skakelaar beheer was.

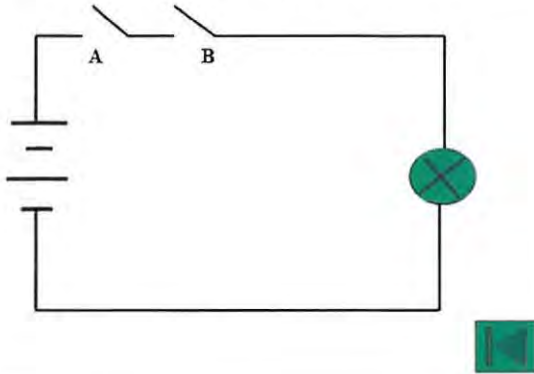
WAARHEIDSTABELLE

INSET	UITSET
AF	AF
AAN	AAN

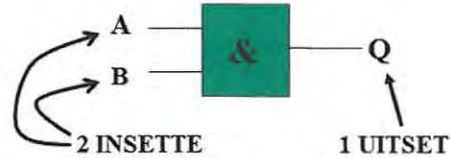
AF = 0 AAN = 1

INSET	UITSET
0	0
1	1

STROOMBAANDIAGRAM



SIMBOOL vir En-Logika
kan ook
En-deurlaat genoem word.

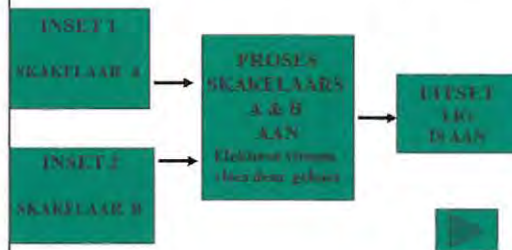


Probeer om die stroombaan wat
julle in die diagram gesien het op
julle stroombaanbord op te stel

TEKEN DIE
STROOMBAANDIAGRAM
IN JOU EIE WERKBOEK



STELSELDIAGRAM



WAARHEIDSTABEL

Skakelaar A	Skakelaar B	Gloeilamp
0	0	
0	1	
1	0	
1	1	

Kyk na die volgende voorbeelde.



Kan julle aan nog toestelle dink
wat met en-logika werk?

TEKEN 'n
STELSELDIAGRAM van EEN
van die toestelle waaraan julle
groep gedink het.



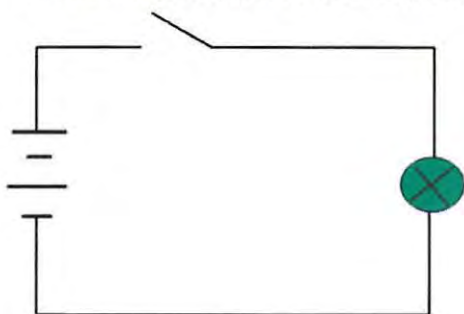
APPENDIX 9.3: Copy of lesson taught on DAY THREE during Phases 1&2

ELEKTRISITEIT

OF - LOGIKA



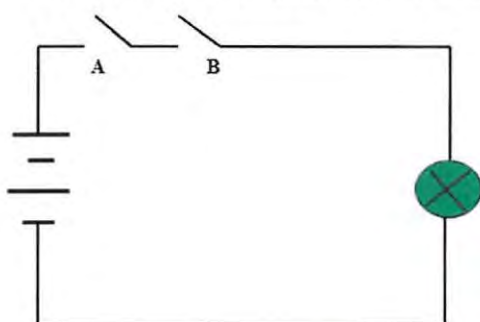
STROOMBAANDIAGRAM



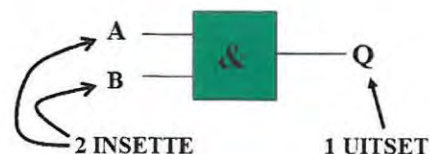
'n STELSELDIAGRAM



STROOMBAANDIAGRAM



SIMBOOL vir En-Logika kan ook En-deurlaat genoem word.



STELSELDIAGRAM



OF-LOGIKA

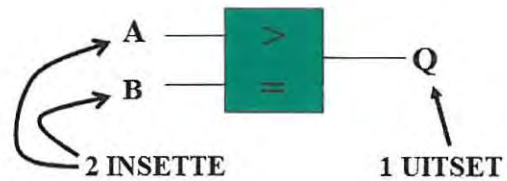
IN HIERDIE STROOMBAAN GAAN ONS WEER TWEE SKAKELAARS GEBRUIK, MAAR.....

HIERDIE KEER MOET DIE LIG GAAN WANNEER DIE EEN SKAKELAAR **OF** DIE ANDER SKAKELAAR AANGESKAKEL WORD.

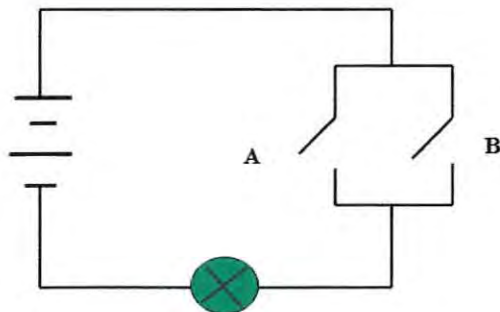
SKAKELAAR A **OF** SKAKELAAR B



SIMBOOL vir OF-Logika kan ook OF-deurlaat genoem word.



STROOMBAANDIAGRAM



WAARHEIDSTABEL

SKAKELAAR A	SKAKELAAR B	LIG
0	0	
0	1	
1	0	
1	1	

VOORBEELDE

1. BED SKAKELAAR
2. KLOKKIE BY VOOR OF AGTERHEK
3. LIG - SENSITIEWE SKAKELAAR
4. TEMPERATUUR - SENSITIEWE SKAKELAAR
5. SKAKELAAR WAT SENSITIEF IS VIR VOG OF KLAMMIGHEID
6. SKAKELAAR BY DIE TRAPPE LANGS BIBLIOTEEK

APPENDIX 10.1 Transcript of audio and video on day 1. (20 October 2010)

INTRODUCTION

This is a transcript of the video and audio recording done on 20 October 2010. The video camera was focussed on the table where the focus group worked. Because the camera was mounted on a stand it was directed at the Circuit board on the table. It is not possible to distinguish faces of the learners but with the help of my two observer teachers we were able to identify the learners who were involved. The learners are called L1, L2 etc. and the teachers are labelled T1, T2 etc.

NO	TRANSCRIPT	
1	T1: Reg julle is nou besig om daar in te draai ne?. Praat, praat as daar 'n problem is.	1,5
2	G2: Gaan weer trug, vat hom stadig.	1,2
3	T2: Kom julle reg?	1,2
4	L's: Ja meneer	5, 2
5	T1: Goed. Hie gaan ons aan. O! wat is sy naam? (Pointing to a slide on the OHP)	5, 4
6	L's: Skakelaar	1,
7	T1 Ek will he julle moet baie, baie mooi luister nou, want daar is iets hierso, se daai woord. (Pointing to a word on the OHP slide)	5
8	L's: Een pool eenslag. Maar as ek na die skakelaar kyk julle, sien ek hy het twee voetjies. (Pointing to the picture on the OHP) Kan julle dit raaksien?	1, 2
9	L's: Ja meneer	1
10	T1: Op daai bord. As jy mooi kyk op daai bord, dan gaan jy sien, daar by die een skakelaar is daar twee terminale en by die die ander skakelaars is daar drie terminale. (Pointing to picture on the OHP slide) Kan jy sien?	1,5,4
11	L's: Ja meneer. (At this point the learners in the group moved their fingers to the components identified)	1, 2
12	T1: Het julle dit raakgesien?	1
13	L's: Ja meneer.	1
14	T1: Nou wil ek weet, wys my 'n bietjie, watter van daai drie skakelaars is, daar is mos drie skakelaars, watter ene is 'n een pool een slag skakelaar? Hy het net twee terminale. (At this point the learners looked at the board in front of them and were able to identify the switch) Nou julle, daai ene, die een pool een slag skakelaar, skakel aan en hy skakel af. (It is possible hear some of the learners anticipating what the teacher is saying and then completing some of his sentences) Hy skakel aan en hy skakel af. Soos hierdie een hierso, hy skakel aan en hy skakel af. (Pointing to device) Maar jy kry ook hierdie outjie. (In the background one learner is saying, "Drie terminale")...wat is sy naam?	5, 1,2, 3
15	L's: Een pool een slag skakelaar. (Teacher points to term on the OHP slide)	2

16	T1:	En wat sien ons by hom?	5
17	L's:	Drie terminale.	1
18	T1:	Hy het drie terminale...Nou hierdie ding. (Pointing to switch on picture on slide) as hy diekant toe wys, wag wag, laat ek nou eers vra, wys 'n bietjie vir my op daai bord, waar is die een pool een slag skakelaar.	5,1
19	G2:	Hiesy, die ene. (This learner pointed to the single pole double throw switch, SPDT but is quickly corrected by the group.) Die ene...(Now pointing to the single pole single throw switch SPST.	1,3,2
20	T1:	Die ene...hoekom se jy so?	5,2
21	G1:	Want hy skakel aan en hy skakel af.	1,2
22	G2:	En die een is die een met die drie terminale. (Pointing to the SPDT switch)	1
23	T1:	(Repeats) Die een het drie terminale en die een het twee terminale. Nou goed. Die ene wat die drie terminale het, hy skakel nie af nie. (Teacher demonstrates on chalkboard) As hy diekant toe gaan dan is hy aan en as jy hom daaikant vat is hy ook aan, maar dan is hy op 'n ander stroom. Ne. So wanneer jy die een ding afskakel dan skakel jy die ander ding af...Nee, praat ek nou verkeerd...As jy die een ding afskakel dan skakel jy iets anders aan. (Learners help to correct teacher) So as jy miskien twee ligte het, As jy die skakelaar diekant bring dan skakel jy die kant se lig aan. As jy die skakelaar daaikant toe vat skakel jy daaikantse lig aan. Dis hoe hy werk. Ne. Hy is een pool tweeslag en die ander een is een pool een slag. (learners are now chorusing the completion of the teacher's sentences before has finished talking.) nou wat doen die Een pool een slag skakelaar? Hy kan net wat doen?	5
24	L's:	Hy skakel aan en af.	1,2
25	T1:	Ja ons het hom. Ek weet hy is daar in die kop nou...Simbole...Nou julle...wat is die nut van simbole? Dink bietjie net. Hoekom gebruik mense simbole? Wat is die nut van simbole? Wat is 'n simbool. Se my 'n bietjie. Dink gou daaroor. Skinder onder mekaar. Wat is 'n simbool?	5
26	G3:	Se nou maar iemand het HIV. Dan is daar 'n simbool wat op hulle klere wys. 'n Teken.	2
27	T1:	is dit 'n teken?	5
28	G2:	'n Simbool is iets wat iets anders identifiseer soos miskien 'n gloeilamp, gebruik ons 'n sirkel met 'n kruis.	2,3
29	T1:	OK. En julle...julle het gese dit is 'n teken ne? (Ja meneer) so, Wat is nou so goed aan 'n teken? Kom ons se 'n simbool is soos jy se is 'n sirkel met 'n kruis binnekant...iemand het gese, is gelyk aan of 'n plus...julle het gese 'n +, wat nog? ¹⁰⁶	5, 2
30	G2:	minus	
31	T1:	Kom ons sit gou hierdie ene by...net vir die lekker. (T1 draws a stop sign on chalkboard) en dan gaan ek sommer die ene bysit. (T1 draws no-entry sign) Dit is rooi met wit. Nou al die goed is simbole. In watter	5

