

Exploring the Effect of a Dialogical Argumentation Instructional Model in Enhancing Grade Two Learners' Understanding of the Day and Night Cycle

**A thesis submitted in fulfillment of the requirement for the degree of Magister
Educationist in Science Education**

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Key Words

Life Skills; Foundation Phase; alternative conceptions; day and night cycle; Dialogical argumentation instructional model; integrated science-indigenous knowledge systems; Toulmin Argumentation Pattern; Contiguity Argumentation Theory; Socio-cognitive Theory

DECLARATION

I, Florence February, hereby declare that this thesis, “**Exploring the Effect of a Dialogical Argumentation Instructional Model in Enhancing Grade Two Learners' Understanding of the Day and Night Cycle**” is my own work; that it has not been submitted before for any examinations or degree purposes, in another University or for another qualification. All sources I have used or quoted have been indicated and acknowledged by complete references.

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ABSTRACT

Over the last 15 years the Department of Education has rolled out various projects in an attempt to improve Mathematics and Science results and to increase the amount of learners who exit their schooling with those subjects. The 2010 - 2014 matric results show a decrease in the number of students who exiting with Science. One of the factors that might influence the learners' decision to do science can be ascribed to the methodologies that the teachers are using to teach Science. In response to the latter, this study investigated the cognitive shifts of grade two learners' conceptual knowledge of the day and night cycle after being exposed to a Dialogical Argumentation Based Instructional Model.

The Contiguity Argumentation Theory (CAT) and Toulmin's Argumentation Pattern (TAP) were used as a framework to capture and interrogate learners' arguments with argumentation frames developed to categorize the learners' argument responses. Analytical approaches were used to assess learners' argumentation skills along four stages namely intra-argumentation, inter-argumentation, whole class discussion and trans-argumentation.

The study employed both quantitative and qualitative methods. The data was collected from grade 2 learners in a primary school in Cape Town, Western Cape Province in the form of a pre-post questionnaire, focus group interviews and classroom observation. The major findings of this study indicated that

- The Dialogical Argumentation Instructional model can assist learners to develop argumentative skills.
- The grade two learners in this study had alternative conceptions regarding the day and night cycle which is not scientifically valid.
- The views that learners hold are egocentric.
- DAIM is an effective teaching strategy to help learners to eliminate the misconceptions

This study has shown that the Dialogical Argumentation Instructional Model (DAIM) seems to be effective in enhancing the learners' understanding of the day and night cycle.

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DEDICATION

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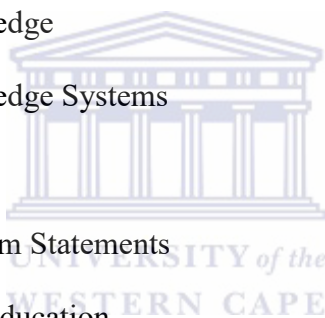
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ABBREVIATIONS

ANA	Annual National Assessments
C2005	Curriculum 2005
CAPS	Curriculum and Assessment Policy Statements
CAT	Contiguity Argumentation Theory
DAIM	Dialogical Argumentation Instructional Model
DNQ	Day and Night Questionnaire
DoBE	Department of Basic Education
DoE	Department of Education
IK	Indigenous Knowledge
IKS	Indigenous Knowledge Systems
Int	Interview
NCS	National Curriculum Statements
OBE	Outcomes Based Education
Pre	Pre-test
Post	Post-test
RNCS	Revised National Curriculum Statements
SIKSP	Science and Indigenous Knowledge Systems Project
TAP	Toulmin's Argumentation Pattern
TIMSS	Trends in International Mathematics and Science Study



CHAPTER 1

OVERVIEW OF THE RESEARCH

1.1 Introduction

Mathematics and science are important for every economy in order to develop a skilled labour force. Furthermore, these two subjects are on demand as they serve as a 'gate-way' for obtaining entry into tertiary institutions and thus to qualify for high skilled jobs. The underachievement of learners in Mathematics and Physical Science is a continuing challenge for the South African Education system. The World Economic Forum (WEF) has ranked South Africa last amongst 148 countries on the quality of Mathematics and Science Education (Wilkinson, 2014). Contrary to the report of the WEF, the Department of Basic Education (DoBE) responded by saying that rankings by the WEF are not an accurate reflection of the state of education in South Africa, but rather a reflection of opinions by some 50 business leaders. The report does not reflect the ability of the learners, but suggests urgent interventions to improve the quality of the South African Education system (Wilkinson, 2014). Based on the 2014 matric results it is evident that there is room for improvement in the Physical Science as well as a need for an increase in the rate of the number of learners who will take up Physical Science. See table below:

Table 1.1: South African learners' performance in Physical Science and Life Sciences for 2013 and 2014

Subject	Year	Number of learners who wrote	Number of learners who passed	Number of learners who passed above 30%	Number of learners who passed above 40%
Physical Science	2013	184 383	124 206	67.4%	42.7%
	2014	167 997	103 348	61.5%	36.9%
Life Science	2013	301 718	222 374	73.7%	47.8%

2014	284 298	209 783	73.8%	48.9%
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Adapted: Department of Basic Education (2015)

Table 1 show the learners' achievement in the Physical Science and Life Sciences for 2013 and 2014. It indicates slight improvement in the learners' results in Life Sciences from 73.7% in 2013 to 73.8% in 2014. The results for Physical Science show a decreased in learners' achievement from 42.7% in 2013 to 36.9% in 2014. It also shows a decrease in the number of learners who exit with Life Science and Physical Science (DoBE, 2015).

Despite the Department of Education's effort to improve the pass rate and quality of results in the core subjects such as Mathematics, Life Sciences and Physical Science, research is showing that learners steer away from pursuing these core subjects (Mucaca, 2013). Although there are more learners sitting down for the South African National Senior Certificate examinations, not many of them exit their schooling with mathematics and sciences as a matriculation subject. In 2014 the Department of Basic Education (DoE) reports showed a decline in the number of learners who wrote mathematics and science between 2009 and 2013 (Spaull, 2013). The graph in Figure 1 below shows a steady decline in the number of learners who took Physical Science as a subject. The numbers dropped from 210 168 in 2010 to 171 549 in 2014 (Mybroadband, 2015).

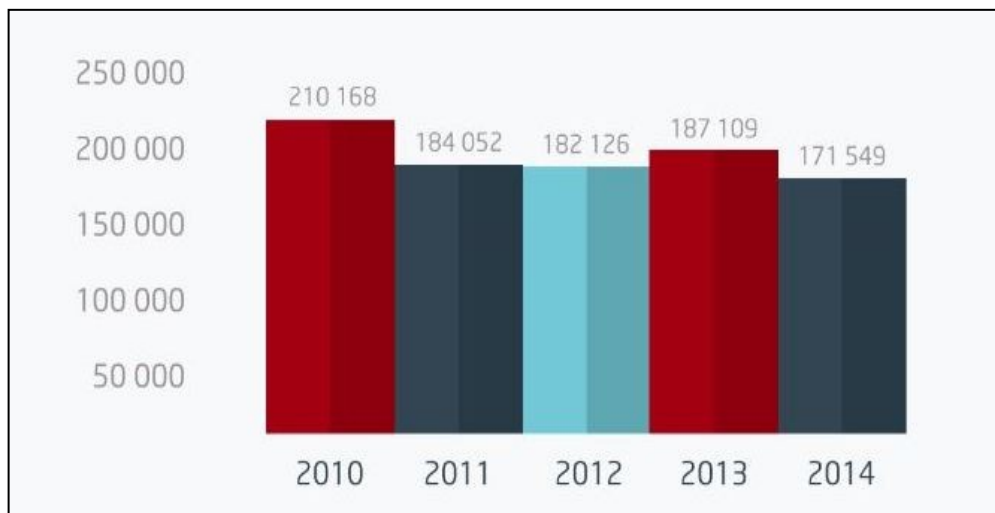


Figure 1.1: Physical Science Enrolment for the period of 2010-2014 (Mybroadband, 2015)

One of South Africa's top educational priorities for the 21st century is to improve mathematics and science education. In 1991, Mathematics and Physical Science have been given presidential priority and various initiatives have been implemented to improve these subjects (Bernstein, 2005), yet the results of the learners show little or no improvement. The number of learners, who passed with 40% and above as shown in Table 1 is a matter of concern. The Department of Basic Education will have to intervene by providing schools, teachers and learners with intensive support to increase the learners' achievement rates in these subjects.

The reason why learners do not pursue mathematics and science can be attributed to a number of factors. A number of researchers have identified possible reasons why learners do not pursue these subjects in the Further Education and Training (FET) Band:

- Learners have a choice to do so.
- They may not have a career path in mind which requires mathematics and science.
- Gender bias (more boys tend to continue with science).
- The greatest barrier seems to be language (especially the African home language speaker who have to learn content-based subjects in English as a second language).
- Difficulty in not only understanding of the words used, but also the cultural context of the material (Henderson & Wellington, 1998).
- Lack practical skills and understanding.
- Schools do not offer mathematics and science due to the *small* number of learners pursuing these subjects, or a shortage of teachers (Makgato & Mji, 2006).

This phenomenon is not only peculiar to South Africa as American students also view science, mathematics and technology as boring subjects; too difficult or unwelcoming, which do not prepare them to meet the challenges of their generation, their country and what the world might face in future (Hossain, & Robinson, 2012). In the same vein Hossain and Robinson (2012) identified inadequate academic and curriculum support as a challenge faced by teachers.

Extensive research undertaken by the Centre for Development and Enterprise shows that the number of Mathematics and Science graduates have not increased. The research also

indicated that the Department of Education is still failing to deliver quality mathematics and science to school learners (Spaull, 2013). This failure in delivery may have a significant impact on our economy if the status quo remains unchanged. According to Bernstein (2005), the Department of Education needs to equip our learners with mathematics and science skills to meet the country's need to improve economic growth.

Globally initiatives are implemented by various organisations, institutions and governments as intervention strategies to improve the teaching and learning of science. Since 1994 the DoBE introduced various initiatives to fast-track mathematics and science in South Africa (Campbell, Max, Perold & Jooste, 2007). A national strategy to improve mathematics and science has given birth to the Dinaledi Programme which sought to improve the mathematics and science matriculation results as well as to increase the number of higher grade learners in these subjects and to increase the pass rate of learners in Grade 10 - 12 (WCED, 2005). Another South African initiative is presented by the University of the Western Cape's Science education department. The project is referred to as the Science and Indigenous Knowledge Systems Project (SIKSP) whose aim is to enhance South African science teachers' ability to integrate science with indigenous knowledge systems within their classroom as proposed by Specific Aims 3 of the Curriculum and Assessment Policy Statements (CAPS) (DOE, 2011). In turn, this initiative is to help learners see the relevance of the science they learn at school in conjunction with their life-worlds and indigenous knowledge as experienced in their socio-cultural-home environments.

One of the initiatives in Australia is the Primary Connections programme presented by the Australian Academy of Sciences, which seeks to improve the learning outcomes in Science and Scientific literacy. The programme is offered to both pre-service and in-service teachers. It is funded and supported by all states and the Australian Education Departments, Catholic and Independent Schools including the science and literacy teacher associations (Hackling, Peers & Prain, 2007). Similar initiatives were implemented in South Africa but not from grassroots; that is, Grades R – 3, or the learners and teachers in the Foundation Phase. These initiatives targeted the Intermediate Phase (Grade 4 – 6), Senior Phase (Grade 7– 9) and the Further Education and Training (Grade 10 – 12) band. To this effect, I have identified the Foundation Phase as an area in need of consideration hence the focus of this study. This study looks at selected science aspects in the Foundation Phase.

Studies based on the learning of elementary science by elementary learners; report that teachers are recognising that young learners can engage actively in learning science. There is an understanding amongst researchers that young children must be exposed to the science content and processes early in their school careers so that they can become more skilled as they navigate through the science content and processes in the higher grades. This can also contribute to the developing of the learners' higher order thinking and reasoning skills which will in turn cultivate their analytical and problem solving abilities; all of which are vital in the learning of science (Keeves, 1995; Rowe, 1992). So how do we do it? Laying a solid foundation for Natural Science should be established in the Foundation Phase on which scientific concepts can be built and constructed.

Generally, children who enter school do not have any formal instruction about scientific topics. The concepts and perceptions which they hold about the natural world are based on their experiences and observations (Trundle, 2007). Various studies were done on the conceptions which learners at various levels and ages hold on the cycle of day and night. For example, Vosniadou & Brewer (1994) studies focussed on grades 1 - 5; Salierno, Edelson & Sherin, (2005) for the fifth graders, Kampeza & Ravanis (2006), Harlow (2009) and Kikas, (2010) for ages between 5 and 6, Papandreou & Terzi (2011) for Kindergarten, Smolleck & Hershberger (2011) for ages between the 3 - 8 years, and Bernstein (2013) for elementary schooling. According to these studies, learners hold different views on the cycle of day and night. Their pre-conceptions which are based on their beliefs were mainly reported as misconceptions or alternatively may now be considered as alternate conceptions.