	drawing of stop sign) In watter taal is daai goed geskryf?	
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31	L's:	Simbole taal	3
32	T1:	Huh? Is dit Afrikaans, is dit Engels, is dit Chinees, is dit Xhosa, in watter taal is dit geskryf?	5
33	L's:	Simboliese taal	2
34	T1:	Wat is goed van simboliese taal? Ek dink amper ek het vir julle die antwoord gegee. Wat is goed van simboliese taal? Hoe help dit? Hierdie ding. (T1 draws a skull with two bones on the chalkboard) Het julle al so iets gesien?	5
35	L's:	gevaar...gevaar meneer	2,3
36	T1:	In watter taal is daai ding geskryf?	5
37	L's:	Simboliese taal	2,3
38	T1:	Simboliese taal. Nou se vir my. Sal dit moontlik wees vir iemand wat Xhosa verstaan om daai simbool te kan sien?	5
39	L's:	Ja meneer	2
40	T1:	Sal iemand wat 'n Chinees is daai ding kan verstaan?	5
41	L's:	Ja meneer	2,3
42	T1:	Sal iemand wat 'n Italianer is daai ding kan verstaan?	5
43	L's:	ja meneer	2,3
44	T1:	So wat is die nut van simboliese taal?	5
45	L's:	Almal kan dit verstaan.	2,3
46	T1:	Almal verstaan dit daarom gebruik ons dit. Daarom in plaas van te se is gelyk aan dan gebruik ons 'n simbool. (T1 writes = on chalkboard). Ons se vermenigvuldig maar ons gebruik 'n simbool (T1 draws x on chalkboard) Nou netso in elektrisiteit gebruik hulle ook simbole om dinge vir ons maklik te maak. Nou Suid- Afrika het hulle satandaardsimbole. Nou die tegnoloe hier in Suid-Afrika gebruik hierdie simbole in plaas van realistiese tekeninge. Nou almal kan mos nie so mooi teken nie. 'n Gloeilampie lyk mos miskien sso daai...(T1 draws a picture of a bulb on the chalkboard) Wat is nou makliker? (T1 draws the symbol for a bulb on the chalkboard) ...dit (pointing to the symbol) of dit...(Pointing to the drawing of the bulb)	5
47	L's:	Die onderste een. (L's agree that the symbol is easier to draw than the bulb)	2,3
48	T1:	T1 repeats the exercise by drawing a picture of a switch and the symbol of a switch)	5
49	T1:	Nou gaan ons 'n tabel het. Kom ons kyk...In 'n Stroombaandiagram word elke komponent...Wat is die komponente weer julle?	5
50	L2:	Alles wat op die bord is. (L2 pointing with fingers to components on circuit board in front of them.)	1,2,3
51	T1:	Ja, al daai los goedjies op die bord. Noem my 'n paar.	1,5
52	L's:	Sel, skakelaar, gloeilamp, terminale...	1,2,3

53	T1: Ja, vir al daai goed gaan ons nou gebruik nou simbole. Hoekom simbole? Want dit kan vining geteken word, dit neem minder ruimte in beslag en dit is maklik verstaanbaar. Se daar vir ons.	5
54	T1:Nou, daars hulle. (T1 shows slide with symbols and definitions) Vir die gloeilampie - 'n sirkel met 'n kruis. (T1 goes through the list in the table) Teacher then draws a circuit diagram on board and explains that it does not really matter in which direction or at what angles you find the wires and other components on the board, the circuit diagram is usually drawn in a rectangular shape.	5
55	L's: (T1 puts on OHP slide with notes and learners read.) Dit kan vining geteken word, neem minder ruimte in beslag en is maklik verstaanbaar, selfs deur mense wat verskillende tale praat.	1,2,3
56	T: Goed ons het hom. Ons gaan aan. 'n Stroombaandiagram. Wat is dit? Almal weet lyk dit vir my. (Teacher now draws another circuit diagram on the chalkboard. Learners talk him through the drawing. The learners identify each of the components as the teacher proceeds. Teacher comments and applaud as the drawing takes shape.) So lyk 'n stroombaandiagram. As ek vir julle vra om 'n stroombaandiagram te teken, dit is wat ek wil he.	1,2,3
57	T: Daai stroombaan wat ons nou oor gepraat het...kyk of jy hom aan mekaar kan sit. Learners start to tackle the board in all earnest. Focus group: About three of the learners have a cell in hand. Teacher reminds them what is needed. (Two cells, one switch and one bulb) the learners talk about positive and negative and fingers are pointing where the cells should be placed.	1,2,3,
58	G2: Een gloeilampie...moet ons uithaal. (she starts unscrewing one of the bulbs - many hands are moving across the board.)	1,2,3
59	G1: Die is die positiewe kant en die is die negatiewe kant. Daai een kan daa in. O ...soos die.	1,2,3
60	G2: Hie is 'n lang een. The learners in focus group experience problems connecting their circuit. T1 approaches. They manage to get it right without his intervention.	1,2,3

61	G1: Ons moet die ene daar sit.	1,2,3
62	G2: Nee nog nie. Ons moet eers van hier af hiernatoe gaan. (Pointing on circuit board)	1,2,3
63	G1: O, OK sien jy.	1,2,3
64	G2: Is dit nie te kort nie. Vat die ene. Dan vat ons hom hievanaantaf tot hieso.	1,2,3
65	G1: Issie. Kyk hie. Die krag gaan mos deur die een dan gaan dit op in die draad en dan na die een. (Ponting at the CB as she's talking) ...en as dit hierso kom gaan dit in die skakelaar af hiernatoe.	1,2,3

66	G2: Vat die ene hiernatoe. (Now the learners try the switch but the bulb is not working)	1,2,3
67	G3: Issit nie omdat...traai 'n bietjie 'n langer een. (Suggesting a longer wire)	1,2,3
68	G2: Moet daar nie iets hier aan gaan nie? (Learners try the switch again...still no	1,2,3

69	G1: (Removes one of the wires) Wag...nou sien ek. Vat die ene dan vat jy hom daarnatoe. (They do as she says but still no response. Then she puts one of the wires removed back and they try the switch again. It works)	1,2,3
70	L's: Meneer! ...meneer	2,3
71	T1: Het julle hom.	5
72	L's: ja meneer	2,3
73	T1: Kom ons kyk, kom ons kyk. Verdudelik vir my at het julle gedoen. (Teacher asks learners to explain what they have done and everyone wants to talk at once. The whole group proudly proclaims a joint effort)	1,2,3

74	G2: Ons het die gevat meneer en hier voor gesit, en die ene van hier tot daar en die een hiernatoe omdat die twee moet soontoe gaan. (Showing with finger as she is talking)	1,2,3
75	T1: Nou wys my hoe loop die stroom?	1,5
76	G3: Die stroom begin hierso meneer en dan so deur. (Learner tracing the current with her finger from the cells, along the wire, through the switch, the bulb and back to the cells.)	1,2,3
77	T1: Daarsy...daasy. Het ons hom almal gekry? (Question is directed to the rest of the class)	5

	L's: ja meneer	2,3
79	T1: Nou kyk gou hieso. Teken daai ding wat jy nou opgestel. Teken hom nou.	5
80	(Each learner in the focus group is given a notebook in which to draw.)	
81	G2: My liniaal is in my sak. Moet 'n mens die ding teken?	2
82	G3: Jy het mos nou gesien op die bord. Ek teken hom netso.	2
83	T1 reminds the learners of the symbols. The drawing goes off relatively easy.	2
84	T1: Almal klaar?	5
85	L's: Ja meneer	2
86	T1: OK, ons gaan aan. Nuwe ding. Elektriese stelseldiagramme. Se dit.	5
87	L's: Elektriese stelseldiagramme	2
88	T1: Wat is die ding wat julle nou net geteken het.	5
89	L's: Stroombaandiagram	2
	L's: ja meneer	2,3
79	T1: Nou kyk gou hieso. Teken daai ding wat jy nou opgestel. Teken hom nou.	5
80	(Each learner in the focus group is given a notebook in which to draw.)	
81	G2: My liniaal is in my sak. Moet 'n mens die ding teken?	2
82	G3: Jy het mos nou gesien op die bord. Ek teken hom netso.	2
83	T1 reminds the learners of the symbols. The drawing goes off relatively easy.	2
84	T1: Almal klaar?	5

85	L's:	Ja meneer	2
86	T1:	OK, ons gaan aan. Nuwe ding. Elektriese stelseldiagramme. Se dit.	5
87	L's:	Elektriese stelseldiagramme	2
88	T1:	Wat is die ding wat julle nou net geteken het.	5
89	L's:	Stroombaandiagram	2

90	T1:	En die ding?	5
91	L's:	Elektriese stelseldiagram	2
92	T1:	'n Kort naam, 'n Stelseldiagram. 'n Stelseldiagram het soos alle ander stelsels, drie komponente, of dit bestaan uit drie dinge uit. (T1 puts puts slide on OHP) Uit wat uit bestaan dit? Nommer een, die inset. Wat is die inset?	5
93	G2:	Wat die stelsel ingaan.	2,3
94	T1:	Mooi. Die ander ene?	5
95	G3;	Proses – hoe die inset na die uitset verander het.	2,3
96	T1:	O, en die derde ene?	5
97	G2:	Uitset – Wat uit die stelsel uit kom.	2,3

98	T1:	Nou goed. Kyk nou na daai stroombaan daar voor jou. Die inset. Met ander woorde, dit wat die stelsel ingaan. Nou wat moet in hierdie stelsel ingaan. Daar moet krag ingaan, maar hoe gaan die krag in. Hoe gaan jy daai krag in hom kry eerste. Wat gaan jy gebruik om die krag in te kry?	1,5
99	G2:	Ons gaan die sel insit en die skakelaar aansit.	2,3
100	T1;	Jy moet die skakelaar aan skakel. Natuurlik, jy moet die selle insit. Dit is jou kragbron, maar as die selle daar is. Daai diagram. (points to drawing on chalkboard) Wat moet jy nou eerste doe nom om daai ding aan die gang te kry? Onthou, alles is in. Hoe moet ek hom aan die gang kry?	1,5
101	G1:	Met die skakelaar.	2
102	T1:	Ek moet die skakelaar aan skakel- nou skakel aan. (learners switch on)	1,2,3
103	T1:	Nou sodra jy die skakelaar aangeskakel het julle, wat het gebeur?	5
104	L's:	Die liggie het aan gegaan.	1,2,3
105	T1:	Maar voordat die gloeilamp kan aangaan moet die krag vloei, en soos die krag vloei, is dit die proses. Die skakelaar is die inset, die proses is die krag wat vloei tot dit by die liggie kom. As die liggie aankom is dit die uitset Die skakelaar is die inset, die proses is die krag wat vloei tot dit by by die liggie kom. As die liggeie aankom is dit die uitset. Ek kan 'n gonser daar in sit...(T1 pointing to where the bulb is) Julle het die idee nou. Nou moet ons hierdie ding teken. Julle wee twat 'n stroombaandiagram is, maar wat is 'n stelseldiagram? Nou kom ons kyk. (T1 draws an example of a systems diagram and talks the learners through the drawing)	1,5

106	(End of video footage) Transcript of audio recording from the point where video stopped.	
107	T1: Teken 'n stelsediagram van wat jy daar voor jou sien.	2,3
108	L2: Inset, proses, uitset	2,3
109	L1: Ek het gesit die krag vloei deur. Wat het jy geskryf?	2,3
110	L3: Hene ek het gedink ons gaan swaar goete kry.	2,3
111	L2: Ek ook. Dis maklike goete. Learners continue to draw the systems diagram and the class is dismissed for the day.	2,3
112	T1: Learners are requested to write reflections on what and how they learned at home.	3

APPENDIX 10.2 Transcript of audio and video on day 2. (27 October 2010)

INTRODUCTION

This is a transcript of the video and audio recording done on 27 October 2010. The video camera was focussed on the table where the focus group worked. Because the camera was mounted on a stand it was directed at the Circuit board on the table. It is not possible to distinguish faces of the learners but with the help of my two observer teachers we were able to identify the learners who were involved. The learners are called L1, L2 etc. and the teachers are labelled T1, T2 etc.

NO	TRANSCRIPT	CODE
1	(T1 points to slide on OHP)T1: Onthou julle nog?	5
2	L's: Ja meneer	2,3
3	T1: Stroombord. Onthou julle die komponente? (T1 goes through the components identified during the first session. Learners respond to his satisfaction.)	1,5
4	T1: Wat gebeur met die 1 pool 1 slag skakelaar?	1,2,3
5	L1: Hy kan net aan skakel en af skakel.	2,3
6	T1: Hy kan net aanskakel en afskakel. Dan het ons...	5
7	L's: 1 pool 2 slag skakelaar.	2,3
8	T1: En nou wonder ek...wat gebeur met die 1 pool 2 slag skakelaar?	5
9	L2: As jy hom diekant toe aansit dan bly hy aan en as jy hom daaikant toe aansit dan bly hy ook aan.	2,3
10	T1: Stem julle met haar saam? (Learners respond in the affirmative) En wat het ons uitgevind hier onder. Het ons gesien dat waar daai ene twee wat het, (Learners respond, "terminals", het hierdie ene, (Learners respond, " Three terminals". En jy het op die stroombord gesien daar sit drie terminale waar daar net twee terminale by die ander skakelaar is. Onthou julle nog die stroombaandiagram? (Learners, "Ja meneer". Waarvoor staan hierdie teken? (T1 pointing to symbol for cell and learners respond, "1 sel".) En daai een. (T1 pointing to the symbol for two cells and learners respond, " Twee selle'.)	2,3 5
11	T1; Goed. As een sel 1½ volts is, hoeveel volt gaan hierdie stroombaan het?	5
12	L's: 3 volt	2,3
13	T1: T1 Recaps what was said in respect of systems diagrams) Learners respond satisfactorily. He also revises logic & truth tables as well as the use of 0 for off and 1 for on.	5,2,3

NO	TRANSCRIPT	CODE
14	New section Learners are asked to look at a circuit diagram and then try to connect the circuit boards in their groups. There is immediate activity around the boards.	5,1,2,3
15	L1: Wag, daar's 'n plus en 'n minus. T1 calls for attention and explains how a circuit diagram with 2 switches should be wired. He requests them to refer to the two switches as Switch A and Switch B. Learners are given the task to figure out how to connect two switches in-line.	1,2,3,4,5
16	This is what was said in the group: L1: Die krag gaan nie vloei nie want die krag moet van die ene af op gaan. Waars daai kleintjie. (She connects the short wire between the two cells. Then she connects a long wire directly to the + and – terminals. She then becomes confused and wants to remove the first short wire.)	1,2,3,4
17	L2: Nee hy's reg. Los die een.	2
18	L1: Hoe gaan die krag van hierso af daantoe gaan? (L2 then connects a wire from the one bulb terminal to the other side of the bulb. L1 stops her saying, "Kyk jy gaan verkeerd". She then connects a wire from switch B to the bulb and says, "sit hom aan". L3 tries the switch but it does not work.) L4 says, "iets is nie reg nie" , pointing to a wire. L2 removes the wire from the cells. L1 removes the short wire she wanted to move at the start.	1,2,3
19	L2: Nee, los hom so! (L2 leaves the short wire but proceeds to put the wire the other learner removed back.	1,2,3
20	L4: Ek sê julle die is nie reg nie. Try die ene nou. lets kom hierso.	1,2,3
21	L1: Wag...ek wil julle gou iets wys. (She removes the short wire again and then connects a long wire to the two terminals of the cell, like she did at the start of the exercise. L4 tries the switch but nothing happens.)	1,2,3
22	T1: (Noting the dilemma at the table, calls everybody to attention) Luister julle. Luister nou mooi. (T1 speaks to the whole class but L1 is not listening. She is fiddling with the wires on the board. T1 tries to attract attention of L1 by saying, Daars mense wat nie luister nie. Hulle gaan problem optel.) She finally looks up, but soon goes back to trying out different combinations on the board without listening to T1. The rest of the focus group is now listening intently. L1 is still busy with the board and proceeds to remove all the wires from the board.	1,2,3,4,5

NO	TRANSCRIPT	CODE
23	<p>L2 becomes irritated and snatches the wires from L1 and follows the instructions given by T1.</p> <p>T1 talks the groups through the sequence.</p> <p>L1 takes wires from L2 but now proceeds to follow the instructions given by members of the group. They try the switch again but it still not working. Some serious inspection of the board follows. Questions are asked. (Not audible for recording.) L1 removes all the wires again. On the advice of fellow learners she puts them back. She puts them back in the way she believes. L3 tries the switch. Still not working.</p>	1,2,3,4,
24	<p>L1: Nee julle, ek kry nie die selle aan nie. (She starts looking at the other tables. The rest of the group stay focussed on the board in front of them. L3 removes a wire and connects it differently. Girl 1 wants to intervene and L3 says, "Wag jy!". L1 accepts L1's intervention and L4 becomes involved. The two observer teachers also come closer and make suggestions.</p>	1,2,3,4
25	<p>L2 who has been listening intently now takes over the wiring process. T1 reminds them to look at the whole wiring process from the start and to do the various connections step by step. They need to trace the flow of the current from its source, through the various terminals so that it could end in a complete circuit. The group settles down and thinks out the sequence of the circuit. L3 takes over the task of wiring the circuit under close scrutiny of the rest of the group. L1 is now part of the process again and listens to the advice of her group members. Step by step the whole group proceeds to wire the circuit.</p>	1,2,3
26	<p>T1 tries the switches...it works. There are satisfied smiles all around. Each of the learners tries the switches to experience the effect.</p>	1,2,3
27	<p>T1: Nou is ons almal waar ek wil he julle moet wees. Wat vind julle uit omtrent hierdie skakelaar? Hoe gaan jy daardie gloeilampie aankry?</p>	5
28	<p>L's: Jy moet altwee skakelaars aansit.</p>	1,2,3,
29	<p>T1: Ek het nie mooi gehoor nie.</p>	5
30	<p>L's; Jy moet altwee skakelaars aanskakel. (L1 looks bored. She takes out her notebook and writes something. It turns out to be the date. T1 explains the term and-logic and shows the symbol as well as the symbol for output = Q. T1 asks learners to draw the circuit diagram for the and-logic circuit in their notebooks. L1 is not drawing. She is looking around while the rest of the learners get on with the task.</p>	2,3
31	<p>T1 focuses the video camera on notebook of L3. L1 starts working. She copies the drawing of the learner next to her. T1 asks learners to draw a systems diagram after they have finished with the circuit diagram.</p>	1,2,3,4,5
32	<p>END OF VIDEO FOOTAGE - AUDIO continues.</p>	

33	Learners are given a truth table to complete. There is general cooperation among the group.	2,3
34	T1: As skakelaar A = 0 en skakelaar = dan is Q?	5
35	L's: 0	2,3
36	T1: As skakelaar A = 1 en skakelaar B = 0 dan is Q?	5
37	L's: 0	2,3
38	T1: As skakelaar A =1 en Skakelaar B = 1 dan is Q?	5
39	L's: 1	2,3

NO	TRANSCRIPT	CODE
40	T1: Met ander woorde, dit is 'n en-skakelaar. Nou loer gou hierso. Wat is die ding se naam. Teacher shows examples of an electric fan, an iron, a hairdryer and a vacuum cleaner. After consulting with the learners it is agreed that for these appliances to work, both the switch at the wall as well as the switch on the appliance itself should be on before the appliance will work. These are examples of everyday appliances that work on the and-logic. Learners are asked to list other appliances that work on the same principle.	1,2,3
41	L's: (With each response the learner is given an opportunity to explain their choice of appliance) Electric kettle, television set, electric stove, microwave oven and computer.	2,3
42	Learners are then asked to draw systems diagrams of one of the examples they have named. This is some of the conversations that could be picked up in the focus group.	2,3
43	L4: Ek sien niks, jy skryf te vining	2,3
44	L2: Wat is nou weer die inset een?	2,3
45	L3: Druk prop in muur en dan skakel jy aan want jy druk eeers die prop in die muur dan skakel jy aan.	2,3
46	L2: Skakel jy nou die TV aan?	2,3
47	L1: Wag nou, wag nou. Ons moet nou na die proses toe gaan. Skakelaar A en B is Nou aan, sien jy? Dan moet dit nou uitgaan. Die televisie is nou aan, sien jy?	2,3
48	L3: Skakelaar A aan, skakelaar B aan, dan gaan die stroom deur die geleier.	2,3
49	L1: Dan die proses in die middle. (Assisting L2)	2,3
50	L2: Skakelaar A en B is aan	2,3
51	L4: Elektriese stroom vloei deur geleier	2,3
52	L1: Klaar. Ons is klaar.	2,3
53	T1: Asks learners in focus group to go and write notes on lesson at home. Class dismissed.	3

APPENDIX 10.3 Transcript of audio and video on day 3. (08 November 2010)

INTRODUCTION

This is a transcript of the video and audio recording done on 08 November 2010. The video camera was focussed on the table where the focus group worked. Because the camera was mounted on a stand it was directed at the Circuit board on the table. It is not possible to distinguish faces of the learners but with the help of my two observer teachers we were able to identify the learners who were involved. The learners are called L1, L2 etc. and the teachers are labelled T1, T2 etc.

NO	TRANSCRIPT	CODE
1	T1 recaps lesson 2, emphasising the and-logic. T1: Nou by die of-logika werk dit 'n bietjie anders. Ons moet twee skakelaars gebruik maar hierdie keer moet die lig aangaan wanneer ons die een skakelaar aanskakel of die ander een aanskakel. Hulle moet apart werk. Het julle hom. As jy die een skakelaar aanskakel dan moet die lig aan kom. AS jy dit afskakel moet die lig afaan. As jy die die ander een aanskakel moet die lig aankom en as jy hom afskakel dan moet daai lig af kom. Ek gaan vir julle 'n voorbeeld gee waar dit so werk (T1 gives an example of a set of lights at a staircase at school where the or-logic is used) Teacher repeats what he wants the learners to do.	1,5
2	T1: Jy moet skakelaar A of skakelaar B gebruik en ek stel voor jy gebruik dieselfde twee skakelaars wat ons die ander dag gebruik het. Maar ek wil julle 'n guns vra. Soos julle die stroombaan opstel wil ek he julle moet praat met mekaar. T1 asks learners to talk as they work. To give voice to their thoughts. He quickly recaps the wiring of a basic circuit and asks them to try and wire a circuit using the or-logic.	1,5
3	T1: Onthou nou. Dit is die bord wat dar voor jou is .(Pointing to an OHP slide) Hierie is mos maklik. Om hierie twee selle aan mekaar te kry, dit weet julle. Julle weet ook om hierdie skakelaar aan die gang te kry. Nou kom die problem. Ek wil he jy moet hierdie skakelaar ook aan die gang kry en net hierdie terminal, sien julle hom, en hierdie een gebruik...maar as jy hierdie een aanskakel moet hierdie liggie aankom. As jy hierdie een aanskakel moet die liggie aankom. Net so terloops, die simbool wat ons gebruik lyk soos hierdie. (T1 draws the symbol for or-gate on chalk board) Hierdie simbool se vir jou of A gaan vir Q aankry of B gaan vir Q aankry. Daar is twee insette en een uitset. Stroombaandiagram. (T1 recaps terminology used in Lesson 1 and 2.)	1,5
4	While T1 is explaining, L1 starts wiring the circuit. Her first connection is not correct. The rest of the group starts brainstorming what needs to be done. Meanwhile L1 removes her first wire and changes the connection. She replaces it correctly.	4,5
5	The rest of the group members engage in a discussion. Unfortunately not audible for recording. After their consultation L2 points to the terminals where the wires should be connected. The rest of the group now joins in and they manage to set up a simple electrical circuit. They try the switch. The bulb comes on but only one switch works. They try to figure out what the problem could be. L3 swops the wires around a bit but now the bulb does not come on.	1,2,3