This study explored the use of learners' prior knowledge and argumentation in facilitating the learning of Natural Sciences of grade two learners with a view to enhance their science conceptual understanding. The focus of the study is based on the conceptions that learners hold about the day and night cycle. The Dialogical Argumentation Instructional Model (DAIM) was used as a teaching strategy as it affords the learners opportunity to share their views with other learners and teachers (Ogunniyi and Hewson, 2008). The collaborative and participatory nature of the processes in DAIM offers an alternative transmission mode and collection of arbitrary facts which is prevalent in school science. DAIM is a useful and effective instructional tool to facilitate the integration of Indigenous Knowledge Systems (IKS) with school science.

Ogunniyi (2008) argues that the interactive classroom arguments and dialogues help participants to eradicate misconceptions, upgrade existing knowledge, acquire new attitudes and reasoning skills, gain new insights, make informed decisions and even change teachers' and learners' perceptions.

1.2 Background

Many students at all levels of high school struggle to learn Physical Science concepts and are often unsuccessful (Nakhleh, 1992). A number of studies have been conducted to discover the reasons why learners experience difficulties in understanding some scientific concepts. One of the reasons is the way in which science terminologies are presented in the Foundation Phase science curriculum and in the workbooks provided by the DoBE. An analysis of the Foundation Phase science curriculum done by Morris (2014) noted that the terminologies used are common, everyday familiar words which are simplistic and not challenging enough for learners to develop scientific knowledge. She substantiates her findings with relevant examples such as the following: 'tummy', 'head' and 'animals which we do not get on earth anymore' (Morris, 2014, p. 168). The everyday representation of school science in the syllabus does not afford the teachers to teach scientific knowledge in relation to the scientific discourse. It guides teachers to teach science in terms of everyday language.

Secondly, this could be further exacerbated by the teachers' lack of confidence. A study by Bosman (2006) reports that South African teachers do not lack the confidence to teach science, but rather their confidence levels are determined by a particular content area that they prefer to teach. Her study found that teachers display a preference to teach the content from the Life Sciences, while they lack an interest and the confidence in Physical Science. This has huge implications for the developing of learners' scientific knowledge in the upper grades, because certain content areas are not covered, or not taught regularly in the foundation phase. The fact that teachers only teach what they are competent to teach, might lead to gaps in the learners' experiences from all the content areas (Bosman, 2006).

There is a great concern in many countries (ICSU, 2011) that the overall level of scientific literacy is poor and learners are not being attracted to do science and or to pursue careers as scientists. Science education is facing serious challenges and developing countries face even bigger problems than economically developed countries due to the lack of teaching resources (ICSU, 2011). There is a great need to improve the preparation of future scientists. Not only

do we need to improve the quality of instruction, but we also need to improve the motivation and interest of learners to exit their schooling with science in order for them to follow a career path into science enquiry.

With the introduction of Curriculum 2005, outcomes-based education (OBE) was the approach to be used as a teaching strategy. OBE is underpinned by three characteristics namely, learner-centeredness, outcomes-based education and an integrated approach to knowledge (Chisholm et al., 2000). However, one of the principles that underpins the National Curriculum, referred to as Curriculum Assessment Policy Statement (CAPS), is - active and critical learning. Active and critical learning seeks to move away from rote and uncritical learning. (DoE, 2011). The National Curriculum Statements (DoE, 2011, p. 5) aims to produce learners that are able to:

- Identify and solve problems and make decisions using critical and creative thinking;
- Work effectively as individuals and with others as members of a team;
- Organise and manage themselves and their activities responsibly and effectively;
- Collect, analyse, organise and critically evaluate information;
- Communicate effectively using visual, symbolic and/or language skills in various modes;
- Use science and technology effectively and critically showing responsibility towards the environment and the health of others; and
- Demonstrate an understanding of the worlds as a set of related systems by recognising that problem solving contexts do not exist in isolation.

The above aims imply that teachers should change their instructional approaches so that learners can take responsibility for their own learning. It requires teachers to consider interactive teaching and learning approaches and methodologies in teaching the content. They are now required to facilitate learning rather than being transmitters of knowledge.

Dialogical argumentation as a teaching and learning strategy has the possibility to enhance the teaching and learning of science and indigenous knowledge systems, with a view to acknowledge the contribution of an otherwise marginalised indigenous knowledge system prevalent to the experiences of the socio-economic-cultural environment as experienced by learners in South Africa (Langenhoven, 2009). Several studies have indicated the value of

dialogical argumentation as an instructional approach to develop the teachers' (Langenhoven, 2009; Kowfie, 2009; Dinie, February and Kroukamp, 2013) and learners' (Ogunniyi, 2004; Ogunniyi, 2014) scientific knowledge in science education as well as increasing their awareness about the nature of scientific inquiry (Ogunniyi, 2004; Ogunniyi, 2014). A dialogical argumentation instructional method creates teaching and learning spaces where the learners acquire skills by analyzing, evaluating and applying knowledge. The teaching environment in a dialogical argumentation paradigm allows learners to express their views freely without being judge. The dialogical argumentation framework used in this study focuses on interaction of individual learners or a group of learners reaching consensus on a phenomenon through argumentation.

The study intended to explore the effectiveness of the Dialogical Argumentation Instructional Model (DAIM) as a teaching and learning strategy when teaching the day and night cycle taught in the Foundation Phase. The Dialogical Argumentation Instructional Model (DAIM) as a pedagogical instructional strategy transpired through the involvement of master and doctoral students in the Science Indigenous Knowledge Systems Project (SIKSP) spearheaded by Professor Ogunniyi. This pedagogy to teaching creates a space for learners to think, speak and share their ideas and experiences by changing from didactic to dialogue. The researcher strongly believes that DAIM as a teaching strategy has the potential to support teachers in teaching science by using the learners' existing (*indigenous*) knowledge as a starting point to teach scientific knowledge.

1.3 Motivation for the study

I was motivated to undertake this study after being exposed to the Dialogical Argumentation Instructional Model (DAIM) in the Science and Indigenous Knowledge Project (SIKSP) at the University of the Western Cape spearheaded by Professor Ogunniyi. The members of SIKSP are in-service teachers, master and doctoral students who are engaged in workshops and seminars to equip themselves with both the content and pedagogical knowledge. The purpose of these seminars is to facilitate the implementation of the Natural Science CAPS syllabus which advocates teachers to integrate IK with the school science knowledge. SIKSP members explored the Nature of Science (NOS), Nature of Indigenous Knowledge System (NOIKS) in order to grapple with the requirement of an integrated Science-Indigenous Knowledge Curriculum. Theoretical and analytical lenses used during the workshop/seminar

series were Toulmin's (1958) Argumentation Pattern (TAP) and the Contiguity Argumentation Theory (CAT) (Ogunniyi, 2007a & b).

During the workshop/seminar series the SIKSP members had the opportunity to share ideas about their research related to the NOS, NOIKS and the integration of both knowledge areas. Dialogical argumentation was used as a framework to scaffold discussions. It made me aware of the potential that argumentation has in learning Science. Firstly, it made me aware of the impact that learners' pre-scientific (existing/prior) knowledge has on their learning of school science. The prior knowledge of learners plays a very important role in the acquisition of new concepts (Pine, Messer & St. John, 2001). Yet, teachers often neglect children's prior knowledge. By ignoring the experiences of learners which are vital in the conceptualization of the world is the same thing as ignoring their alternative conceptions which they hold about the world. It is inappropriate to ignore the learners' preconceptions of the different phenomena, and hope that they will overcome it at a later stage in their schooling. In contradiction to the latter, Driver (1981) reported that the learners prior knowledge can hamper learners' ability to learn further about a topic in the context of more formal learning. Learners' prior knowledge is often based on their cultural and religious beliefs, therefore Ogunniyi (2009) emphasized the importance of the teachers' awareness of the learners' IKS or religious worldviews; these views can help teachers to determine to what extent learners from traditional communities accept scientific worldviews. The learners must be encouraged to adjoin the two worldviews and not to abandon their cultural knowledge for conventional science. Ogunniyi further noted that scientific views are often not robust enough to explain the learners' vast experiences to which they are daily exposed to.

Secondly, implementing DAIM in my instructional practice assisted me to integrate selected science and indigenous knowledge topics naturally. DAIM provided me a framework to encourage learners to speak freely and at the same time giving me the opportunity to discover their preconceptions as well as their indigenous knowledge. I found that using DAIM give learners the opportunity to construct knowledge collaboratively, as well as improving their communication skills, especially during the cognitive harmonization stage.

1.4 Statement of problem

A lot of research was done in science education on foundation learners, but not a lot of research was done in the South African context on Earth Sciences. In the review of literature, I only managed to locate three research studies done in the South African context in Natural Science on different topics in the foundation phase.

It must be noted that when learners enter school, they do not have any formal teaching in astronomy (Hannust & Kikas, 2007). However, the views that learners hold are based on self-observation, everyday experiences, pictures, television, and oral transmission of information passed on through story telling by family members.

On the contrary, the Revised National Curriculum Statement (RNCS) (DoE, 2002), and the Curriculum and Assessment Policy Statement (CAPS) (2011) advocated that knowledge in the Natural Sciences and Social Sciences syllabus be integrated with indigenous knowledge as a strategy to induct and to develop the learners' scientific knowledge. In doing so it is believed that teachers tap into the prior knowledge of learners to teach school knowledge. This in turn, develops a holistic understanding of their socio-cultural environment and bio-physical environment.

The conceptions formed by learners are normally different from the scientific facts which sometimes influence their learning and might lead to resistance to change, (Stahly et al., 2008; Smolleck & Hershberger, 2011). The conceptions and perceptions that learners hold are not the same. This can be due to the fact that their experiences and information which was passed down are either religious and/or cultural beliefs. Hence, the goal of science education is to assist learners to develop understanding of concepts and to apply them when solving problems (Çelikten & Ipekcioglu., 2012).

Globally, studies done with learners on the occurrences of day and night reported that their views range from naïve to scientific ideas of the cause of day and night (Küçüközer & Bostan, 2010; Smolleck & Hershberger, 2011) Learners have alternative knowledge to the canonical science of the cause of day and night, and on the sun and the moon cycles (Mosoloane, 2006). A study done by Küçüközer & Bostan (2010) with 52 six year olds from Turkey found that learners have various ideas which are not accepted as scientifically

accurate on the conceptions of day and night, the seasons and moon phases. It is worth noting that some astronomy-related phenomena such as the changes of the moon can be observed physically with the naked eye, whereas learning about the shape of the earth depends on social transmission of information (Bernstein, 2013).

Based on the findings of Bosman (2006), foundation phase teachers select the content of the curriculum with which they are confident to teach. Her findings reveal that Earth and Space are one of the least favourite content areas that teachers teach. Of the 191 foundation phase teachers in her study, only 33% indicated that they prefer to teach the Earth and Space content. In addition to the latter, a report by Spaull (2013) reported that the South African teachers are unaware of their own learning deficits and they do not fully understand the demands of the curriculum. This has huge implications for the learning of classroom science in the upper grades.

1.5 Purpose of the study

The purpose of this study is to determine the effectiveness of a Dialogical Argumentation Instructional Model (DAIM) on grade two learners' understanding about the day and night cycle in the Natural Science curriculum. More specifically, it investigated things such as:

- Grade two learners' pre - and – post scientific conceptions about the day and night cycle and the influence it has on their daily activities.
- The effectiveness of DAIM in enhancing the foundation phase learners' understanding of the effect of day and night on their daily activities.

1.6 Research questions

In pursuance of the aims of the study, answers were sought to the following questions:

- What are the grade two learners' conceptions about the day and night cycle?
- Can grade 2 learners associate daily activities to the night and day cycle?
- Can DAIM be used effectively to enhance the learners' understanding of day and night?

1.6.1 Research Hypotheses

The following null hypotheses with regard to the questions above were posited for testing:

- Grade two learners do not hold valid scientific conceptions of the effect of the day and night cycle.
- The Dialogical argumentation instructional model will not have significant influence on the learners' conception of the day and night cycle.

1.7 Theoretical Framework

This study is inspired by a quest to explore the effectiveness of DAIM as an approach to teaching scientific knowledge in the Foundation Phase. This study is informed by Vygotsky's (1978) Socio-cultural constructivism theory. It is further informed by Ogunniyi's (2005) Contiguity Argumentation Theory (CAT) and Toulmin's (1958) Argumentation Patterns.

Toulmin's Argumentation Pattern assisted the researcher to determine the degree to which learners learn to engage in discussions. Toulmin (1985) provided various elements by which a learner's substantive arguments can be analyzed. It includes the following 6 elements, claims, warrants, backing, data, qualifiers and rebuttals. Due to the complexity of TAP various researchers modified TAP, such as Erduran, Simon and Osborne, (2004) who used the analytical framework to determine learners' argumentative discourse during group work.