NO	TRANSCRIPT	
6	After some frantic discussion, not audible for recording they manage they change the connection again. They manage to get the bulb working again. They are still not able to get the second switch working. L5 suggests that maybe the cells are the problem. He attempts to change the cells but is stopped. Whilst they are trying to get switch b working, switch A stops working. L4 asks, "Wat het julle nou weer gemaak?"	1,2,3,
7	The group is stuck. They are unable to figure out where they went wrong. They decide to remove all the wires and start from scratch. L5 still insists that they should use another cell but he is told that the problem does not lie with the cells.	1,2,3
8	L1 proceeds to wire the circuit and insists that the circuit was wired correctly in the first instance. It is evident that the group is familiar with the setting up of a simple electrical circuit with one switch, but is having problems bringing switch B into the circuit. T1 offers a suggestion. It becomes obvious that some of the group members are now guessing where to connect the wires.	1,2,3
9	T1 cautions that we should never try to guess where wires should be connected. He mentions that we are working with 3volts and no serious damage can result due to an incorrect connection, but when working with electricity we need to be extremely careful. We need to be absolutely certain of our connections because the outcome could be potentially dangerous. They are asked to work on the circuit board with the same respect as they would work with a board of higher voltage. He uses an analogy of defusing a time-bomb.	1,2,3
10	While T1 was talking L1 continued connecting the wires. In her haste she neglects to connect the one terminal to the – side of the cell. She tries the switch but it does not work.	1,2,3
11	L5 also stick out his hand and tries the switch. No response.	1,2,3
12	After the talk L3 takes a wire from L2 and connects it to the – side of the cell. She tries both switches. Still no success.	1,2,3
13	T1 begs learners to think carefully before they make any connection. He goes through the sequence again	1,2,3,,4,5
14	L2 removes a wire from switch A and attempts to connect it to switch B.	1,2,3,
15	L1 takes the wire from her and connects it. L1 then takes another wire and connects it, but changes her mind and puts it back. She then points to the + side of the cells and says that something is missing. She then takes another wire and connects it the other side of the bulb	1,2,3,4
16	L2 tries switch A but the bulb does not come on. The learners look puzzled again. Then somebody tries switch B. The bulb comes on. There is clear excitement on the faces.	1,2,3,4,
17	They try both switches. Now there l s no response from both switches. After switching switches A and B alternatively, switch B manages to light the bulb. Learners are puzzled.	1,2,3,4
18	T1 steps closer. He asks them to carefully trace the flow of the current. They look at the board trying to see where they went wrong	1,2,3,4,5,
19	A debate ensues. Unfortunately not audible for recording. They try to explain to one another what should happen	1,2,3,4
20	L2 uses the example of the staircase given by T1 earlier	1,2,3,4

NO	TRANSCRIPT	CODE
21	An interesting finger tussle develops between L1 and L2. L1 wants to remove a wire but is stopped by L2.	1,2,3,4
22	The board is then moved around the table for each learner to get a closer look at the connection. They appear not able to find the solution.	1,2,3,4
23	T1 visits the table again. There is a long pause of indecision.	5
24	Then L1 swaps the terminals at switch B. Switch B is still working well. The problem lies with switch A.	1,2,3,4,
25	T1 asks them to start over and to follow the instructions meticulously.	5
26	L1 explains what should happen. She is still not following the instructions.	1,2,3,
27	T2 steps closer.	1,2,3,4,
28	L1 proceeds with the wiring of the circuit.	1,2,3
29	She is now being assisted by the rest of the group. Questions are asked as the process unfolds.	1,2,3,
30	T1 steps up to the table again. He asks them to please follow the instructions. He shows them what the diagram expects them to do.	1,2,3,4
31	L1 takes the initiative again.	1,2,3,
32	T1 asks her to slow down a bit. He asks her to think about every single connection she is making. He asks them to consult each other before making a connection	1,2,3,4,
33	L1 proceeds without consultation. She tries switch B. Still no success.	1,2,3,
34	She tries to convince the group that the right connections were made	1,2,3,
35	T1 steps up to the table again. He tests the circuit and tries the switches. Both switches work	1,2,3,4
36	L1 is all smiles	1,2,3,
37	L3 still fiddles with the board. She tries to add bulb B. It does not work.	1,2
38	L1 stops her and L3 responds, "Wag man, ek speel julle."	1,2
39	T1 calls everybody to attention. He recaps the drawing of a circuit diagram and asks the learners to draw a circuit diagram of an or-logic circuit.	5
40	End of video.	
41	Teacher then asks learners to take books home and draw the systems diagram at home and to write a report on what transpired. Books to be returned after a week.	3

APPENDIX 10.4 BROAD CATEGORIES emerging from recordings 201010 to 081110

PHASE ONE

DAY 1 Wednesday 201010

No	Category	Ref no	Theory
1	Using Board as reference and interacting with Board	10, 11, 14, 18, 19,22, 50, 57 -76,	
2	Use of OHP to supplement Easy Electrical Board	7,8,10, 15, 54, 92	
3	Interaction between learners, correction, consultation	19, 25-45, 58 -69, 98-104	
4	Explain answer, verbalise thought, writing reflections	20, 74, 76	POEE Hinchey
5	Teacher not know all	23,	
6	Use of chalk Board	31,34, 46, 48, 54	
7	Thinking aloud, Learner Talk	57, 58,59, 60, 58-69	Lemke Van Someren
8	Teacher wait time, time to solve problem	60	
9	Argumentation	62-65	

DAY 2 Wednesday 271010

No	Category	Ref no	Theory
1	Using Board as reference and interacting with Board	1-13, 14	Teacher Talk
2	Use of OHP to supplement Easy Electrical Board	1-13,	Teacher Talk
3	Interaction between learners, correction, consultation	15, 16 , 17-21,25, 43, 47-49	Cooperative Learning
4	Explain answer, verbalise thought, writing reflections	15,16, 17-21,41,42, 53	POEE Hinchey
5	Teacher not know all		
6	Use of chalk Board		Teacher Talk
7	Thinking aloud, Learner Talk	15, 16, 43 -52	Lemke Van Someren
8	Teacher wait time, time to solve problem		
9	Argumentation	16, 17-21, 23, 24	
10	When to intervene and how?	22	
11	Group dominance	22	

DAY 3 Wednesday 081110

No	Category	Ref no	Theory
1	Using Board as reference and interacting with Board	1-3	Teacher Talk
2	Use of OHP to supplement Easy Electrical Board	1-3	Teacher Talk
3	Interaction between learners, correction, consultation	5, 6, 7, 8, 10-17, 22	Cooperative Learning
4	Explain answer, verbalise thought, writing reflections	41	POEE Hinchey
5	Teacher not know all		
6	Use of chalk Board	3	Teacher Talk
7	Thinking aloud, Learner Talk	5	Lemke Van Someren
8	Teacher wait time, time to solve problem		
9	Argumentation	6, 7, 21	
10	When to intervene and how?	9, 18, 23, 29, 35	
11	Group dominance	4, 33, 34	
12	Critical thinking. Is learning really taking place?	8,19, 20	
13	Learning can be an enjoyable experience	38	
14			

APPENDIX 10.5 SUMMARY OF BROAD THEMES FOR 3 DAYS

No	Category	Theory
1	Using Board as reference and interacting with Board	Teacher Talk, Practical Tasks
2	Use of OHP to supplement Easy Electrical Board	Teacher Talk LTSM
3	Interaction between learners, correction, consultation	Cooperative Learning, Constructivism
4	Explain answer, verbalise thought, writing reflections	POEE, Constructivism Hinchey
5	Teacher not a know- all	Positivism
6	Use of chalk Board	Teacher Talk, LTSM
7	Thinking aloud, Learner Talk	Lemke, Van Someren, Constructivism
8	Teacher wait time, time to solve problem	
9	Argumentation	
10	When to intervene and how?	
11	Group dominance	Group work
12	Critical thinking. Is learning really taking place?	Critical thinking, Constructivism
13	Learning can be an enjoyable experience	

Learner One

Wednesday 20 October 2010

Woensdag!

Ek het meer gelder oor elektrisiteit en stroombane. Ek het geleer oor naarheids tabelle en stelseldiagramme. En om mekaar te help as klasmaats en om te luister na mekaar se voorstelle wat ons gee. Ek het geleer dat om skakelaars te gebruik

Learner One

Wednesday 27 October 2010

Woensdag 2:

Ek het meer oor stelsel
diagramme geleer en hoe
om met mense te
werk en mekaar te help
wanneer jy hulp nodig
het. Ek het meer
oor elektrisiteit geleer
en stroomboarde en
hoe om met dit
te werk

Ek het geleer hoe om met
mense te werk en meer
oor elektrisiteit en stroomkare
en hoe werk h mens met
elektrisiteit werk en meer
omr ander te werk en
meer oor die en logika en
die of logika
Ek het geleer oor wat
terminale is en hoe
om te werk met simbole
en hoe om die simbole te
teken. Ek het geleer om
na ander se voorstelle
te luister en nie merkbaar of
te druk nie, en om mekaar
kans te gee om te
praat of se wat jy wil se.
Ek het geleer waarom mens
moet in simboliese taal
moet skryf sodat almal

moet verstaan wat jy sê.

Learner Two

Wednesday 20 October 2010

Groedis Tegnologie
Elektrisitat 20-Oktober-2010
Tuiswerk

Vandag het ek meer oor elektrisiteit geleer veral die groot nuwe dinge soos stroombanddiagramme, waarheidstabelle en stelseldiagramme.

Ek het gesien hoe dit werk en dit was heerlik om oor elektrisiteit te leer met nuwe kinders van 8^B en 8^A.

Die stelseldiagram was baie interessant, ek verstaan nou baie beter hoe dit werk. van die inset na die uitset.
Die elektrisiteit begin by die stekedoor jou inset, dan vloei dit deur jou geleierensel dis die proses en dan na die geleierensel na die uitset.

Learner Two

Wednesday 20 October 2010 (continued)

Hy elektrisiteit is simboliese taal skryf.
sal almal dit verstaan, al is jy Xhosa,
Chinees of moslem sal jy dit ~~set~~
verstaan. Nou weet ek wat komponente
is, dit is al die klein dinge in 'n
elektriesestroombaan soos die selle,
terminale, skakelaars en gloeilampies. Ek
weet wat 'n eenpoorthoeslag is en 'n
eenpoortweeslag. 'n Eenmanhoeslag het
twee terminale en 'n eenmanweeslag het
drie terminale. Ek sien baie uit om oor
elektrisiteit te leer.

Wednesday 27 October 2010

Tuiswerk. Elektriesiteit. 27/10/10

Vandag het ek geleer oor stekediagramme met twee stakelaars wat ons stakelaar A en B genoem het. Dit is belangrik dat jy moet altyd twee stakelaars aanskakel want as A aan is gaan die gloeilamp af wees maar as jy stakelaar B ook aanskakel sal jou gloeilamp aan wees. Ek het ook meer geleer oor ~~stakelaars~~ ^{stelseldiagram} waar jy die inset, proses en uitset kry. Die meneer het gesê ons moet in ~~stakelaars~~ ^{stelseldiagram} teken van die stroombron met die twee stakelaars. Toe het ons twee insette gehad by ons stekediagram. Nou weet ek somer vele van elektriesiteit, en ek voel baie gelukkig. Dit is baie beter as jy met iets werk en sien wat doen jy as om te hoor daarvan.

Wednesday 08 November 2010

Tuiswerk.

27/10/2010

08/11/2010.

Vandag het ons oor al ons vorige werk / lesse gegaan en gesien wat ons die drie lesse gedoen. Ons het met OF-Logika gewerk en ek het meer geleer daarvan. Soos die keer toe ons moes in stroombaan op die stroombord moes maak het ons deurmekaar geroak want ons moes van een skakelaar twee draad vat na die twee ander terminale van die ander skakelaar. Toe het ons in waarheidstabel opgestel van hierdie OF-Logika stroombaan. Dit was baie heerlik om staan met meneer Accom, juffrou Accom en juffrou Lallo te werk en baie dankie vir al die leringe se ondersteun

Learner Three

Wednesday 20 October 2010

Woensdag 1

Ek het meer geleer oor skroombone en hoe om elektrisiteit aan mekaar te koppel en het baie nuwe dinge oorgeleer bv: hoe om 'n gloeilamp te laat brand en ek het ook geleer dat simboliese taal verstaan almal al watge rasie is en dit maak ook werk makliker en help jou om te sien waar gewaar is. Ek het ook geleer van die verskillende soorte terminologie en ek het baie nuwe ~~geleer~~ waarde geleer. Ons het ook geleer om saam te werk en om mekaar te help en om na mekaar se opinies te luister.

Learner Three

Wednesday 27 October 2010

Ek het geleer oor 'n stelseldiagram en
het ook geleer dat 'n stelseldiagram twee
insette het een proses en een
uitset. Ek het ook geleer hoe
om 'n stroomkaardiagram op te-
stel. En ons het ook geleer om
mekaar te help en mekaar te
verstaan. En mekaar te respekteer.

Learner Three

Wednesday 08 November 2010

Ek het geleer oor \bar{n} of-logika
of \hat{y} kon die lig hierdie kon
aan skakel of \hat{y} kon dit
daardie kont aan skakel. Ek
het ook geleer oor \bar{n} waarheid
tabel opgestel. Ek die verskille
verbreedde van \bar{n} of-logika
geleer.

Learner Four

Wednesday 20 October 2010

Woensdag 1

Tegnologie 20.10.2010

Ek het geleer dat tegnologie baie belangrik is. En dat Elektrisiteit baie gevaarlik is as 'n persoon met dit speel. Woensdag was 'n baie heerlike dag want ek en my klasmaats het van stroombane, terminale, Eksponente, positiewe en negatiewe terminale en stelseldiagramme geleer op die lekkerste manier want almal werk saam en ons help mekaar. Ek, Lereen, Roman, ^{Darolee} ~~Lereen~~ en Luchandra het 'n stroombaan bymekaar gesit en dit was lekker om met kinders van ander klasse te werk en hulle beter te leer.

Wednesday 27 October 2010

Woensdag 27.10.2010
Tegnologie

Vir middag het ek van die proses van drie skakelaars wat saam aan geskakel word. As die een aan is en die ander een nie getoosel die krag nie kan deur vlei nie en dit noem ons EN LOGIKA. Ek voel dat tegnologie baie belangrik en help baie van ons om beter te lewe.

Wednesday 08 November 2010

Woensdag 3 Tegnologie

Vandag het ons van
Of logika geleer. Of Logika
beteken dat as een
skakebaar aan is en
die ander een nie kan
die krag nogsteeds deur
vloei, jy kan een of die
ander skakebaar gebruik
want die krag gaan deur
vlei. Daar is in paar voor
beeld van of logika soos
in Bed skakelers kettel
~~as jy in kettel mit gebruik~~
~~moet jy eers die by die~~
~~prop van sker Bed Skakelers~~
en in klokke by voor of
agter hek.

May Waters - gr 8

Elektrisiteit Stroombaandiagnose

20 October 2010

1. Leerders kuster goed.
2. Leerders is gewy on met stroom borde te werk.
3. Hulle onthou goed. Het ook notas gemaak van les.
4. Hulle was in staat om stroom-bane te teken asook stelsel diagramme.
5. Leerders is redelike vertroud met selle, batterye, skakelaars, terminale, draade, ens.
6. Elkeen was graag beters en doen ~~so~~ dat dit kan werk.
- 7.

Stroombaan

21 Oktober 2010

1. Herkennings was goed, van leeders se kant af.
2. Het temas en funksies onder van vorige les.
3. Leeders is ~~te~~ althief bezig - hulle wil weet hoe die stroombaan werk. Leeders is gretig en bring mekaar eg in groepe. Besprekings vind plaas ondermekaar. Een af twee konnekteer die drade om die stroombaan te laat werk. Twee skakelaars moet werk.
4. En ~~of~~ skakelaars - leeders verstaan goed hoe dit werk. En-logika - leeders het baie voorbeelde genaem soos tv.; ketel; stoof; mikroloff, ens. Samewerking is goed.
Oefening: Leeders moet een

1. toestel van druk en ~~teken~~ is stelseldiagram teken. Hulle was in staat om dit te doen. Diagramme was duidelik en netjies. Leeders het begrip van elektriese stroombaan.

03.11.2010.7

08 Nov. 2010.

Leerlinge het herseunig gedou
en van die temas en name
vergeet. Het later by gekom.
Leerweg het sy les van begin
deur ^{te} ~~aan~~ die bekende
en na die onbekende
te beweeg. Hy het die
klas vroe gevra, hulle
was gedring ^{alhoth} betrokke
by die les. Groepwerk
werk uitstekend, want leerders
is vrymoedig onder mekaar.
Leerders is onseker van EM-
logika en OF-logika.
leerders verstaan waarheids-
tabel. van $0 + 1$.

27/10/2010

LEARNING AREA : TECHNOLOGY

TOPIC : ELECTRICITY

CIRCUIT BOARDS

The teacher asks questions from what they know.

Learners are divided into 4 groups with a circuit board in front of each group.

They identify some parts of electric circuits.

They connect switches on the circuit board.

They are given a chance to take part.

Examples of household products like a fan, iron, hair dryer - they you have to switch in the wall and the product. They also give their own examples.

In this way of teaching and

learning learners understand better because they see and touch. They are able to apply what is taught, practically. They respond to the questions asked by the teacher

GROUP WORK - learners get a chance of expressing themselves, they help each other, correct each other and they understand better than when the teacher talks alone and just write on the board.

The teacher is able to identify the learner who doesn't understand. because each learner in a group is given a chance to participate.

If a learner has not captured what was said / the teacher was saying, the teacher can go back and explain.

8 NOVEMBER 2010

ELECTRICITY

The teacher shows them (learners) an electric Board.

He asked them to name the parts of the electric board. - They recall the parts by giving answers.

They give their own example of ~~AND~~ logic e.g. kettles, irons

OR-LOGIC

Activity

The teacher learners should connect two cells for A and B

The teacher interacts with them by moving from one group to the other. - He shows them step by step they follow instructions.

Learners who understand show those who struggle

Learners have to draw the of-logika diagram

- It is easy to recap by locating the mouse e.g. if a learner forgets or confuses things, the teacher can immediately capture it, i.e. it is an easy locator.
- They can grasp/learn without the teacher's guidance as the computer easily directs the one who is using it.
- The teacher can go back (if learners forget certain information) to ~~check~~ retrieve information if learners forget certain information.
- Learners quickly take down notes (They don't waste time when copying the notes)
- Unlike the chalkboard usage where teacher should rub off ^{the} work that is done, the teacher can save up that work & and can use it in future.

Tegnoloë

Lizeel Jacobs

Ons het oor elektrisiteit geteer nuwe
woorde en oorsboombane hoe die vorm
van die stroombaan is en hoe dit werk
en hoe dit gebruik word

Ek voel baie goed oor die werk en
ek is vrywillig om meer te leer en
ek vind dit baie interessant en die
belangrikste ding is dat ek baie daar
uit leer en dit toe pas. Dit is n baie
spesiale les wat ek leer en wat ek
ook ander sal kan help. Hoe meer ek
leer hoe meer dit interessanter dit word
vir my en vir ander

Tegnoloë dit is 7 September 2011
Jacobs

Vandag het ons van waarheidstabelle, stelseldigramme, kontrole logika en En-logika geleer dit was baie interessant en ek het baie baat daar uit gevind. Na dit het ons aan die stroombaan gewerk dit gekondteer tenstens 'n geleidings terminaal by die negatiewe kante van die selle en 'n geleidings terminaal na die skakelaar toe van af die skakelaar nog 'n geleidings terminaal na die gloeilampie toe dan nog 'n geleidings terminaal na die selle toe en dan vloer die krag deur die selle en so gaan dit aan

Dit sal baie beter om met ander te werk asom alleen te sukkel om dit reg te kry Om met ander te werk is dit 'n goeie uitdaging vir my en vir ander. Dit sal beter wees om met ander werk te probeer en nie alleen nie ek is baie bly omdat ek maatsies het wat saam met my werk en ons werk baie lekker saam

Die einde

Tegnoloë

Lizze Jacobs

9 September 2011

Ons het vandag oor aflogika, vog en blammigheid geleer. Dit was n baie interessante bespreking het ons ook oor elektisiteit geleer

Ons het die baie geniet en te kyk vooruit na n ander bespreking toe. Na dit het ons oor die stroombaan gewerk vastens het ons die geleidingsterminal by die negatiewe en a die positiewe kante van die twee kante van die selle aangesit van skakelaar A na skakelaar B het ons nog n geleidingsterminal aangesit van die skakelaar af na die glotilampie toe van die glotilampie af terug na die selle toe. Ons het n bietjie gesukkel maar uiteindelik het ons reg gekom dit was makliker om met ander te werk as om alleen te werk ek voel baie gelukkig om met ander te werk ek vind dit baie maklik om te gliklag met ander wat ek saam te werk. Ons werk nog al baie lekker saam en ons verstaan mekaar baie goed. Ons kyk vooruit om vir die klas te verduidelik nie ek alleen nie maar saam met my maats wat saam te werk

Die einde

Baie dankie

Graad 8^B Technologie September 2011
Jamie-lee
Freeman
Ek het baie van elektrisiteit geleer soos om hoe
om op 'n stroombaan 'n gloeilamp te laat lig
deur gebruik te maak van geleidingsterminals
en sette. Ek voel dat ons beter sal verstaan as
ons meer praktiese werk doen as wanneer die
anderyser net verduidelik. Ek het baie nuwe
woorde geleer en baie dinge verstaan wat ek
nie van gewoone het nie.

Graad 8^B Technologie 7 September 2011
Jamie-lee
Freeman
Ek het baie nuwe woorde geleer en om hoe
om op 'n stroombaan 'n gloeilamp te laat
gloei. Ek het ook geleer hoe om 'n waarheids-
tabel te voltooi. Hoe om 'n en logika te voltooi.
Ek voel baie gelukkig om praktiese te kan werk
want ek verstaan baie beter die werk wan-
neer ons praktiese werk. Dit is ongelukkig om
self te probeer en in 'n groep te werk, van
wanneer jy in 'n groep werk verskil almal se
opinie en ons kan verskeie maniere uitgeef.
Op so manier sal ons gouer kan uitvind
hou die produk of iets werk.

Graad 8^B
Technologie
8 September 2011
Jamie-lee Freeman

Ek het baie geleer oor elektrisiteit en baie
nuwe woorde wat ek nie van gewoone het
nie. Ek het ook baie van die praktiese werk
gehou wat ons gegee het. Ek voel dit is
baie beter om praktiese te werk, want
ek verstaan beter wanneer ek praktiese werk
en ek voel dit beter wanneer ons in 'n
groep is van wanneer ons alleen is sal ons
baie sukkel en baie tyd werk beter as een

Grades
Levels
Size

Tegnologie
Terminaal

07 September 2011

① Wat het ek geleer?

Ek het geleer hoe om met ander mense in 'n groep span te werk, en dat jy nie te mag skaam te wees nie en dat jy moet jou opinie ook kan gee. Ek het ook geleer hoe om met elektrisiteit te werk sonder te probeer maar met draad (geleidingsterminale) en dat 'n mens nie net met krag kan werk nie maar as dit nodig is en nie om te se battery nie maar stelle in Tegnologie ^{en} het nuwe woorde ook geleer wat ek moet van gehoor het nie soos (Skroefterminaal) en Middelterminaal.

② Wat dink ons van die praktiese werk.

Ek dink dat dit is beter om meer praktiese werk te doen as om dit te skryf moet ons dit meer doen dan sal sommige kinders dit te beter verstaan, want onder kinders sal die praktiese werk verstaan maar ander sal dit nie kan verstaan nie.

Grades
Levels
Size

Tegnologie

07 September 2011

Wat het ek geleer?

Ek het geleer hoe om met elektrisiteit te werk en hoe om die vrees te oorkom. Ek het ook geleer hoe om met twee skakelbatterye te werk maar met een gloeilamp. Dit voel in my ook beter om saam as 'n span te werk.

Wat dink ek van praktiese werk.