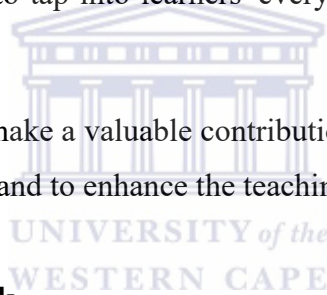
Contiguity Argumentation Theory, on the other hand assisted me to determine the cognitive shifts learners made after they have been exposed to DAIM, a teaching and learning strategy used to improve their understanding. CAT deals with both logical or scientifically valid arguments as well as non-logical metaphysical discourses expressed while airing their indigenous, traditional worldviews as based on their religious, cultural and or other beliefs. Ogunniyi's CAT interprets learning as a dynamic process prone to change as a person's cognitive state changes especially when he or she is dealing with conflicting worldviews. The worldviews can change from one context to another. This theory asserts that a worldview that is dominant in one context may become suppressed in another or it can be assimilated into a dominant worldview (Ogunniyi, 2005).

1.8 Significance of the study

Learners enter the Science classroom with some conceptions about natural phenomena, such as the day and night cycle, that are not scientific. This is mainly due to the learners' traditional beliefs and social and cultural practices. The conflicts between the two views hamper meaningful learning of Science if it is not addressed. This study deemed to have the potential to:

- Create an awareness of the learners' conception of the cycle of day and night.
- Enhance their understanding of the impact that day and night cycle has on their daily activities.
- Inform the Department of Education in terms of an alternative and effective methodology to assist teachers to implement the South African CAPS science-IKS curriculum.
- Inform teachers on how to tap into learners' everyday knowledge to teach scientific knowledge.

It is hoped that the findings will make a valuable contribution to the Department of Education to improve the results of learners and to enhance the teaching and learning process.



1.9 Conceptual Framework

In this section, I will discuss the context and design of the research. Furthermore, I will establish the research paradigm and finally I will give a brief explanation of the methodology I used in this study.

1.9.1 Context and research design

This study was conducted with 77 grade two learners from a school situated in Mitchells Plain, Cape Town in the Western Cape, South Africa. A pre-post questionnaire was designed to ascertain the conceptions that learners hold about the day and night cycle which is taught in the grade two Life Skills curriculum. Follow-up interviews were conducted with a sample consisting of a group of six learners to provide richer information on the data supplied in their questionnaires.

The quantitative research design used in the study was a quasi-experimental design. An intervention session with the experimental group (E) was conducted to explore the

effectiveness of an argumentation based instructional model, the Dialogical Argumentation Instructional Model (DAIM) using different activities, models and other resources to enhance the learners understanding of the day and night cycle. To determine the effectiveness of DAIM a comparison with a traditional instructional method was conducted using a control group (C) also on the concepts that are taught in grade two.

As this study is limited to 77 participants, the study is not representative of South African schools. More detail is provided about the sample groups and setting in Chapter 3.

The background of this study and the research literature provided the rationale for the investigation of the research questions. Furthermore, the third research question was necessary as it provided me with answers on the effectiveness of DAIM. I observed changes in the learners' understanding, as well as attitudes and learner involvement during Natural Science lessons.

1.9.2 Research Paradigm

Babbie (2010) asserts that research paradigms are used as frames of reference that we use to organise our observations and reasoning. Sikes (2004, p. 8) explains that a research paradigm is “a basic set of beliefs that guides action”. Paradigms play an important role in our daily lives. Babbie (2010, p. 33) further recognise that we operate within a paradigm (1) "we can better understand seemingly bizarre views and actions of others who are operating from a different paradigm", and (2) sometimes we benefit from stepping outside our paradigm. To move out of your paradigm makes it possible for one to see new ways of seeing and explaining things.

According to Sikes (2004) two paradigms exist that have influenced educational research, namely scientific, positivist, objective, quantitative paradigm, and the interpretative, naturalistic, subjective, qualitative paradigm (Sikes, 2004). To answer the research questions a descriptive research paradigm was used that includes a quasi-experimental, interpretative and mixed method. A mixed method was used in which the study elaborates and expands on the quantitative data findings qualitatively (Creswell, 2007).

The procedures used and data collection procedures to answer the first and second research question are both interpretive and descriptive in nature. A pre-post questionnaire determined the pre- conceptions which learners hold on the day and night cycles. The data collected from the questionnaire were quantitatively analyzed. The data collected during the interviews were conducted with both the (E) and (C) groups based on the alternative views learners hold. The produced data during the interviews, classroom observation and the intervention were qualitatively analyzed.

1.10 Operational definitions

Some of the terminology that is used in this study is briefly explained from the point of view of this study, and to ensure that is clearly understood. The following operational definitions will be used throughout the report of this study.

Life Skills

Life Skills is a subject that forms part of the Curriculum and Assessment Policy Statements (CAPS) document that is taught in South African schools, in the Foundation Phase. The Life Skills subject is central to the holistic development of learners. It is organised into four study areas, namely, Beginning Knowledge, Personal and Social Well-being, Creative Arts and Physical Education (DoE, 2011).

Foundation phase

The National Qualifications Framework (NQF) (1996) refers to the Foundation Phase as the lowest level of the General Education and Training Band (GET). This term is used in the study to refer to grades R, 1, 2 and 3. The focus of this phase is on the development of primary skills, knowledge and values, and to lay a good foundation for further learning (DoE, 2003). The foundation phase was previously known as junior primary.

Worldview

To Kearney (cited by Ogunniyi et al., 1995: p. 818) 'A worldview is a culturally organised macro-thought: those dynamically interrelated assumptions of a people that determine much of their behaviour and decision making, as well as organising much of their body of symbolic creations'.

Concept

Wikipedia defines concept as a mental symbol or an abstract idea about the nature of a given subject matter, drawn from an individual's experience or the result of a transformation of existing ideas. Kikas (2010) views the knowledge of children's concepts as important for learning, as it influence the way learners interpret new information while learning in school.

Alternative conception

Alternative conceptions are conceptions held by learners, which developed through their own interpretations, experiences and explanations in their early years which differ from scientific facts (Smolleck et al., 2011).

Indigenous Knowledge Systems (IKS)

A system of thought peculiar to people of a local geographic location or socio-cultural environment. This implied that knowledge was not borrowed from another locality or culture (Ogunniyi, 2008).

Contiguity Argumentation Theory (CAT)

Contiguity Argumentation Theory consists of five cognitive-mental states that are constantly in flux and used in this study as an analytical tool to analyze conceptions, perceptions and worldviews of people of a qualitative nature (Ogunniyi, 2000).

Toulmins' Argumentation Pattern (TAP)

TAP is an analytical tool used to rate claims, evidence, warrants, qualifiers, counter-claims and rebuttals of people. It can be used to rate the rigour of an argument involving controversial socio-scientific issues (Toulmin, 1958).

Dialogical argumentation instructional method

This refers to a dialogical argumentation based instructional strategy use in science classrooms during which statements or viewpoints are made and challenged or defended through an organized procedure. If DAIM is employed as an approach to teach, it requires from the teacher to develop structured activities to facilitate the learners' learning. DAIM construes argumentation as starting from the individual (intra-argumentation), then the small groups (inter-argumentation), and finally to the whole group (trans-argumentation) where the final collaborative consensus is reached (Ogunniyi, 2015).

1.11 Thesis layout

Chapter 1

This chapter provides a rationale for conducting this study with grade two learners located at a school in the Western Cape, South Africa. The chapter is focused on the purpose of the study, research questions, theories underpinning the study, as well as an introduction to the Dialogical Argumentation Instructional Model (DAIM).

Chapter 2

This chapter interrogates the literature based on the research questions in order to explain the use of the selected appropriate conceptual framework and theoretical bases. The theoretical underpinning to the study was also discussed here. The literature reviewed was also used in the discussion of the findings in Chapter 4.

Chapter 3

Chapter 3 focuses on the research design used and the selection of the sample used in the study. Qualitative and quantitative methods were used as tools to gather data as to find answers to the research questions. It is also elaborated in this chapter how data was collected, interpreted and analyzed using both qualitative and quantitative methods. Lastly, ethical considerations undertaken in the study are presented.

Chapter 4

The data generated in this study is presented and discussed in this chapter. The qualitative and quantitative findings are discussed at length in terms of the intervention strategy, DAIM employed in this study. The discussion and findings are considered with reference to the literature review in Chapter 2.

Chapter 5

Chapter 5 finally respond to the research problem and give answers to the research questions investigated in the study. This chapter also draws conclusions, reflect on the study, discuss the research limitations of the study and offer some recommendations based on what I've learnt and also suggest some issues for further research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter explores the theoretical and practical aspects of this study. It examines the literature in a broader context of learners' conceptions which they hold about the day and night activities which are taught in grade two classes. It highlights the alternative conceptions held on the day and night cycle. The chapter also provides a report on successful professional development intervention programmes, which informed the design of the instructional model that was used during the study. Finally, this chapter explores the theoretical framework based on the Contiguity Argumentation Theory and Toulmin's Argumentation Patterns which is used to guide the study. This study is related to empirical research undertaken by Ogunniyi (2007 a&b), Jegede (1995) and Erduran, et al. (2004).

A review of literature made me aware of several theoretical frameworks that have been proposed to describe the implementation of DAIM in the classrooms to increasing learners' understanding on various scientific concepts (Philander, 2012; Riffel, 2013; George, 2014). Since my study seeks to determine whether DAIM has an effect on learners' conception of the day and night cycle, I found the Vygotsky's socio cultural constructivist theory, Toulmin's Argumentation Pattern (TAP) and Contiguity Argumentation Theory (CAT) appropriate to guide this study. These theories provided a framework for the method used, the data collection and analysis based on the effect that DAIM has on the learners' understanding when teaching the topic, 'life at night' in the foundation phase Natural Science curriculum.

2.2 Natural science in the foundation phase

Natural Science in the foundation phase curriculum is a study area in the subject, Life Skills. Life Skills is central to the holistic development of the learners in the foundation phase. It entails the social, personal, intellectual, emotional and physical growth of foundation phase learners. Life Skills is viewed as the umbrella subject that supports and strengthens the other core subjects such as Mathematics and Literacy.

The aim of Life Skills is to guide and prepare learners for life and its possibilities, as well as equipping learners for meaningful and successful living in a rapidly changing and transforming society. Learners are exposed to a range of knowledge, skills and values which strengthen their:

- Physical, social, personal, emotional and cognitive development;
- Creative and aesthetic skills and knowledge through engaging in dance, music, drama and visual art activities;
- Knowledge of personal health and safety;
- Understanding of the relationship between people and the environment;
- Awareness of social relationships, technological processes and elementary science. (DBE, 2011:9)

Life Skills is categorized into four study areas, namely Beginning Knowledge, Personal and Social Well-being, Creative Arts and Physical Education. The time allocation for Life Skills in the foundation phase is as follows:

Table 2.1: Instructional time allocation for Life Skills

Grade	Beginning Knowledge and	Personal and Social Well-being	Creative Arts		Physical Education	
	Time allocated per week	Time allocated per term	Time allocated per week	Time allocated per term	Time allocated per week	Time allocated per term
Grade R - 2	2 hours	20 hours	2 hours	20 hours	2 hours	20 hours
Grade 3	3 hours	30 hours	2 hours	20 hours	2 hours	20 hours

(DBE, 2011:14)

The subject Natural Science is often neglected in the foundation phase, as the foundation phase teachers regard the subjects, Literacy and Mathematics as the 'main priorities' (Bosman, 2006, p.241). This can be due to the amount of time allocated for Natural Science, as well as the place of Natural Science in the Foundation Phase curriculum. The allocated instructional time for Natural Science in the curriculum for the various grades are:

Grades R - 2 is one hour per week and in grade 3 the time allocated is two hours per week. Bosman's (2006) study reflected that only 52% of the teachers who participated in her study teach Science at least once a week, and 48% of the teachers do not teach enough Science.

For the purpose of the study the focus will be on the study area, Beginning Knowledge and more specifically on Natural Science. Below are the key concepts and skills relating to these disciplines in the curriculum at Foundation Phase level.

Social science concepts: conservation, cause and effect, place, adaptation, relationships and interdependence, diversity and individuality, and change.

Natural Science concepts: life and living, energy and change, matter and materials; planet earth and beyond.

Scientific process skills: the process of enquiry which involves observing, comparing, classifying, measuring, experimenting, and communicating.

Technological process skills: investigate, design, make, evaluate, communicate.

Beginning Knowledge are organized in topics which can be integrated with content from the different study areas where possible. The topics can be adapted to suit the school contexts; and teachers can choose their own topics which they find most appropriate (DBE, 2011).

2.2.1 Teaching Science in the Foundation Phase

The teaching and learning of Life Skills in the foundation phase is guided by principles, such as:

- Age appropriate activities. Instead of memorizing facts which are not within the learners' contexts, learners should be encouraged to collect pictures themselves, engaged in classroom discussions relevant to their age and interest, as well as talking to people in their community.
- Lessons must be presented in the learners' home language. Foundation Phase teachers must create opportunities for learners to express themselves in which they can show their competence or understanding of concepts.