Ek voel dit is beter om dit te doen as praktiese werk. 'n Mens kan dit beter verstaan. Ek dink die meeste van ons sal die geskryfte werk nie kan reg verstaan nie. Dit is ook beter as om alleen te werk maar jy gaan sukkel. Dit is beter in 'n groep mense.

Grondidee
Denken
Size

Technologie

05 September 2011

Wat niet ik geleer

Vandaag niet ik geleer om meer te focus op die ding
wat ik niet bezig is en me speel of anderszins
te doen me meer een ding op 'n dag te doen
en verstaan wat ~~is~~ nu jou gewoonte word of als
jij me verstaan me moet jij niet doen dat nu jou
verduidelik word.

Wat dink jij van praktische werk

Ik dink dit is nog steeds beter als dit moet
gelezen word als om dit te ~~skryf~~ skryf sal dit
dalk ~~meer~~^{ent} moontlik wees en sal beter wees
as dit prakties geboen word

APPENDIX 16 Copy of Notes of Learner Four Phase 2

(1) Ons het vandag van elektrisiteit geleer. Ons het geleer van die hoeveelheid volt in batterye (selle) en in gloeilampe. Ons het van skakelaars geleer en dat daar twee verskillende skakelaars is met die name, Eenpooleenslag en Eenpoeltweeslag. Ons het nuwe woorde geleer en ook van frekwensie-terminaal. Ons het vandag geleer hoe elektrisiteit vloei.

(2) Ek dink dis beter as kinders die werk op hul eie uitwerk van so gaan hul meer verstaan as wat die onderwyser vir hul verduidelik en die antwoorde gee.

Janeve Mintoor
Graad 8 B
Tegnologie
Elektrisiteit
1 September 2011

Graad 8 B
Tegnologie
Janeve Mintoor

7 September 2011

1. Ons het vandag van waarheidstabelle, stelskiagram, kontrole logika, En-Logika en En-Deur/oot geleer. Ons het ook n paar same gedoen.

2. Ek dink dis beter as kinders self die werk doen, van op so manier sal hul kreatief is en die werk verstaan.

Janeve Mintoor
Graad 8 B
Tegnologie
3 September 2011

(1) Ons het vandag van OF-Logika geleer. Ons het ook geleer hoe om n stroombaan te maak, waar wanneer jy die een skakelaar aan sit dan skyn die lig. Ons het ook n waarheidstabel gedoen.

(2) Ek dink dis beter as die kinders saam werk en saam uitwerk hoe om dit te doen. Die meneer kan ook maar verduidelik as die kinders sukkel.

APPENDIX 17 Copy of Notes of Learner Five Phase 2

Grandes Tegnologie September
Vinches to Holster

① Wat het ons van dag geleer
① Ons het geleer hoe om die stroom baan te voltooi. Ons het geleer van Geleidingsterminal en van Kompomete.

② Wat dit ons ~~met~~ van pratiese werk
② Interessanter Dit is interessanter om pratiese werk te doen want ons leer van alles ~~wat ons nie kan leer~~.

Vinches to Holster 7 September 2011
Tegnologie

Dit is baie lekker om met stroom baan te werk. Maar om ook nie alleen te werk nie om saam vriende te werk.

Ons het ~~geleer~~ geleer oor Waarheidstabelle wat ons nie gekan het nie. Ons het geleer van e logika.

Dit baie lekker om met pratiese werk te doen. Dit is baie interessanter om met stroom baan te werk.

Vinches to Holster 08 September 2011
Tegnologie

Ons het geleer oor elektrisiteit. Ons gewerk met gelykspan, skakelaar, gelykspan terminal en Delle. Ons het gewerk met belangrike dele wat ons nie gekan het nie.

Is lekker om met pratiese werk te werk want jy weet wat om te doen want iemand se jou wat om te doen.

Lloyd Brink

1 Ek het geleer nou om in stroombord te gebruik en nou om Sella (bat) en in skakelaar en in gloelamp te gebruik met geleidingsterminaal te maak dat die gloelamp kan gloe. Ek het ook 'n paar nuwe woorde soos Stroomterminal, Middelterminal, Komponente, Geleidingsterminaal, Stroombord en Eenpooleksel en Tweepooleksel. Ek het geleer nou om te stroombord te werk.

2 Ek dink dit sal beter wees as ons prakties se werk doen want dit is makliker. En al die stroom werk is baie en die kinders sal geleer en die dit sal interessanter wees en ^{nuwe} sal dit hulle ondhou.

Lloyd Brink 7 September 2011

Ek het geleer van Kontrole Logika en En-Logika. Ek het ook geleer hoe om in stroombord op te sit met twee skakelaars, twee self een gloelamp en 'n paar geleidingsterminaal en ek weet nou dat Tegnologie net saam met 0 en 1 werk en as die wissel 0 wees en die wissel 1 daan gaan die gloelamp ook aanwees.

Soos ek gesê het dat ons sal hulle beter leer want as jy dit verbeert kry kan jy net weer probeer en ek dink dit sal beter wees as daar twee saam werk want ek hou nie om 'n klomp mense te werk nie.

Lloyd Brink 8 September 2011

Vandag het ek geleer van OF-Logika. OF-Logika is dat daar twee skakelaars is maar dit is nie dieselfde die selfde soos En-Logika nie. As jy een skakelaar aan sit en die ander een is af gaan die gloelamp gloe. Dit is op 'n stroombord maar werk nie saam nie.

Ek dink dat ons moet op die stroombord werk dit is makliker en ons sal 'n bietjie sibil maar ons sal reg kom.

Day:

Electricity: Technology 06:09:2011.
Battery: Bani sets bymekaar.

Stroombord: Bestaan uit selle; terminale; gloeilamp skakelaar

leerlinge sien, verstaan en raak aan dele van stroombaan. He het later begrip met stroombaan voor hulle.

Komponente: He kyk na die battery en neem waar dat daar 'n positiewe terminaal (+) en 'n negatiewe terminaal (-) op battery voor kom. He kyk en bespreek ander komponente soos die gloeilampe wat hulle kan sien of kan omdraai tussen die skroefterminale en middelterminal. (Krag/Volt word verduidelik waarmee batterye werk). Geleidingsdraad word ook bespreek en verduidelik.

Gloeilampbehoer: lampie word daarin gestroef.

Skakelaar: Eenpoortleedslag skakelaar (eenkant omdraai)

Eenpoortleedslag " (twee-kante omdraai)

Geleidingsdraad/terminal: - geleid elektrisiteit vanaf sel.

Simbole: He verstaan dat elektrisiteit met simbole werk as dit voorgestel word.

Stroombaandiagramme: Verduidelik en wys hoe stroombaan lyk en daarna probeer leerlinge eende om self 'n stroombaan op te stel. He se "poging was onsuksesvol, want hulle vind self dat daar 'n

font gemaak is. He probeer 'n tweede keer en vind self uit waar hulle foutkeer het. Dit het tyd geneem en aan die laaste probeerslag het hulle die stroom laat vloei. Die gloeilamp het gebrand. He vind dat hulle vir anders ook sal kan wys hoe 'n stroombaan werk.

Electricity:

Technology

07:09:20H

Day 2

Revision of previous work. EN-LOGIKA.

System diagram:




Control Logic - What is it?

Truth Table OF $0 = 0$ $0 = 0$ $1 = 1$ - We have an idea.

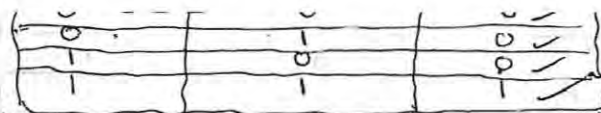
Waarheidstabel: We het verstaan dat die waarheidstabel met 0 + 1 werk. Toestelle wat om ons is werk almal op hierdie manier.

Stroombaan - oefening deur keeringe - hulle vorm die stroombaan kometodes. op hulle die en kyk dit reg. hulle verduidelike mekaar hoe die stroom vloei.

Hierdie keer word we toegelaat om weer met die stroombaan te werk, maar hierdie keer met twee skakelaars. hulle vertel mekaar hoe om te werk te gaan. We was bietjie onseker maar aan die einde het twee van hulle dit reggekry om die stroom te laat vloei. Skakelaar A + Skakelaar B moet aangesluit wees en lig te laat stroom. (En-Logika)

A -  - Q 2 in sette - 1 uitset - i lampe

We nou self uitvind hoe om die d' die elektisiteit te laat vloei



Hulle vind uit dat gloeilamp sal stroom stroom en skakelaar A + skakelaar B aangesluit word, dan sal die toestel werk of (lig stroom). Voorbeelde was gesien deur onderwyser en we het ook ander voorbeelde soos ketels; TV's, rekenars. ens gesien van en-logika.

Electricity:
Day 3

Technology

08-09-2011

OF-LOGICA.

Wie is goed vertrouwd met die Komponente van die Stroombaan. - Hersiening. → Stroombaan-diagram.

Stelseldiagram: 2 insette - proses
Simbool vir OF-Logika.



Wie was in bujie onseker Nam die OF-Logika. Laat genees voor hulle dit reggekry het op stroombaard. Uitendeleke het iemand dit reggekry en aan die ander verduidelike hoe dit werk. Ander leeders het dit bestuur en toe verstaan dat die stroombaan voltooi moet word en hoe om die draad te konnekteer.

Waarheidstabel OF-Logika.

He het op die stroombaard getoets en die waarheidstabel verstaan.

- bedsketelaa
- lokaal by voordeur.

ELECTRICITY

06/09/2011

THE CIRCUIT BOARD

The teacher introduces parts of the circuit board

1) A cell

2) Terminals - positive and negative terminals

3) Bulb

4) Switch

5) Volt

Differences on switches - [two terminals and three terminals]

Identify how many volts does the cell has.

PARTS OF BULB - middle / centre terminal
screw terminal

SYMBOLS SOUTH AFRICAN STANDARD SYMBOLS

Why do we use symbols?

- Instead of realistic drawing of electrical circuits we use symbols
- Quickly to write
- Easily understandable
- Can be used by people of different languages



cell/battery of cells



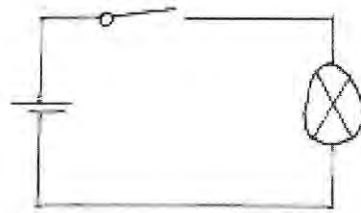
Light bulb



switch

A CIRCUIT DIAGRAM

Learners have to draw the (electric) circuit diagram using different symbols



The teacher asks the learners if the light bulb will be on, on the above diagram.

Learners response: No because the switch is open

Activity

Set up the circuit/electrical board according to the diagram they have seen.

1. Put on the cell - The learners put on the terminals towards the bulb. The bulb did not light on.

The learners advise each other and change the terminals to check what have they done wrong - Ask questions to show their understanding

They move from the first step until the switch was ON.

Conclusion

Learners could remember the steps to follow from the first step to the last. In order to do

this they give each other to have an input:

- One learner sets the circuit board whilst others tell him what to do or how to move from first step to the last one.

In conclusion due to the lesson presented learners were able to transfer the knowledge they have learnt from the lesson and apply it practically on the circuit board.

Homework

- What have they learnt from the lesson?
- How do they feel about working on their own (practically) or listen to the teacher?

DAY 207/09/2011

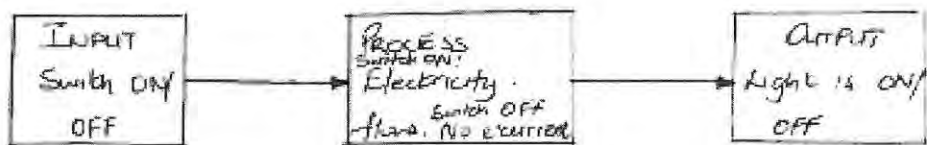
The teacher revise terms used in the lesson on the previous day and to set out the circuit board as they did on the day before.

Today learners were introduced to the Electrical System diagram

An electrical circuit has three components
1) Input, output and process.

The teacher explains/define these terms so that the learners can be able to understand them.

- 1) Input: what goes into the circuit
- 2) Process: how the input changes into the output
- 3) Output: what comes out of the circuit



This is also called the CONTROL SYSTEM.

THE CONTROL LOGIC

The teacher explains what the control logic is. - The thinking used in a system to control the output is called the control logic.

The control logic can be shown in a table called a TRUTH TABLE where words OFF and ON are shown.

Mostly in control circuits designers simplify them by using numbers instead of the words e.g. OFF (0)

and ON (1)

The teacher explains how it works and what the numbers 0/1 mean/stand for in terms of OFF and ON
 The teacher also explains what happens if one of the terminals is taken away - the light gets off
 He asked them to take one cell off and put the terminals to close it - the result is the bulb is dim.

Activity

1) learners were asked by the teacher to transfer the information on the diagram into the circuit board.

• learners show each other - changing the pins to check if both switches ^{can} work at the same time.

After taking turns they were able to operate the two switches to light on / put on the light.

2) learners were asked what happens if the circuit A is ON and circuit B is OFF

Response:

2. AND LOGIC

• The teacher introduces the AND LOGIC SYMBOLS



• The teacher explains how the AND LOGIC works -

It uses two switches - one on the wall and one on the remote

He asked the learners to give examples of household items that use two switches.

LEARNERS RESPONSE: Kettles, fans, computers, hair dryers etc!

- learners were asked to do the truth table
1. From the electrical board they were asked to switch off cell A and Cell B and say what the output/result was and write it down
 2. They switch off Cell A and switch ON cell B and write down the result.
 3. Switch ON Cell A and cell B off and write down the result.
 4. Switch ON Cell A and Cell B ON and the results of that.

After they have done the above exercise practically they draw up the TRUTHTABLE on the worksheets provided.

A	B	LIGHT(O/L)
0	0	0
0	1	0
1	0	0
1	1	1

They found out that for the light to be ON A and B should be on.

In conclusion learners were better off ^{in understanding} given a chance to apply the information they had into practice. Secondly they were better off to do tasks as groups because if one learner understands/came, remember he/she can remind the others of what was said before. learners can also remember what the other learner was saying in the group discussion than working alone.

Day 3

08/09/2011

7

The teacher started with the revision on the circuit board, terms used and how it works learners could remember what they have done from day one

Today the teacher introduces the OR LOGIC
How does it work?

It works when ^{either} one switch or the other switch or both switches are on.

He introduced the OR LOGIC SYMBOLS



Activity

* learners were asked to connect the circuit so that the energy moves to switch A and B. They connect it practically - they talk to each other, help each other and ultimately they could not follow up.

The teacher ^(intervene) asked them to start again step by step. They eventually were able to connect it.

STEP 1: The teacher asked them to switch OFF A and B they wrote down the result - was OFF

STEP 2: They switch ON A and switch OFF B - the result was ON

STEP 3: They switch OFF A and ON B - the result was ON

STEP 4: They switch ON A and B ON - the result was ON

From the information they have used on the circuit board, learners were asked to write on the truth table worksheets.

Switch A	Switch B	OUTPUT From bulb
0	0	0
0	1	1
1	0	1
1	1	1

In conclusion by switching ON and OFF the circuit board learners were able to do the TRUTH TABLE meaning by doing practicals learners were able to see and understand how the OR logic works.

The teacher gives the learners examples like bed lamps, light sensitive lamps etc.

NO	QUESTION	RESPONSE
1	Goeie more. Se maar net jou naam vir die mikrofoon asseblief	My naam is Liezl Jacobs
2	OK. Liezl. Net so paar vrae hoor	Ja meneer
3	Die ene is, Jy kan onthou ons het twee lesse gedoen. Of twee sessies gehad oor elektrisiteit. Die een was in die klas toe doen ek parallel en	...en series
4	Series stroombane. En in die middag. Daar is mos en skakelaars en of skakelaars.	Ek onthou meneer
5	Nou goed. Nou wat kan jy vir my se van parallel en series. Kan jy onthou daar.	Uh. 'n Parallel stroombaam het uhm drie stroombane.
6	Drie stroombane. OK	Series stroombane het twee.
7	Twee. Sal jy vir iemand kan verduidelik hoe dit werk. Die bane in die series.	Die parallel ene het drie stroombane, as een gloeilampie af gaan dan lig die ander nog.
8	Uhm	Soos byvoorbeeld. Die een gloeilamp gaan af dan lig stroombaam twee en drie nog. Dan brand die gloeilampe.
9	En by series?	Serie as die een stroombaam afgaan dan brand die ander gloeilamp nog.
10	So dit kan meer as drie ook wees hoor, Dit kan twee wees, drie vier vyf OK. Wat kan jy vir my se van en skakelaars en van of skakelaars. Wat kan jy vir my daarvan se. Die wat ons in die middag gedoen het.	Hoe meen meneer nou
11	Die wat ons in die middag gedoen het. Daai wat julle so saam gewerk het.	Daar ook van...ons het die stroombaam. Ons het daar aan gewerk. Uhm die eerste een . Ons het die twee selle aangesit. Een by die negatiewe kante en een by die positiewe kante. Toe sit ons die geleidingsterminale aan van die battery af na die skakelaar toe van die skakelaar af na die gloeilamp toe dan af na die sel toe.
12	Nou daai is goed. Nou wil ek weet. Ons het by ene twee skakelaars gesit ne	Ja meneer
13	Nou wanneer ons die en logika het. Wat gebeur. Wat moet gebeur met die een skakelaar en die ander skakelaar?	Die een skakelaar . Is hy af. Hy moet aan wees.
14	Is dit by die en skakelaar?	Ja meneer
15	En by die of?	By die of ene moet die . As die een skakelaar by 1 is dan is die ander 0.
16	So jy kan net die gloeilampie aan kry deur of die een skakelaar aan te sit of die ander skakelaar	Ja meneer

NO	QUESTION	RESPONSE
17	En dan hoe werk die en nou weer. Jy het nou twee skakelaars. Jy moet die een aansit .	As die een. Een skakelaar by 1 is en as die ander ene by 0 is , dank an jy daai ene aansit meneer en dan die ene weer afsit dan is hy af.
18	Daai ene is nou is nou af. Met ander woorde altwee die skakelaars moet aan wees.	Nee meneer.
19	Is is dit nou by die of skakelaar. Dis die een of die ander een	Ja meneer.
20	En by en skakelaar. Is dit die een en die ander ene. So byvoorbeeld ek druk hom by die muur in dan moet jy hom by die ketel aansit om hom aan te kry?	Nee meneer
22	Uhm. Nou OK. Se vir my uh. Van die twee lesse wat jy gekry het ne. Watter en was vir jou die lekkerste.	Altwee meneer
23	Altwee. Ek praat nou van die ene in die klas van die parallel en die series en die ene wat jy in die middag gekry het na skool wat ons met die stroomborde gewerk het. Watter een dink jy was die beste.	Die ene wat ons na skool gedoen het meneer
24	Nou, nou hoekom se jy die ene wat julle na skool gedoen het?	Daar aan meneer het ons baie gedoen wat ons al nooit van geleer het nie. Daar kon ons aan die stroombaan werk. En ons kon verstaan. Ons het verstaan wat ons mee besig was.
25	So jy het beter verstaan se jy.	Ja meneer
26	Toe jy met die stroombord self gewerk het	Ja meneer
27	As wat toe ek die goed daar op die bord geteken het. Soos wat ek met die parallel gedoen het.	Ja meneer
28	So watter een het jy verkies se jy.	Na skool
29	OK. Nee wat. Dankie ons is klaar.	OK

NO	QUESTION	RESPONSE
2	OK Jamie –Lee, jy onthou mos nou van elektrisiteit ne.Ons het twee sessies gehad. Een was in die klas, toe praat ons oor parallel en series. Ne.En dan , die wat ons in die middag gehad het, het ek gepraat van en skakelaars en of skakelaars.Ne. Nou goed. Wat kan jy vir my se van parallel en series. Kan jy onthou. Dinge wat ons daar geprat het. Enigiets. (Silence) Enigiets. Wat is parallel geskakel. Wat is series geskakel. Watter een is die beste. Parallel of series. Wat gebeur met die lampies in parallel en wat gebeur met die lampies in series. As jy nie so mooi kan onthou nie is oraait.	
3	Kan jy nie goed onthou van parallel en series nie.	Nee meneer.
4	Glad nie	(Nods head)
5	OK. Kan jy vir my vertel van die aan skakelaar, die en skakelaar en die of skakelaar. Daai wat ons in die middag gedoen het.	Dit is die een wat die twee skakelaars vat meneer.
6	Twee skakelaars	Die of skakelaars. As jy die een skakelaar afsit is die gloeilamp af en die ander een aan.
7	Uh uh	En by die en skakelaar is hulle aan. Al twee die skakelaars moet aan wees
8	So al twee die skakelaars moet aan wees	Aan wees.
9	Om die gloeilampie aan te kry. En by die of skakelaar?	Moet die ene af wees en die een skakelaar aan wees
10	So dit moet die enenwees	Of die ander een
11	Mooi. Nou se vir my. Van die twee lesse nou wat ons gedoen het oor parallel en series en die ene wat ons gedoen het, daardie in die middag. Uh, watter ene was vir jou die lekkerste een	Die een in die middag.
12	Hoekom	Ek het meer verstaan wat gaan aan met die praktiese les.
13	Uhm	Ek het beter verstaan oor elektrisiteit want ons het dit self prakties gedoen. Ek het beter verstaan oor wat gaan dit eintlik
14	Is dit nou ook hoekom jy vir die ene onthou as die ander ene onthou.	Ja meneer

NO	QUESTION	RESPONSE
15	Nee Ok. Jy het nou sommer my ander vragie ook beantwoord. Die ander vraag is, watter een van die twee het jy die beste verstaan en jy se dit is die een wat ons in die middag gedoen het. Die rede nou weer?	Omdat ons dit practise gedoen het
16	Nee goed dan is ons klaar. Baie dankie dis al. is nie so erg nie ne.	
17	Nee OK. Dankie hoor.	

NO	QUESTION	RESPONSE
1	En se nou eerste jou naam lekker hard vir die mikrofoon	My naam is Deveron Size
2	Deveron Size. OK. Nou Deveron, Ek het by twee geleenthede met julle oor elektrisiteit gepraat ne. Die een was in die klas toe praat ek van parallel stroombane en seriestroombane toe teken ek daai prentjies mos op die bord met die drie lampies. En die ander tyd wat ons van elektrisiteit het was in die middag na skool. Dan het julle mos op daai stroombord gewerk. Onthou jy.	Ja meneer
3	Goed. Wat kan jy nou vir my se. wat onthou jy van paprallel en series. Die ene wat ek in klas op die bord getrek het.	Dat die by die paprallel daar is drie verskillende goete. Elkeen het sy eie stroombaan.
4	By die parallel. Right en wat nog? So as die een lampie doodgaan wat gebeur met die ander een	Die ander sal nog steeds lig.
5	OK. En by series?	Uh. As die draad geknip word of iets gaan dood en dan gaan die anders wat na daai ene is nie lig nie.
6	So OK. Dan is die stroombaan nie voltooi nie.	Ja meneer
7	Reg goed so. Nou wat kan jy vir my se omtrent die goed wat ons in die middag gedoen het. Uh wat kan jy daar onthou. Ken jy so paar goedjies daar vir my noem? Ek praat nou nie van parallel en series nou nie. Ek wil nou weet van daai wat ons in die middag kom doen het. Wat ken jy daar onthou?	Dat daar drie soorte logikas is.
8	Drie soorte? Hulle is.	Of logika en en logika.
9	Die of en die en logika. Wat ken jy vir my se omtrent daai logika? Kom ons se die en logika	Uh. Twee ...skakelaars en twee gloeilampe.
10	Uhm. Nou kom ons se jy het twee skakelaars . By die en logika. Moet altwee daai skakelaars aan wees vir die liggie om te brand?	Uhm. Altwee
11	Altwee.	Ja meneer
12	Daarom roep hulle hom 'n en skakelaar. Is skakelaar A	En Skakelaar B
13	Mooi so. En by die of?	Is. Die een moet aan wees of die ander.
14	Een of die ander. Nou goed. Nou se vir my. Van die twee lesse. Die ene wat ek daar op die bord geteken het van parallel en series of die ene wat julle op die stroombord gewerk het. Watter een was vir jou die lekkerste een	Die ene waar ons moes gewerk het.