- The knowledge chosen by teachers must enhance the life skills of the learners. The knowledge which is taught in the foundation phase must be relevant and expand on the learners' life experiences, yet teachers must not limit them only to what they already know, but the knowledge must be selected to expand on their existing knowledge (DoE, 2003).

2.2.2 Earth and space science in the foundation phase

Earth and space science deal with the Earth or any part of it and the Earth's space environment. It deals with disciplines of geology, oceanography, meteorology, and astronomy. It involves the application of physical and biological sciences in a study of Earth, the solar system, and its place in the universe. The concepts taught in the earth and space sciences include properties of materials, weather, the dynamic earth systems, aerodynamics, space flight, the solar system, stars, and the universe (Sunal & Sunal 2002).

Learners in the foundation phase should have experience with and understand that:

- Some events in nature appear once, while others have a repeating pattern. The changes from night to day. The motions of the sun, moon, and stars all have regular patterns.
- The sun appears in different locations in the daytime sky. The location is related to the time of day and the seasons. The location of the sun can be determined by its height in the sky and its direction along the horizon.
- Sometimes the moon is in the sky at night and sometimes it's in the sky during the day.
- The moon looks different every day. It gets larger and then smaller and repeats its shape change month after month. The location of the moon in the sky is different from day to day. Evidence for its location can be determined from its height in the sky and its place along the horizon.
- There are more stars in the sky than we are able to count. They do not all have the same brightness and colour. They are scattered throughout the sky. Stars appear only in the evening sky. Stars appear to move slowly together across the sky each night.
- The different appearance of a planet and a star can be observed with a telescope or by observing it over a period of time to see if they change their positions among the other

stars. The names of the planets that orbit about the sun. All the planets revolve around the sun in the same direction.

- Stars are suns that are so far away that even though they have motions of their own, to the naked eye each seems to continuously remain stationary in relation to the other stars around it. Stars in the night sky are different distances from earth, but they are so far away that they all appear to be the same size. The Sun is an average star in terms of its physical characteristics. Stars have different sizes, temperatures, compositions, and life histories.
- The Earth. The different types and textures of soil.
- Satellites and information that we get from satellites (Adapted from Sunal & Sunal 2002).

Research indicates that learners have developed ideas related to concepts about the movement of the earth, planets, the sun and moon (Sunal and Sunal, 2002). Studies done by various researchers reported that learners in the foundation and intermediate phase hold alternative conceptions about the changes of day and night (Papandreou & Terzi, 2011; Kampeza & Ravanis, 2006) and the shape of the earth (Bernstein, 2013; Celikten & et al., 2012; Kampeza & Ravanis, 2006; Vosniadou, Skopeliti & Ikospentaki, 2004). Learners have different explanations to explain to themselves or to others events which are linked to the cycle of the day and night. According to Galperin & Raviolo (2015) the day and night cycle can be explained satisfactorily using two frames of references: (a) topocentric - referring to the movement of the sun in the sky below or above the horizon), and (b) heliocentric (Earth rotating on its own axis, alternating the parts that get direct sunlight). In their study done with both teachers, teaching at primary and secondary level, and learners of different ages and schools, they found that elementary and secondary learners primarily explained the day and night cycle using the topocentric frame of reference. They further note that this frame of reference is appropriate for the teaching of 'astronomical phenomena' at elementary level (Galperin & Raviolo, 2015).

Earlier models which were used by learners to explain day and night cycle and of celestial bodies and other phenomena are influenced by egocentricity which is deeply rooted in direct observation by themselves (Kikas, 2004; Nussbaum & Novick, 1982).

Below in Table 2.2 are some of the ideas/conceptions expressed by learners about the shape of the earth and the occurrence of day and night as reported by researchers.

Table 2.2: Preconceptions held by learners

Shape of the earth	Day and night cycle
"The Earth is round"	"we sleep and then it becomes day again"
"Yes, it is like a ball" (Papadreu & Terzi, 2011)	"the moon goes off, hides in the mountains and the sun comes" "the sun falls in the sea and then becomes night and the moon and the stars" (Kampeza & Ravanis, 2006)
"The earth is round but when you look at it, it is flat"	"During the day the Earth has the sun and the clouds...when it leaves, it is night... and all the children all around go to sleep"
"Because if you were looking around it would be round."	(Papandreou & Terzi, 2011)
"Round, like a thick pancake." Vosniadou and Brewer, 1992	"The earth's movement around the sun leads to the occurrence of day and night" "When sun moves around the, day and night occur" "I think when the moon covers the sun, night occurs. When the moon does not cover the sun, day occurs" (Celikten & Ipekcioglu, 2012)

Researchers and teachers (Kambouri & Briggs, 2013) often referred to ideas such as the above statements expressed by learners as "alternative conceptions" (Lucariello & Naff, 2015), "pre-perceptions" (Garnett & Treagust, 1992), "naïve theories" (Pine et al. (2001) or "misconceptions" (Schoon, 1989; Celikten, et al. 2012). For the purpose of this research study, the term alternative conceptions will be used to refer to the learners' ideas that are not scientifically accepted amongst scientist.

2.3 Alternative conceptions of learners

Conceptions refer to ideas, objects or events that help us understand the world around us. In contrast to the latter, alternative conceptions refers to ideas that provide an incorrect understanding of such ideas, objects or events that are constructed based on a person's experience (Martin et al., 2002 in Thompson and Logue, 2006). Alternative conceptions are

often not incorrect, but based on learners' cultural and IKS background, which often differ from what is to be scientifically correct.

When learners enter school, they often hold deeply rooted knowledge or conceptions about the world. These conceptions derive from limited observation and experiences (Goris, 2010; Salierno et al., 2005; Smolleck, 2005). One of the limitations of alternative conceptions is that it lacks universality, which means that the conception might be true or work well in one situation, but not in others. Goris (2010) suggested if it is not altered, these alternative conceptions will exist for years. Alternative conceptions held by learners influence the way how learners learn formal science experiments in school. Although this may be true, it can at some time prove good foundation for formal schooling, whilst other conceptions might be incompatible with scientific knowledge (Goris, 2010). Learners can carry alternative conceptions with them for long periods, even into adulthood. As noted by Pine et al. (2001) and Ogunniyi et al. (1995) often teachers themselves can have alternative conceptions about science, and children's alternative conceptions may be as a result of this (teachers' alternative conceptions).

Learners are not aware that the knowledge or conceptions they hold may be scientifically incompatible, because alternative conceptions can be deep-rooted on their thinking. Alternative conceptions formed by learners tend to be resistant (Ferrer, 2013) to instruction, because it entails replacing or radically re-organise their knowledge. Learners use these inaccurate understandings, to theorize and grasp new information. Therefore educators should not ignore the learners' alternative conceptions (Kambouri & Briggs, 2014; Valanides, 2000), but utilize it as a foundation for learners to understand school science. Identifying and utilizing these conceptions of learners into their lessons create an opportunity for learners to develop scientific knowledge which counter runs with their existing knowledge. Sithole (2004) explains that the two world views (IK and School Science) are underpinned by different epistemic authorities, and both of science and IK strive for objectivity.

Teachers are placed in a very challenging position to bring about significant change in learners' knowledge, as the teachers' own cultural beliefs are also influenced by their own cultural beliefs and practices. Therefore science teachers must recognise that cultural practices can influence the teaching and learning of science (Taale, 2009).

2.3.1 Identifying and utilizing alternative conceptions for conceptual change/knowledge construction

Conceptual change theories may view the co-existence of the different world views as a failure, because the relationship between science and IKS is of conflict, and the one replaces the other. Researchers such as Aikenhead, 1996; Jegede, 1995 Oguuniyi and Hewson, 2008 view this co-existence of thought systems as a more realistic view about knowing and coming to know as it reflects the realities that teachers and learners live in. As individuals, we are consistently confronted in situations where we need to tap from appropriate thought systems in different contexts.

Learners tend to compare and connect their views on where they live (Sunal and Sunal, 2002; Ferrer, 2013) to the knowledge which is presented in the classroom. The existing ideas and conceptions of learners have been recognised by (Smolleck, 2005) as a necessity in order for teachers to adapt their teaching strategies. Determining and diagnosing learners' pre-existing knowledge is important for teachers to plan their teaching activities and help learners to connect new knowledge to what they already know. Smolleck (2005) contend that learners' prior knowledge is the starting point as it guides their perceptions about what they have experienced in the real world as well as what they ought to learn. In doing so, it can also help learners to construct their own understanding of scientific concepts. This calls for teachers to make use of innovative strategies to activate and to be aware of their existing ideas and conceptions.

Cimer (2006) suggested the following approaches to enhance learners' conceptual understanding of scientific phenomenon:

- questions and answer
- small group activities
- small group or whole group discussions
- practical work, and
- incorporating information communication and technology into their teaching.

Schoon, J (1989) suggested direct observation of natural phenomena during science lessons to overcome these alternative conceptions. In order for learners to accommodate scientific knowledge, Nussbaum and Novick (1982) suggests that teachers should make learners aware of their own alternative conceptions. They further noted that learners must believe that their

existing conceptions are unsatisfactory. In order for new conceptions to be acknowledged, it must be intelligible, plausible and fruitful (Posner, Strike, Hewson & Gertzog, 1982). Whilst they suggest self-discovery through the manipulation of physical resources to assist learners to retain important information regarding science, Lucariello & Naff (2015) presume that traditional forms of instructions such as lectures, 'chalk and talk', discovery learning and simply reading of texts, are not appropriate approaches to help learners to deal with cognitive conflict to accommodate scientific concepts (Postner, et al., 1982). Furthermore Posner, Strike, Hewson & Gertzog (1982) contend natural science must not be taught in isolation, but integrating science with other subjects should be emphasized during teaching. The science curriculum does not specify how teachers can help their learners to recognize and value IKS in order to integrate it with school science.

As previously mentioned in Chapter 1, the Curriculum Assessment Policy Statement (CAPS (DOE, 2011) advocates for the integration of indigenous knowledge in the Natural Science and Social Science curriculum to introduce and develop learners' scientific knowledge. Ogunsola-Bandela (2009) reported that a cultural view of science combined with appropriate instructional approaches have shown to be effective if educators are provided with a conceptual framework and pedagogical approaches which support the science learning to different learners. Taale (2009) emphasizes that it is important for teachers to recognize that cultural practices will most likely influence the teaching and learning of science. However, teachers must also understand that such influences can either be negative or positive. Recognizing learners' indigenous knowledge gives them the opportunity to learn, understand and to appreciate the cultural knowledge beliefs and practices in a multi-cultural society such as South Africa.

2.3.2 Language contributes to alternative conceptions

Language is one of the issues affecting learner achievement in science or any other school subject. For most times the medium of instructions is not the learners' home language, therefore learners struggle to learn science effectively (Gumede & Msimanga, 2013).

In certain cases learners learn science in their second or third language. In most South African classrooms the Language of Learning and Teaching is English, which is not the language of Science. The language of Science is a language socially constructed by means of observation and experience. Science teachers in South Africa are faced with major challenges

of trying to close the gap between the learners' home language, the language of teaching and learning and the language of science.

According to Vygotsky (1987) language plays an important role in learning as it involves speaking (Vygotsky, 1987; Odora-Hoppers, 2005) and thinking (Gumede & Msimanga, 2013). However, in multilingual classrooms it is difficult to organize learner's knowledge because science is taught in a language that makes it hard for learners to talk about and think through scientific concepts (Probyn, 2006).

Makgato and Mji's (2006) study used a non-experimental, exploratory and descriptive method to establish grade 11 learners' and 10 educators' views about factors which contribute to poor achievement in both Mathematics and Science. One of the indirect factors attributed to learners' poor achievements was the general language usage together with its understanding in these subjects. It must be noted that the mother-tongue of these learners is Sepedi, and the science and mathematics lessons are conducted in English. The learners in their study find that it is difficult to understand some of the concepts in mathematics and science. Learners find words which overlap in usage problematic as it sometimes affect their understanding of the subject and it result in them developing alternative conceptions. Most of the teachers confirm that it is sometimes difficult to explain concepts in the vernacular because it brings about confusion and misinterpretation of ideas. This caused one of the teachers to depend heavily on the language used in the textbook in the hope that learners will understand as he explains the concepts Makgato and Mji's (2006).

2.4 Indigenous Knowledge Systems

Indigenous Knowledge Systems is defined by Odora-Hoppers & Makhale-Mahlangu (1998, p.8) as:

The combination of knowledge systems encompassing technology, social, economic and philosophical learning or educational, legal and governance systems. It is knowledge relating to the technologies, social, institutional, scientific and developmental experiences including those in liberation struggle.

Ogunniyi (2008) on the other hand view it as:

A system of thought peculiar to people of a local geographic location or socio-cultural environment. This implied that knowledge was not borrowed from another locality or culture (Ogunniyi, 2008, p. 8).

Ogunniyi's definition is based on the knowledge a community in a specific area accumulated over years, passed on orally or through imitation and demonstrations from generation to generation. It encompasses all forms of knowledge which include technologies, practices (Mosimege & Onwu, 2004) and beliefs which enable a community to sustain and adapt their lives in a variety of environments. This implies that such knowledge is changing and evolves as it develops through the influence of both internal and external circumstances and interaction with other knowledge systems. Such knowledge includes the content and contexts such as agriculture, architecture, engineering, mathematics and other systems and activities, medicinal and indigenous plant varieties. Thus, the knowledge can be referred to as philosophies that have developed over years by societies through interaction with their natural surroundings and other people.

IK is not compartmentalized in various disciplines such as the structure of the science education curriculum which is categorized into different disciplines. In the South African context CAPS require the foundation phase teachers to teach science holistically, but in the FET band science become specialized and is taught in different subject areas. The learners are then allowed to choose amongst the following subjects: Life Science, Agricultural Science and Physical Science.

Table 2.3: Assumptions underlying science and indigenous knowledge systems (Ogunniyi, 2004)

Assumptions underlying science	Assumptions underlying indigenous systems
Nature is real, observable and testable	Nature is real, and partly observable and testable
Space is real and has definite dimensions	Space is real, has definite dimensions but ultimately incommensurable
Time is real and has a continuous , irreversible series of durations	Time is real, continuous and cyclical
Matter is real and exists within time and space	Matter is real and exists within time, space and the ethereal realm
All events have natural causes	The universe is orderly, metaphysical, partly predictable and partly unpredictable
The universe is orderly and predictable i.e. nature is not capricious.	The universe is orderly, metaphysical, partly predictable and partly unpredictable
Scientific laws and/generalization are causal, logical, rational, impersonal and universal.	Indigenous generalizations have causal, personal, rational/non-rational, logical/non logical dimensions.
Language is not important to the workings of the natural world.	Language is important as a creative force in the workings of both the natural and the unnatural worlds.
Science is culture free	Indigenous knowledge is a critical part of culture
Science is concerned with ‘what’ not, ‘what ought to be’.	Indigenous knowledge is concerned with ‘what ‘ ‘what ought to be’ and ‘why’
Scientific facts are tested observations	Facts within indigenous knowledge corpus are both tested and experiential observations
Science is based on a dualistic worldview	Indigenous knowledge is based on a monistic, dualistic and pluralistic worldview.
Humans are capable of understanding nature	Humans are capable of understanding only part of nature

Both school science and IKS hold certain aspects of the cultures from whence they have evolved. It goes without saying, that colonialism and Western education have given the former a distinctive and political advantage over the latter. One must remember that the objective of the IKS-science curriculum is to integrate the two – knowledge and not to dichotomize one of the two, but to see how the two types of knowledge can co-exist and be harnessed to enrich the lives of indigenous people in their struggle to adapt to a rapidly changing environment (Ogunniyi, 2011).

2.4.1 Integrating indigenous knowledge into the school science curriculum

The integration of indigenous knowledge (IK) into science education is a process requiring the infusion of two worldviews which appear to be in conflict. Such integration may seem impossible as the two thought systems are premised on different epistemological, ontological, axiological and metaphysical beliefs (Diwu & Ogunniyi, 2011, 2012; Ogunniyi, 2007a). The integration of science and IK in the school curriculum requires a lot of sensitivity for it to succeed, but in doing so it can provide indigenous learners with an opportunity to express and reflect on their ways of knowing. This will allow learners to gain ideas of how to engage and exchange ideas with scientific explanations.

Although the majority of South African learners come from indigenous population, a Western culture is usually epitomized in the way explanations about various natural phenomena are taught in school science. School science often fails to give priority to harmonizing school science with the learners' life-world culture, their native language (Makhure, 2013) and culturally appropriate learning strategies (George, 2013). The education system has undergone transformations since 1994 when the ANC-led government came into power, in its attempts to provide good quality teaching for all learners in South Africa. In 1997 when Curriculum 2005 (C2005) was introduced, an outcomes-based approach to education was adopted, to ensure that all learners achieve the educational outcomes (DOE, 2002), Curriculum 2005 (C2005) also called for the integration of school science with Indigenous Knowledge Systems (IKS), because these systems reflect the wisdom and values which the Southern Africa people acquired over centuries (Ogunniyi, 2009). C2005 has caused debate amongst the role players in education, especially the teachers, because it failed to show how teachers can support learners to recognize and value IKS in order to integrate it with school science (Ogunniyi, 2007). The available science textbooks often do not consider IK, or did not reflect the cultural practices in the learners' communities (Ninnes, 2000).

In many other countries such as Namibia (Uushona, 2013) and Mozambique (Castiano, 2009) there was also a call for the integration of Science and IK. The Namibian National Curriculum for Basic Education (2010) advocates the integration of indigenous knowledge with science thus emphasizing cultural inclusivity in education. Namibian teachers are encouraged to adequately include IK in their teaching and learning practices to harmonize it with the Nature of science (Uushona, 2013). Mucaca (2013) sees the integration of IK-

science curriculum in Mozambique as a strategy for teachers not to ignore the fact that learners at their schools come from different cultures, have different identities, and perceptions of reality which may have an impact on the different meaning which they assign to objects, processes and natural phenomena.

Many other African countries did the same, but the teachers have difficulty in understanding what the term IK means (Ogunniyi, 2007). Furthermore they do not know which teaching strategies can be used for incorporating IKS within the conventional science classroom without comprising the integrity of both systems of thought (Ogunniyi, 2013). Ogunniyi (2006, 2007 a&b) elucidates that the integration of school science with IK require more than good subject specialization, the availability of teaching and learning materials, but it is critical for teachers to have a thorough understanding of the nature of both science and IKS. Although IK is an unfamiliar concept among educators, IK practices do exist in the local communities where they lived and taught. In a study done by Onwu (2009) it was found that teachers often have the tendency to position indigenous knowledge in opposition to science as if there were an absence of science in IK, or no IK in Western knowledge. In Onwu's (2009) study the conceptions of the teachers' IK were based on one dimensional view of IK, as spiritual, cumulative and collective knowledge that is continually reinterpreted, and not based on hypothesis testing, theories and laws.

Widely, researchers acknowledge that an inclusive IK-science is the foundation to learners' understanding of the relationship between school science and the learners' life world outside school. Integrating IK with school science promotes cross-cultural interactions among all learners to enhance the development of societal identity amongst learners from demarcated indigenous communities (Ogunniyi, 2013). It can be used as a mechanism for the development of learners' skills and expansion of their knowledge. Indigenous knowledge in the teaching and learning process of Natural Sciences are of great importance (Mucaca, 2013), because it allows teachers to tap into the learners' IK to teach school science. Prior knowledge use in lessons invites and engages learners, as well as raising an interest by learners to do science. Onwu (2009) construes that inclusivity dictates that all learners should get the opportunity to participate actively in learning and experiencing science.

Although the integration of the IK-science have the potential to improve the learners' understanding of the science concepts, the structure of the science lessons still reflects a

western type of education structure which does not accommodate indigenous methods of teaching learning and assessing (Masemula, 2013). This can be due to the fact that IK does not form part of assessment in an exam-driven curriculum in the South African education system (Diwu, 2010). The latter has the potential to minimize the urgency of learning about IKS and its importance to learners whose main goal is to pass their exam (Masemula, 2013).

It is worth noting that a culturally responsive science curriculum seeks to connect what is known about the world in science education with what the local people know and value. Jegede (1995) argues that it is difficult for new learning to take place if the socio-cultural environment of the learner is ignored. Coupled with the latter is the mismatch between the socio-cultural environment of the learner and science curriculum which often results in ineffective learning of science, as well as the teachers' inability to harmonize science with the learners' IK (Diwu, 2010).

2.5 Constructivism

Constructivism is rooted in the work of constructivist theorists such as, Jean Piaget's (1962) and Lev Vygotsky (1978). Both of these researchers see learners as active, not passive, in the construction of knowledge and their own cognitive structures of meaning. According to Piaget (1962), the intellect is an internally organized structure which is continually constructed and reorganized as the individual adapts to the environment. The construction process involves the interaction between the internal structure of knowledge and the external stimuli that occurs when the individual acts on things which he or she experiences in the world. The interaction and construction produce an intellectual structure of a higher order as the learner organizes and adapts incoming information. As the child grows, the mind does not make copies of reality, but it organizes information into existing patterns (Piaget, 1962).

Lev Vygotsky, a Russian psychologist, offered an alternative to Piaget's stages of cognitive development. His Socio-cultural Theory of Development became a major influence in the field of education. One of the features that are unique is that mental processes exist between people and amongst people in social learning settings (Van de Walle et al., 2013). Vygotsky's (1978) approach was the first modern psychological study which looked at the view of human development which takes into account the cultural and social experiences of

development. Another feature of his theory is the way in which information is internalized. Internalizing information greatly depends on whether it was within the learner's zone of proximal development (ZPD). The zone of proximal development refers to a physical or cognitive space, it refers to the gap between a learner's actual level of development (what he or she already knows) and his or her potential level of development (what he/she is capable of under adult guidance or in collaboration with more capable peers) (Vygotsky, 1978).

2.5.1 Socio-cultural constructivism

It is incumbent upon the educator to create an environment which encourages learning. The educator should use teaching methods which will make the lessons interesting and encourage learners' creative and critical thinking.

This study is underpinned by socio-cultural theory as espoused by Vygotsky. In this perspective knowledge are constructed when learners actively engage socially in talk and activity about shared problems and tasks. It can be assumed that to make meaning is thus a dialogic process that involves people in conversations. Learning in a socio-constructivist environment takes place in conjunction with a more skilled member. This implies that learning makes learners appropriate cultural tools through their involvement in the activities of this culture. Throughout the learning process, a more experienced person of a culture supports a less experienced person by structuring tasks, making it possible for the less experienced person to perform them and to internalize the process (Driver, et al., 1994).

Constructivism provides a perspective on teaching and learning science in classrooms, to improving the effectiveness of science teaching, and in doing so enhancing learners' learning. The core principle of constructivism on learning science suggests that knowledge construction is strongly influenced by social environments. Learners learn science through a process of constructing, interpreting and modifying their own representations of the world based on their experiences and observation. Therefore, constructivists acknowledge social dimension of learning such as the classroom and the learning community whereby learners make meaning of the world through personal and social processes (Driver et al, 1994).

However, this sort of learning environment is not likely to occur if the educator dominates the instructional process through the chalk-and-talk teaching method. Learning is a cultural

activity, which enables one to relate in a meaningful way to the human and material environment. Within the socio-cultural constructivist regime arguments and dialogues are an effective way of communication and freedom of expression.

2.6 Argumentation

Argumentation is a rhetorical tool used by early Greek philosophers, and are still currently being used by scholars in their attempts to unravel the nature of matter and the universe as a whole (Govender, 2013). For the last two decades there has been an increased interest to explore the effectiveness of argumentation in enhancing teachers' and learners' understanding of the nature of science. Several studies have shown the importance of introducing argumentation in science classrooms (e.g., Driver, Newton & Osborne, 2000, Siegel, 1992), to support knowledge construction (Driver, et al, 2000; Erduran, Simon & Osborne, 2004).

Argumentation is a statement or constellation of statements advanced by an individual or group to justify or refute a claim in order to attain the approval of an audience or to reach consensus on a controversial subject (Ogunniyi, 2007a), or to reach consensus on a controversial topic (Govender, 2013). Erduran, Simon & Osborne (2004) observed that argumentation is becoming popular as a leading instructional approach and educational goal for science education. Duschl & Osborne (2002) claims that learners' engagement with scientific processes can be facilitated through the process of argumentation. Furthermore, group discussions and arguments allow learners to develop the necessary argument skills to convince the other group about the validity of their argument.

Philander (2013) used a dialogical argumentation approach as an alternative teaching method to enhance a group of grade three learners' understanding on water pollution. The results of the study shows that some of the alternative conceptions which learners held on water pollution were remedied through argumentation and discursive classroom courses. It was found that the learners in her study found it initially difficult to engage in discussions and even more so to co-construct arguments. However, after coaching the learners in argumentation skills (Christenson, 2015), they were able to demonstrate higher order thinking skills to support their claims and counter arguments. Findings from Philander's (2013) study are not congruent with the findings from the study by Foong and Daniels (2010) who investigated the Form Two learners' (aged 14-15 years) grounds in terms of Genetically

Modified Foods. Their study shows that learners were unable to refute grounds above their cognitive levels of understanding.

To successfully implement argumentation in the classroom necessitates professional development for science teachers (Lawson, 2002). Ogunniyi (2004, 2005, 2007a, 2007b) and Ogunniyi & Hewson (2008) have carried out various studies in an attempt to:

- Explore teaching strategies which support argumentation, and
- Analyse the ability of science teachers to implement argumentation-based instructional approaches in science classrooms.