NO	QUESTION	RESPONSE
15	Die stroombord. Hoekom?	Want jy doen beter so practise.
16	So wanneer jy self met dit besig is. Doen jy dit beter. Nou watter een het jy die beste verstaan . Parallel en series of die en logika. Watter een het jy die beste verstaan.	Die parallel en series.
17	Het jy dit beter verstaan as die en. Hoekom nou	Want jy weet as die ene nie kan werk kan die ander ene lig by die parallele.
18	Jae k hoor. Miskien het ek nie vir jou die vraag vir jou reg gestel nie. Jy het gese jy het die middag se goed beter geniet want jy werk self. Nou waar het jy beter verstaan. Toe jy self werk of toe ek daar op die bord die lyne trek.	Self gewerk het
19	Toe jy self gewerk het. Met ander woorde. Jy het dan die en logika...jy het met die praktiese werk het jy beter verstaan .	Ja meneer
20	As met die ...met die ander ne?	Ja meneer
21	OK dis wat ek wou weet. Ja nee. Dit is reg Dit is wat ek nou by jou wou geweet het. So wat...as jy nou vir 'n onderwyser wil se hoe moet hy les gee. Hoe sal jy vir hom se wat hy eerder die kinders laat doen?	Praktiese werk
22	Praktiese werk. Want julle verstaan beter as dit so is.	Ja meneer
23	Reg baie dankie hoor. Daarsy. Dan is ons klaar.	

NO	QUESTION	RESPONSE
1	OK, Se net jou naam lekker hard sodat ons kan hoor wie praat	Janeve Mintoor
2	Janeve Mintoor.	Ja meneer
3	OK. Janeve. Uhm. Ek twee keer of by twee geleenthede gepraat oor elektrisiteit. Een keer is in die klas .Was jy in die klas toe praat ek oor parallel stroombaan en series stroombaan. Toe teken ek dit net so op die bord ne. En die ander keer was in die middag na skool. Wat julle mos hier kom sit het en dan het julle gewerk mos na skool. Maar nou wil ek eers weet wat kan jy onthou van parallelle stroombane en series stroombane. Wat kan jy onthou van daai goed?	Parallel het twee stroombane en series het drie stroombane.
4	Parallel het twee stroombane en series het drie stroombane	Ja meneer
5	Se vir my. So terloops nou as. Se nou maar in parallel as die een gloeilampie doodgaan dan wat gebeur met die ander.	Die ander een skyn nog.
6	Hy skyn nog.	Ja meneer
7	En met Series	As die een doodgaan dan skyn die ander twee nog
8	Dan gaan die ander twee ook dood	Nee dit skyn nog.
9	Skyn dit ook nog. OK dan. Nou wil ek weet, daai wat ons in die middag gedoen het. Wat kan jy onthou van die stroomborde wat jy mee self gewerk het.	Van...wat ons geleer het meneer/
10	Uhm	Ons het geleer hoe om 'n ...hoe twee terminale, twee skakelaars te gebruik om 'n gloeilamp aan te sit en ons het nuwe woorde geleer. Ons het ook geleer van geleidingsterminale en van en logika en of logika.
11	En logika en of logika	Laughs
12	Wat is die en logika nou weer. Issit . Se nou jy het twee skakelaars. Hoe moet daai twee skakelaars wees vir die liggie om aan te kom?	1
13	Hulle moet altwee aan wees?	Ja
14	En by die of skakelaar?	Dan ken een aan is en die ander een af is

NO	QUESTION	RESPONSE
15	Die een kan aan wees en die ander een kan af wees. So jy kan of by die ene hom aan sit of by die ander ene.	Ja meneer
16	OK. Nou wil ek weet. Watter van die twee het jy die beste nou uh geniet. Die wat ek met parallel en series daar op die bord gedoen het of die wat julle na skool kom doen het.	Na skool
17	Na skool. Hoekom het jy dit meer geniet?	Want ons het dit self gedoen.
18	Julle het dit self gedoen	Ja meneer, ons het dit self uitgewerk
19	Self uitgewerk	Ja meneer
20	En watter een het julle beter verstaan. Die ene op die bord of die ene wat julle in die middag gedoen het.	In die middag op die stroombaanbord.
21	Hoekom het julle dit beter verstaan	Want ek het meer uitgevind oor dit. Hoe om <u>waar die geleidingsterminale te sit.</u>
22	Die goed het jy so voor jou gesien. Jy het gesien hoe lyk hulle	Ja meneer
23	Is nie strepies wat getrek word op 'n bord nie ne	Ja
	Ja. OK. Dankie. Janeva	

1	Se maar net jou naam lekker hard vir die mikrofoon. Wie is jy?	Vinchesto Holster
2	Vinchesto Holster. Nou OK Vinchesto. Met elektisiteit ne, Het ons twee lesse gehad ne. Was jy op die skool daai dag toe ek op die bord met parallel en series gewerk het?	Ja meneer
3	OK. En dan in die middag het ons ook mos agter gebly toe werk ons met die en skakelaars kan jy onthou.	Ja meneer
4	Die een en daai en skakelaar. En toe was dit die skakelaar of daai skakelaar onthou jy. Die en skakelaars toe on snog gewerk het op die stroombord. Toe julle self gewerk het. En die ander ene parallel en die series het ek net daar by die bord gestaan en ek het op die bord geteken daai drie gloeilampies. OK. Nou wil ek he jy moet vir my se. se vir iets van parallel en series. Wat kan jy onthou wat ons daar gedoen het?	Silence
5	Ons het mos so drie gloeilampies gehet ne. wat ken jy onthou. Ken jy onthou wat ons daar gepraat het.	Nee meneer.
6	Uh	Silence
7	Niks	Meneer paralle is daai drie kolomme
8	Ja. Daai wat ons so drie gloeilampies mos gehad het. Toe praat ons van series en parallel. Jy kan nie lekker onthou nie.	Silence
9	OK. Wat kan jy onthou dan van die en skakelaar en die of skakelaars. Daai goed wat ons in die middag gedoen het. Wat kan jy vir my daar se. Wat het ons daar gedoen?	Toe ons die... stroombaan, stroombaan voltooi het meneer.
10	Ja. Daai met die ding wat julle die selletjies en die drade en so aan. Wat ken jy daar onthou?	Silence
11	Se iets wat in jou kop kom man. Wat het julle gedoen daar	Ons het die stroombaan getoets meneer.
12	Hoe gemaak/	Ons het die geleidings draad aan die terminal ...
13	Jy kan sommer enige woorde gebruik. Jy hoef die daai groot woorde van geleidingsterminale...jy kan sommer maar se drade en bulb ok ne. ek wil net wee twat kan jy nog onthou van daai les.	Ons het die draad na die bulb toe gevat meneer en na die skakelaar toe. En van die skakelaar af toets ons dit na die sel toe meneer en toe toets ons hom uit.

NO	QUESTION	RESPONSE
14	Toe toets julle hom uit	Ja meneer.
15	Toe wat vind julle nou uit daar waar hy twee skakelaars het. As jy die een aan skakel wat het moet met die ander een gebeur?	Ek gaan daai ene afsit.
16	Gaan hy hom afsit. Daai is mos nou die of skakelaar ne? En was daar enetjie wat die ene en daai ene moet aansit dan kom lampie aan?	Ja meneer
17	Daai was mos nou die en skakelaar ne?	Ja meneer
18	Nou wil ek jou vra, watter een was vir jou nou die lekkerste ene. Die ding wat ek in die klas op die bord gedoen het of die ene wat julle in die middag aan die borde gewerk het. Wat was die...watter ene het jy die meeste geniet?	Daai een wat ons op die bord gewerk het.
19	Daai ene wat julle aan die bord gewerk het?	Ja meneer
20	OK. Nou hoekom?	Ons het beter geken meneer.
21	Julle het dit beter geken?	As daai ene op die bord. (Referring writing board)
22	Watter ene het jy die beste verstaan?	Die stroombaan
23	Die met die stroombord. Beter verstaan. As daai wat ek op die bord geteken het. Hoekom het jy dit beter verstaan. Hoekom dink jy?	Dit was maklik meneer.
24	Julle het dit self...	Voltooi
25	Self voltooi en dit het jou beter maak verstaan.	Ja meneer
26	Ja OK dan. Dankie. Jy lyk so bekommerd.	Laugh

NO	QUESTION	RESPONSE
1	OK. Se net jou naam lekker hard vir die mikrofoon asseblief.	Lloyd
2	OK. Nou wat ek by jou wil weet ne.	
3	OK Lloyd se net weer jou naam lekker hard sodat ond kan hoor of die ding werk.	Lloyd
4	OK. Nou kyk hieso. Ons het mos twee keer oor elektisiteit gepraat ne.	Ja meneer
5	Die een keer in die klas. Daar teen die bord toe ek met daai klomp ander goete gewerk het toe het ek so 'n parallel getrek met die gloeilampie sommer op die bord toe praat ons van parallel en van series. En die ander keer was dit weer in die middag. Toe bly julle mos na skool en toe werk julle met daai borde. Nou ja. Ek wil eerste weet. Uh, wat kan jy my se van parallel en series. Ken jy iets onthou.	Jo...meneer
6	Kan jy niks daar onthou nie.	Ek het vergeet meneer.
7	Het jy vergeet. Nee dis OK. Nou wat kan jy my vertel van wat ons in die middae gedoen het. Kan jy dit onthou?	Ja meneer. Ons het van daai stroomborde gepraat meneer. Ons moen die...die uhm ...die terminale en die goeters so vas aan mekaar maak meneer sodat die gloeilampie ken gloei meneer.
8	OK. So jy ken dit onthou. Sal jy daai bord weer so kan opstel as weer so 'n kans kry.	Ja meneer
9	OK. Wat ken jy nog onthou van die en skakelaar .	Ja meneer
10	Jy moet twee skakelaars het. Nou wat gebeur met die en skakelaar. Wat kan jy onthou. Hoe moet dit...Jy het mos twee skakelaars ne en dan jou liggie. Nou wat moet gebeur met die en skakelaar.	Hy moet ok aan wees as die ander een aangeskakel is.
11	So altwee moet aan wees. En die of skakelaar? Jy het ook mos twee...	Die een moet af is en dank an die ander een aan is meneer.
12	So dit maak nie saak nie. Hulle kan een vir een aan gaan. Nou wil ek by jou weet. Watter les het jy die beste geniet. Die ene wat na skool was of die ene wat ons in die klas gedoen het.	Die een na skool.
13	Hoekom	Is beter om soos daai te werk met die goete meneer. As jy dit verkeerd het kan jy dit weer oor doen.
14	Ken jy dit weer oor doen. Watter een het jy dire beste verstaan. Die ene in die klas waar ek die lyne getrek of die een wat julle op die bord gedoen het?	Haai een op die bord meneer.
15	Op die stroombord	Ja meneer

16	OK Nou hoekom het jy dit beter verstaan?	Want meneer is makliker net meneer. Soos uhm. ..weet ook nie hoe kan ek nou se nie.
17	Die stroombord.	Ja meneer
18	Die ene wat jy self doen	Ja meneer. Wat jy die goed self
19	Jy verstaan dit beter. Help gou. As jy dit beter verstaan, jy onthou dit makliker.	Ja meneer
20	Omdat jy self daarmee gewerk het.	Ja meneer
21	Wil jy nog ietsietjie byse daar. Van daai stroombord	Nee meneer. A.a
22	Wat verkies jy. Verkies jy ...	Om so te werk meneer
23	Self met die drade en goed.	Ja meneer
24	Nee dan dankie. Ons is klaar hoor. Jy moet jou vakansie geniet ne.	OK meneer.