One of the limitations of argumentation instructional approaches is the time spent on one lesson. The focus in science education is on learners' results, as schools are measured against the number of learners who passed the examination, and not on the quality of learning. For this reason many teachers may steer away from argumentation based instruction, because they need to cover the curriculum in a short space of time, and preparing learners for the examination.

2.6.1 Dialogical argumentation instructional model (DAIM)

The majority of the South African science teachers are not familiar with the dialogical argumentation instructional model. DAIM attempts to create a classroom environment where learners are able to work together, learn together, clear their doubts, express their views freely without intimidation, and affirm their sense of socio-cultural identity in the spirit of Ubuntu (Diwu & Ogunniyi, 2012; Ogunniyi, 2004; 2007a & b; 2011). It also seeks to evaluate the teachers' perceptions of DAIM and to implement and indigenized science curriculum.

DAIM construes argumentation as starting from the individual (intra-argumentation), then the small groups (inter-argumentation), and finally to the whole group (trans-argumentation) where the final collaborative consensus is reached (Ogunniyi, 2015). Habermas' (1972) notion of fair argument namely:

- No person who is unable to make a relevant contribution may be excluded.
- All participants have equal opportunities to contribute.

- Participants are truthful in what they say and,
- Learners' contribution is freed from internal or external coercion (Ogunniyi, 2004; 2007a & b).

During participation in dialogical argumentation learners perform cognitive tasks where they are able to employ all forms of reasons at their disposal (both scientific and IK-based arguments). It is during this process where learners can clear their doubts, reconstruct their views and reach consensus with their peers.

2.6.2 Toulmin's Argumentation Pattern (TAP)

Toulmin's Argumentation Pattern (Toulmin, 1958) was used as a framework to initiate debate on conceptions and perceptions of the day and night cycle. TAP has been used by various researchers (Eduran, Simon & Osborne, 2004; Ogunniyi 2004; Simon, Erduran, & Osborne, 2006; Ogunniyi & Hewson, 2008) to improve teachers' and learners' understanding of the Nature of Science. Toulmin's Argument Pattern below (Figure 2.1) is a useful tool in this study to categorize arguments into 'discernible patterns' for example, claims, backing, warrants, qualifiers and rebuttals.

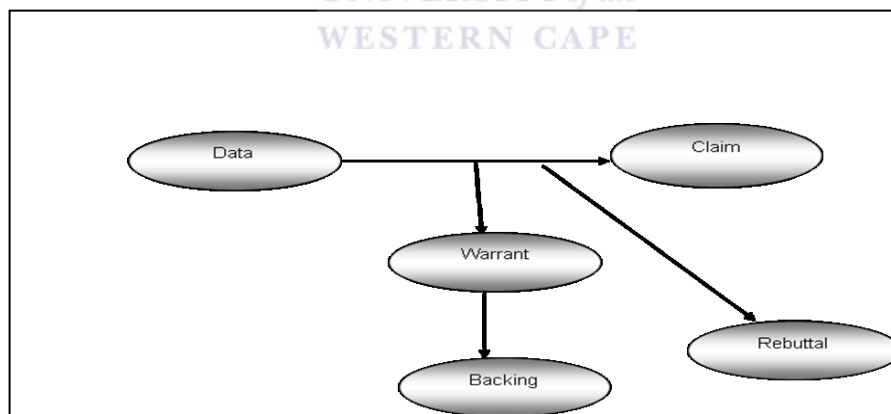


Figure 2.1: Toulmin Model of Argumentation

Essentially TAP involves the following aspects, processing of **data** – which is the facts or evidence used for supporting a claim, **claims** – is the statement or belief about a phenomenon whose merits are in question, **warrants** – is statements used to establish or justify the relationship between the data and the claim, **backings** – which is the explicit assumptions underpinning the claim, **qualifiers** – which is the conditions governing the claim, and **rebuttals** – which are statements which show that the claim/counter-claims or any of the

grounds are invalid. TAP argumentations in the classroom discourse can be classified into seven levels of argumentation, from level 0, which is a non-oppositional argument to level 6, which involves arguments with multiple rebuttals challenging the claim and/or grounds. According to Ogunniyi in Diwu (2013) TAP cannot be used to explain congruities in the learners' arguments, especially where two or more worldviews are interfaced.

On the other hand Erduran, Simon, & Osborne (2004) collapse Toulmin's data, warrants and backings into grounds due to the practical difficulties of reliably differentiating between these argumentation components. According to Erduran et al. (2004), the structure of argumentation and its assessment is based on two major assumptions about what counts as quality. Firstly, high quality arguments must contain grounds (i.e., data, warrants, or backing) to substantiate a claim because developing rational thought is reliant on the ability to justify and defend one's beliefs. Secondly, arguments which include rebuttals are of better quality than those without oppositional episodes. Arguments without rebuttals have the potential to continue forever with no change of mind or evaluation of the quality of the substantive aspect of an argument.

2.6.3 Contiguity Argumentation Theory

The theory, Contiguity Argumentation Theory (CAT) draws on the Platonic and Aristotelian contiguity's school of thought which claims that two states of mind tend to connect and co-exist to create an optimum cognitive state.

According to Ogunniyi (2007a&b) the Contiguity Argumentation Theory recognizes five categories into which conceptions can move within a student's mind or amongst students involved in dialogues justifying scientific and/or IKS-based conceptions. He contends further that these five categories exist in a dynamic state of flux in a person's mind. The cognitive states are as follow:

- **Dominant mental state** – a powerful idea that is most adaptable to a given context.
- **Suppressed mental state** – the dominant cognitive stage can be overpowered by another more adaptable mental stage.
- **Assimilated mental state** – when the dominant mental stage is absorbed into another more adaptable mental.

- **Emergent cognitive stage** – an emergent cognitive stage occurs when an individual has no previous knowledge of a given phenomenon as would be the case with scientific concepts.
- **Equipollent mental state** – when two competing ideas or worldviews tend to co-exist in the mind of the individual, without necessarily resulting in a conflict.

The Contiguity Argumentation Theory provided me with a framework to analyse the perceptions and conceptions of the learners after they have been exposed to DAIM, to determine whether there was a cognitive shift or whether their worldviews stayed the same.

2.7 Empirical studies on conceptions of day and night cycle

Over the last few decades, researchers started to recognize that students do not enter the class as empty vessels, but come to school with a wealth of informal knowledge about the world and how things are operating. Various studies have been conducted on the science content which is taught in primary schools, as well as the alternative conceptions learners hold on certain topics. Globally, studies were done to determine the conceptions learners and teachers hold on the day and night cycle, as well as the impact of dialogical argumentation as a teaching strategy. The findings of some of these studies report on the value which the prior-conceptions of learners have in developing learners understanding and knowledge in natural science.

A case study done by Salierno et al. (2005) reported on three grade five learners' conceptions of the relationship of the earth and the sun. The aim of the study was to investigate the effectiveness of Planetary Forecaster in enabling students to develop understanding which they can recall and apply when appropriate, as well as capturing the students' alternative conceptions about the factors which affect surface temperature. The data were collected through pre-post interviews, classroom observation and classroom interactions. Throughout the study, the learners displayed alternative conceptions which were previously identified in other research studies. However, the three new alternative conceptions below appeared in the data collected:

- The sun rays of the sunlight from the sun can curve around and reach portions of Earth that are not facing the sun.

- A different part of the sun sent rays of different strength to Earth and indicated that the farther that rays of light travelled, the stronger they are.
- One of the learner's pictures depicted spots that resemble sunspots from the popular press.

Their study found that learners retained some of the alternative conceptions they held at the beginning, and their conceptual understanding regarding the relationship between the earth and the sun is more fragmentary than theory-like. The activities designed for this study indicated that it supported and helped learners to construct new understanding which closely resembles scientific understanding, but it does not fully address these learners' preconceptions (Salierno et al., 2005).

Pine et al. (2001) did a study among 122 primary school teachers teaching Key Stage 1 (i.e. children in year one and two between the ages 5-7) on the children's misconception in Science. This study identified 130 misconceptions in science which they bring to the science classes. A questionnaire was used to gather data on: (1) the science topics which learners have difficulty with and the naive ideas the learners exhibit, (2) the teachers' awareness of the learners' prior knowledge and how it affects their learning, and (3) learners' understanding of scientific experimental procedures. The data reflects that teachers are aware that learners do not come to school with a wealth of knowledge about their physical world based on their everyday experiences.

Papandreou and Terzi's (2011) study examined methodological issues, designing and implementing the processes. This study was done in Greece with sixteen children between the ages 5-6 and five children between the ages 4-5. The multi-method approach and activities in conjunction with group discussions were used to elicit the children's thinking. They started off using a doll to get learners involved and to encourage learners to express their ideas. Their results revealed that drawings can be a useful tool for learners to express their ideas. They (Papandreou & Terzi, 2011) found drawings to be a useful tool for learners to communicate the content of their drawings, but through group discussion they communicated content which is not present in their graphical presentation. Their study makes it clear that drawings and group discussions can be used as alternative methods for learners to express their ideas freely. They suggest that the design of the processes and activities must take into account the socio-cultural characteristics and habits of learners. In doing so, the activities done in science

lessons will have some meaning, because it takes into account their experiences and it helps the learners to represent and communicate their thinking.

Thurston, et al. (2006) explored the constructivist methods to support and enhance the learners' science understanding regarding light and earth space, highlighting the importance of language and social interaction. The data collected from a group of 41 nine year old learners in this study supports social interaction as an effective model to promote the children's learning in science, as well as conceptual change. Taking the learners' preconceptions into account, the teaching techniques used in this study such as questioning and scaffolding supported learners to widen and deepen their understanding on the topic in question.

Kampeza & Ravanis (2006) study revealed that learners' initial knowledge about the day and night cycle and the movement of the planets were poor, whilst the earth's shape was more familiar to them. The pre- and post tests done in the study shows a significant difference ($z = 7,05, p < 0,001$) in the learners understanding about the simultaneous movement of the earth. Their findings suggest pre-school learners are capable of understanding elementary astronomy concepts, regardless of their perceptive nature in most of the content.

The day and night cycle is a phenomenon which learners experience daily. They have different explanations to explain to themselves or to others events that are linked to the cycle of day and night. Earlier models which were used by learners to explain day and night cycle and of celestial bodies and other phenomena are influenced by egocentricity which is deeply rooted in direct observation of themselves (Kikas, 2004; Nussbaum).

Dialogical argumentation is a teaching approach used in science classrooms to make learning interactive. It offers an alternative to the traditional teaching method and collection of arbitrary facts that is prevalent in school science classroom (Stone, 2009; Ogunniyi 2007 a&b). The co-construction of concepts that emerge from the dialogue based on the way scientist think and work (NOS), allows a place for indigenous interpretation (Stone, 2009).

2.8 Summary

This chapter reviewed literature about the alternative conceptions held by learners regarding the day and night cycle, argumentation as a teaching strategy in an attempt to integrate

science and IK in science classrooms as well as constructivism. The different stages of the dialogical argumentation instructional model used in the study were highlighted to indicate the important role that it has in a collaborative learning environment.

Toulmin's (1958) Argumentation Pattern (TAP) and Ogunniyi's (1997) Contiguity Argumentation Theory (CAT) were identified as a lens to interrogate claims made by learners. The two theoretical frameworks are chosen because of their amenability to classroom discourse dealing with phenomena on which learners might be holding conflicting worldviews.

Chapter 3 will describe the background of the research strategy and includes an explanation of the research methodology, the participants, the data collection, the data analysis techniques as well as ethical issues and validity employed in this study.



CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the overall research design and methods used in conducting this study. The approach described in this study will be, followed by the methods of data collection. Data was collected through pre and post-test questionnaires and focus group interviews. This study aimed at determining the effectiveness of a Dialogical Argumentation Instructional Model (DAIM) on Grade two learners' understanding of the day and night cycle in the foundation phase Life skills curriculum. To be more specific, Beginning Knowledge which forms part of Natural Science is the focus of this study. The focal points will be: the learners' concepts and perceptions of the day and night cycle before and after the proposed intervention. This chapter gives a detailed account of the approaches used in the development of the instruments, and to determine the effectiveness of DAIM in enhancing the Grade two learners' understanding of the effect of day and night on their daily lives. Lastly it will establish the validity and reliability regarding the research process. It also includes the research design, sampling procedure, collection of data and analysis.

3.2 Research setting

The study was conducted at a multilingual and multiracial township school in the Western Cape. There are 1 274 learners and 37 qualified educators at the school. The classes range from Grade R to Grade 7. Each class has an average of 40 learners, which gives teacher-learner ratio of 1:40. There is a security guard who monitors the school gate for the safety of the teachers and learners. Four caretakers are employed to take care of the cleanliness of the school. The school has one science laboratory, but it is currently used as a classroom, as there are not enough classrooms to accommodate all the learners at the school. Most of the learners are described by the teachers as coming from a poor background. Poverty, unemployment, shack-dwelling and related survival ethos and other social problems are rife. A feeding scheme is in place at the school to ensure that learners get a plate of food.

The language of teaching and learning (LoLT) is English as the first language, and Afrikaans as a second language. Extra-mural activities are offered to learners after school hours.

This particular school was selected due to the fact that I have access to the classrooms and school grounds. Good relationships of trust with the learners, teachers and principal of the school have been established in a school-based project which I conduct at the school. The researcher has currently been mentoring a novice teacher at the school over a period of two years. Demonstrations of lessons are one of the core processes in the mentoring programme, which gives the novice teacher a wonderful opportunity to observe a teaching approach which engages learners in group work and argumentation. The study was conducted during teaching time. The timetables were followed as the researcher did not want to disrupt the daily programme of the teacher.

3.3 Research sample

This study used purposive sampling of learners to illustrate the conception of learners on the cycle of day and night before and after the interventions. The participants were purposefully chosen by the researcher. According to Cohen, Manion and Morrison (2000, p. 103):

“The purposive sampling technique is used when the researcher handpicks the cases to be included in the sample on the basis of their judgment of their typicality” and experience of the central phenomenon being studied”.

In addition, McMillan and Schumacher (2006, p. 319) also agree that purposive samples are chosen because they are likely to be knowledgeable and informed about the phenomena the researcher is investigating. This form of sampling compliments my research approach and design as the qualitative approach mainly focuses on the in-depth description on samples or participants selected purposefully.

The subjects in this study consisted of 77 grade two learners as indicated in Table 3.1 below, 42 girls and 35 boys from two classes at the same school. The learners in the study were heterogeneous. One class was used as the experimental group another class was designated as the control group. The validity of the results may be influenced due to the fact that both groups come from the same school, thus the possibility that contamination could have

occurred between the two groups. To minimize any contamination, the researcher arranged that both classes write the pre-and post test at the same time and finish at the same time to prevent learners discussing the questions during interval.

The teacher who taught the control group who received an alternative intervention is a qualified Foundation Phase teacher with 26 years teaching experience at the school. She is the Foundation Phase head of department at the school. She is currently teaching a Grade two class and also have teaching experience in the Grade one and three class.

Table 3.1: Class distributions based on gender, age and language

Learners group	Experimental E (n =)	Control₁ C₁(n =)	Total
Gender			
Girls	16	11	27
Boys	13	16	29
Language of learning and teaching (LOLT)			
English	29	27	56
Home Language			
English	6	7	13
Afrikaans	8	5	13
isiXhosa	14	12	26
Other	2	2	4
Age			
6	4	4	8
7	11	12	23
8	14	11	25

3.4 Research design

The quantitative research design used in the study was a quasi-experimental group design. An experimental study seeks to determine whether or not a program or intervention had the intended causal effect on program participants. The three key components of a quasi-experimental design study involves: (1) *pre-post test design*, (2) an experimental (E) *group* and a *control (C) group* and (3) *random assignment* of study participants.

A pre-post test design requires a researcher to collect data on the participants' level of performance before the intervention takes place (pre-), and to collect the same data after the

intervention took place (post) to determine whether there were cognitive shifts in the learners' conceptions; such as in the participants' behaviour, knowledge and skills. The pre-post test design is one means of ensuring whether the intervention had a causal effect on the learners' performances.

This design made it possible for the researcher to compare the post-test scores for the two groups in this study. One of the classes in study was identified as the experimental group (E) and the other class was identified as the control group (C). The intervention used in the study was based on a Dialogical argumentation instructional model (DAIM) which the experimental group (E) was exposed to. The control group (C) received an alternative intervention, namely the traditional method of teaching which I used before I was exposed to the argumentation instructional approach. However, both groups were exposed to the content of the day and night cycle taught in Grade two. The independent variable was the different instructional methods used and evaluated, namely DAIM. This variable was used to observe the participants responses (Shavelson, 1981). The dependent variable was the performance of the learners' pedagogical settings and their results at the end of the sessions. To ensure that the results of the research are reliable, the content taught was kept the same for both groups.

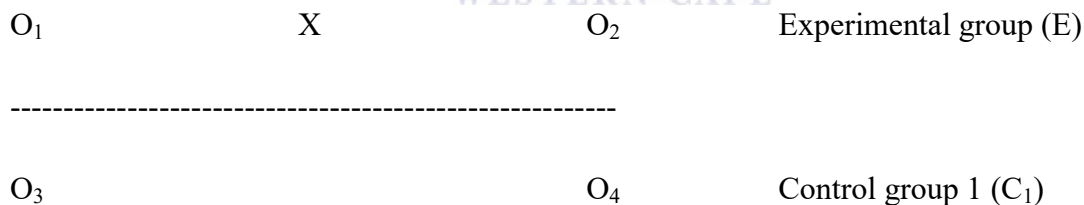


Figure 3.1: Quasi- experimental two group design

The symbols O₁ and O₃ (in figure 1) indicates the pre-test and O₂ and O₄ are the post-tests while the X stands for the intervention, in this case Ogunniyi's (2008) dialogical argumentation-based instruction. The groups were not derived from a randomization process, but the classes were randomly assigned to the experimental and control group conditions. The line between the different groups indicates that intact groups were used rather than randomized groups (Ogunniyi, 1992:91).

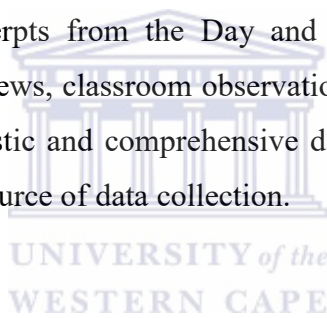
A pre-test was conducted with the experimental group and control group (C), followed by different intervention strategies to teach the day and night cycle. Both the E and C group

were exposed to equal teaching time of 40 minute periods. Thereafter, a post-test was conducted with both the experimental (E) and control group (C).

3.5 Research methods

3.5.1 Qualitative and Quantitative approaches

The purpose of this study is to determine the effectiveness of a Dialogical Argumentation Instructional Model (DAIM) on Grade two learners' understanding of the day and night cycle in the Foundation Phase Life skills curriculum. Qualitative and quantitative research methods were used in the study, a balance which was intended to make a valid contribution to the study. Using both methods gave me insight and a deeper understanding of the learners' conceptions before and after the use of DAIM. The quantitative and qualitative methods both provided useful outcomes in seeing the cognitive shifts learners achieved in their understanding of the day and night cycle. The qualitative component of the study involved a focus group interview and excerpts from the Day and night questionnaire (DNQ). The multiple methods, such as interviews, classroom observation, questionnaires and video/audio recordings provided a more holistic and comprehensive data than would not have been the case if I had relied only on one source of data collection.



A literature review was conducted to find out what conceptions learners hold on the day and night cycle. This was followed by interviews with learners, to gain an in-depth understanding of their conceptions of the day and night cycle. However, this study used both quantitative and qualitative approaches as both methods provided useful outcomes for interpreting the learners' conceptions. The quantitative research design was based on a pre and post test which provided data of the participants based on their conceptions of the day and night cycle which is taught in Grade 2. It was hoped that the results will be a reflection of their views on the day and night cycle. Quantitative descriptions have merit in summarizing a vast amount of information within a small space. It also provides useful clues about the relationship between actions and consequences of such actions (Ogunniyi, 1992, 2008).

The qualitative aspect of the study sought to capture and to record their conceptions of the day and night cycles before and after the treatment using the Dialogical Argumentation Instructional Model. The qualitative aspect also attempted to understand issues and viewpoints expressed by the learners during the interviews and classroom observations. The

qualitative aspect of the research design was used to describe the learners' views on the day and night cycle, as well as the way in which DAIM enhanced their understanding. The information collected was in the form of words about human experiences, which includes both written and spoken language.

3.6 Research instruments

To determine the effects of dialogical argumentation instructional model on Grade two learners' conception of the day and night cycle, four instruments were developed by the researcher. The four types of instruments in the study involved, a day and night questionnaire (DNQ), followed by an interview with learners, learner worksheets and a structured classroom observation schedule (See appendix C).

The following instruments were used to collect data:

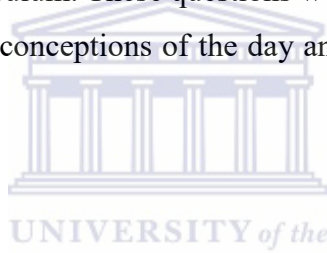
- A pre-test and post-test day and night questionnaire consisting of seven questions and sub-questions to probe learners' conceptions of day and night, as well as their argumentation skills.
- Focus group interviews to gain an insight into learners' existing knowledge on the cycle of day and night.
- Argumentation worksheets that were used during the lessons. The lessons were videotaped to capture the learners' gestures, responses and group work activities.
- Classroom observations were done during lessons. Focus was placed on the interaction amongst learners during the discussions.

3.6.1 Questionnaire - Day and Night Questionnaire (DNQ)

The Day and night questionnaire (See appendix A) that was used in the study was administered amongst Grade two learners. They had to write their names, grade, home language and gender. The findings obtained from the DNQ were integrated with their presentations to inform the conceptions that learners have of the day and night cycle. The instrument employed elicited diverse responses that answered the research questions in the study.

The questionnaire and argumentation worksheets focused on the influence that the day and night cycle has on the activities of people and animals. The concepts that were identified guided my teaching and they were well thought through in order for learners to engage in activities and for effective teaching to take place during the intervention period. The questionnaire has been structured in a similar format as the Annual National Assessment (ANA) of the national Department of Basic Education (DoBE). The learners had to respond in writing to closed and open ended questions, missing words and multiple questions. The DNQ consisted of seven questions with sub-sections. It was also expected of learners to draw various pictures, e.g. activities that learners do during the day and night, etc.

The day and night questionnaire was designed to collect both qualitative and quantitative data. The DNQ was developed to measure the cognitive achievement of the learners in the experimental (E) and the control group (C). The DNQ consisted of content-based questions derived from the Life Skills curriculum. These questions were designed to collect information about the knowledge of learners' conceptions of the day and night cycle, and their reasoning skills during argumentation.



3.6.2 Interviews

3.6.2.1 Focus group interviews Schedule (FGIS)

Semi-structured interviews are highly efficient to collect qualitative data (Patton, 1990: 335). It is another approach to collect data rich, detailed materials that can be used in qualitative data (Lofland and Lofland, 1984). Interview questions were prepared consisting of questions related to several angles of the cycle of day and night. The interview questions were structured to elicit information that assisted the researcher in answering the research questions. The interviews provided additional information that was not captured in the questionnaire in that it is more amenable to a higher response rate than the latter (Babbie, 2010). The interviews gave the researcher access to the learners' views, their experiences, feelings and theories of the day and night cycle. It also provides data that interviewees have not thought about. Interviewees usually do not simply report their experiences, but they create or make more explicit what they think during interviews (Øvretveit, 2010).

In this study semi-structured interviews were conducted with six participants which were selected from the main study in order for the researcher to triangulate the data from the questionnaire. Semi-structured interviews are often used to gain a detailed picture of a participant's beliefs or perceptions about a particular occurrence because the researcher will have a set of prearranged questions (Greef, 2005). The reason semi-structured interviews were chosen was to ensure the interviewer remain on track so as not to dwell off the topic, yet maintain a comfortable environment. These forms of interviewing involve direct interaction between the researcher and the group (Tromchin, 2009).

3.6.2.2 Selection of interviewees

Six learners from both the experimental and control group were randomly selected by the researcher. The interviews were scheduled beforehand and forced the researcher to anticipate difficulties that might be encountered in terms of the questioning and the terminologies. Provision was made by using open-ended, unbiased and non-judgmental predetermined questions that allow participants to respond and express their views freely and comfortably. Probing questions were asked based on the responses of learners to understand the interviewees' beliefs, experiences and their ways of thinking and reasoning about the phenomena addressed in the study.

The interviews were conducted to further determine the participants' conceptions of the day and night cycle. The interviews were planned for 45 minutes so that participants have enough time to respond. However the interviews took much longer than was planned because time was given to participants to comprehend the questions and respond to it (Babbie, 2010: 276). This resulted in good responses from the interviewees. The interviews were digitally recorded and the recordings were stored on the computer, and thereafter it was transcribed before the data was analyzed.

3.6.2.3 Interview setting

The interview was conducted in the classrooms where the learners did their activities. The relatively open nature of the interviews permitted the researcher and the interviewees to build a relationship of mutual trust. The interview was conducted in English, their language of learning and teaching (LOLT) to allow learners expressing themselves fully and to be encouraged to speak freely (Ramorogo, 1998).

The group of learners were interviewed twice: a preliminary interview after the learners had written the pre-test, and a repeated interview was conducted after the learners were exposed to the content in question (experimental group - DAIM and the control group - traditional method) and completed their post-test. The first interview started with getting acquainted with the learners and establishing a good relationship and trust. Six questions were asked to the interviewees during the interview. In the repeated interview, the same questions were asked, but with relation to the lessons that were taught by the researcher. This was done in order to see whether there was a cognitive shift in the learners understanding as a result of the interventions. The interviews were recorded using a voice recorder and transcribed with strict preservation of the interviewees' responses.

3.6.3 Classroom observation

In accordance with Moseley (1999), observation offers potentially helpful insight into effective teaching and learning in general. Direct observation is valuable when doing research, but it is very time consuming. It allows the researcher to observe behaviours of participants instead of their perceptions. Observations were noted and conclusions were made from the notes. During the treatment learners were given activities which they had to do individually, and then further discussions in their groups to come to a common agreement on their answers. The classroom observations that were conducted provided the researcher with rich, authentic data that was used to answer certain elements of the research question. An observer was present during all the lessons that were conducted with the experimental group. The researcher and the principal of the school observed the lessons and recorded the interaction and concepts of the day and night cycle of learners during the intervention.

3.6.3.1 Classroom observation schedule

An observation schedule (see Appendix C) was used to monitor the learners' interaction and their responses. The classroom observation schedule was adapted from the West Virginia Department of Education's observation schedule (n.d), to suit the context of the research setting. It was reviewed and rated by some of the members of the SIKSP. The items on the schedule included the following:

- a. The group arrangements
- b. Learner behaviour

- c. Communication skills
- d. Learner interaction
- e. Attitudes demonstrated by learners

Observation as a technique for gathering of data relies on a researcher's seeing and hearing things and recording their observation, rather than relying on the subjects' self-reported responses to questions or statements.

3.6.4 Video recording

Voice recorders were used to record learners' responses during classroom activities and group discussion in order for the researcher to determine the level of engagement of the learners in each group, as well as tracking the learners' thinking and showed how previous knowledge was used or adapted during concept development. The lesson was video recorded to report on the learners' gestures and the level of arguments during whole class discussion, as well as to determine the learners' initial conceptions of the cycle of day and night. The recordings allowed opportunities for the interpretation that provided the researcher with a better understanding of how learners construct meaning of the lessons presented.

3.7 Description of intervention

To support learners' understanding of the day and night cycle, a dialogical approach to teaching and learning was adopted in this study. The Dialogical Argumentation Instructional Model (DAIM) developed by the Science and Indigenous Knowledge Project (SIKSP) located in a South African University (Ogunniyi, 2007a & b). DAIM focus on the interaction between learners and teachers through dialogue, argumentation and discussions with the intention to reach consensus on the phenomena in question. Argumentation can be used to learn new things, and to deepen your scientific understanding. The ultimate aim of an argument is to shed light on one's thoughts in order to make a decision.

Kucukozer and Bostan's (2010) study has reported that learners have alternative conceptions that are based on their experiences which may be different to those of school science. The intervention attempted to develop learners' existing knowledge of the day and night cycle so

that they may accommodate the school science worldview. In addition, the intervention was also used in testing whether the learners' conceptions on some of the issues had shifted from traditional worldviews to the scientific worldview.

The worksheets presented to the learners were adapted from Toulmin's Argumentation Pattern (1958) (TAP). The Contiguity Argumentation Theory (Ogunniyi, 2007a and b) (CAT) has been used to gauge learners' cognitive stances inherent in their claims and reasons described by TAP. As this methodology takes on an argumentation approach, it is vital that the activities include elements of argumentation, e.g. learners must fill in the answers (claims), and provides grounds (reasons, warrants and/or backings) for their answers to substantiate their claims.

3.7.1 Structure of lesson

The presentation of most of the activities is based on the Dialogical Argumentation Instructional Model (DAIM). This model was inspired by earlier works of Eduran, Simon & Osborne (2004) and Ogunniyi (2007 a & b). The representation of the cyclic spirals in the model provides space for a return to any stage of discussions and arguments if requested.

3.7.1.1 Stimulus

The lesson is introduced by means of a stimulus for example a picture, a case study, question or answer session to elicit a discussion amongst the class. The stimulus must be linked to things that learners are familiar (known to) with, in order for learners to connect it with the unknown (in this instance, scientific knowledge). The stimulus must motivate learners to find out more about the topic in question. The introduction of the lesson must be able to:

- Draw the learners' attention
- Encourage learner participation, and
- Tap into learners' existing knowledge

3.7.1.2 Intra-argumentation - Individual learner task

During this phase of the lesson learners are given an activity with which they can engage with individually. The activity which is given to the learners must be well prepared and thought through by the teacher. Learners must answer their questions (claims), and give grounds

(evidence, warrants and/or backings) to substantiate their answers. The role of the teacher during this stage of the lesson is to monitor the learners and assist learners where necessary.

The teacher must take the following into consideration when planning the activity:

- the context of the learners (socio, economic and cultural diversity of learners)
- the language and conceptual level of the learners
- the activity must be challenging

3.7.1.3 Inter-argumentation - Small group task

Learners are divided into groups to explain, compare and share their answers with one another. During this stage of the lesson learners are in discussion to come to a consensus where possible based on their claims, evidence and warrants, which will be presented to the rest of the class. If there is any misunderstanding amongst the learners, they can consult the teacher to assist them. The teacher monitors the group work to make sure learners are on track and can guide them by asking questions and making suggestions. The teacher must listen for trends that arise during group discussion, so that the teacher can address it during the whole class discussion. The teacher, classroom arrangements and access to resources must facilitate group work:

- Groups are structured in such a way that encourages active learning and discussions.
- Learners have enough time for discussions.

3.7.1.4 Trans-Argumentation - Whole class discussions

The group presentations activity can be done in various ways, depending on the topic in question, for example by means of oral presentation, posters, or any other acceptable form. Each group gets the opportunity to present all their answers, or some of the answers depending on the time available to the rest of the class. The rest of the groups could have the opportunity to provide insightful comments or questions to reach a consensus. According to Langenhoven (2009) this stage can be considered to be the mediated co-construction of knowledge stage, where the teacher records the learners' ideas or key words which are raised during presentations to validate learners' contribution. The claims, evidence and counter claims are grouped and class comes to a conclusion of the issue under discussion. The teacher facilitates open discussion.

3.7.1.5 Evolving cognitive harmonization

During this stage the teacher determines how much learning and understanding took place. This can be done through focus group interviews (Vaughn, Schumm, & Snagub, 1996) in an attempt to record aspects that may indicate whether constructive learning took place, e.g. whether the learners understand the content, and whether their views had changed after they had been exposed to argumentation.

The teacher can ask questions based on the content which has been covered to clarify misconceptions with respect to the objectives of the lesson. Another idea is conclude the lesson with a shared writing activity to assemble learners' knowledge and use it as notes for the learners' workbooks.

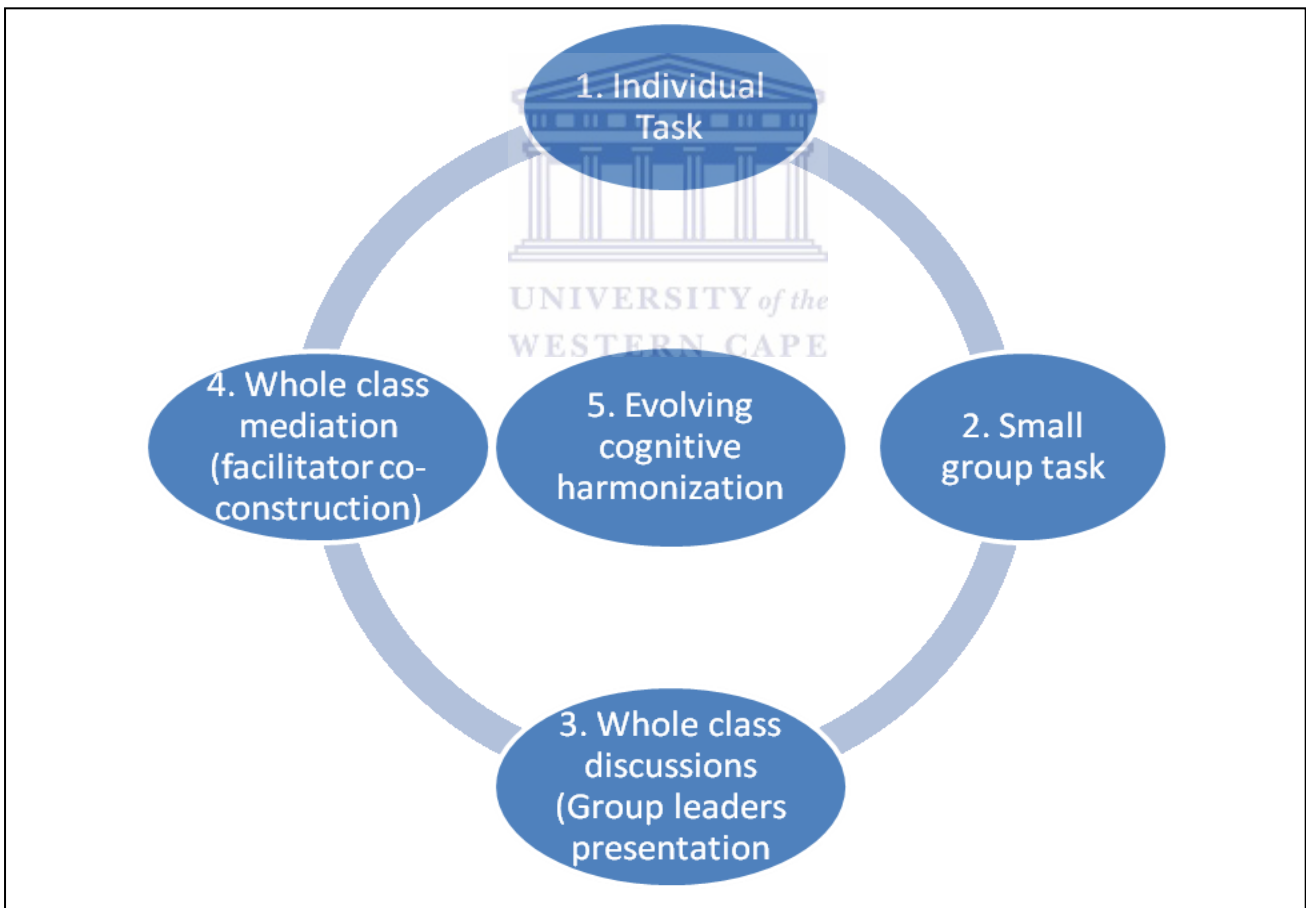


Figure 3.2: CAT-based dialogical argumentation instruction model (DAIM) (2015)

Table 3.2: An exemplar of an argumentation lesson plan for the experimental group

Time	Activity	Learner activities	Teacher activities
5 minutes	Introduction	Listen and respond to teacher's instructions.	Teacher introduces the new concept to set the tone for what will follow in the lesson.
10 minutes	Individual tasks	Learners complete the argumentation tasks individually.	Moves round to give assistance to learners who need it.
15 minutes	Small group tasks	Small group discussion	Moves round to help learners in different groups by giving prompts, asking leading questions.
20 minutes	Whole class discussions	Groups present their results to the whole class. Learners get the opportunity to ask questions or offer rebuttals.	Mediates the whole class arguments. Helps learners to reach a consensus if possible or to accept the absence of a consensus.
10 minutes	Consolidation	Shared writing activity	Writes down the conclusion of the argument for learners to copy.

3.7.2 Overview of lesson content

The content of the lessons presented in the study was based on the South African Foundation Phase Life Skills Curriculum and Assessment Policy Statement (CAPS) (DBE, 2011). The topic, Life at night was presented through activities in a sequence, since it is expected of learners to already have developed an understanding of:

- Shadows
- To identify objects that they see in the sky during the day and at night.
- To develop an understanding of the day and night cycle in terms of the earth spinning on its axis.
- To identify and communicate things people do at night.
- Identify people that work at night
- Understanding why some animals only appear at night.

One of the strategies proposed by the Western Cape Primary Science Programme (PSP) (2014) is to scaffold the learners' learning from the known to the unknown. Therefore, the topics addressed in this study were sequenced and attention was paid to the progression at which the lessons rolled out in the classroom (DBE, 2011). The researcher took in consideration the learners' indigenous views expressed during the interviews as well as their responses to the questions in the questionnaire. This made it possible for the learners to connect their everyday understanding of the day and night cycle to the scientific conceptions presented in the science class. This led to a high participatory rate among learners during argumentation and class discussion.

3.7.3 Lesson plans

The lesson plan in table 3.3 below gives a detailed description of the lessons that was presented to the learners during the study. It indicates the time, specific aim(s), topic, content, activities, strategies and resources for each lesson. The lesson plan gave the researcher an indication on what to teach, how to teach and when to teach the lessons. It also helped the researcher to prepare the activities prior to the lesson.

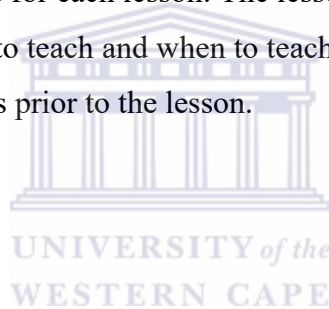


Table 3.3: Lesson plans of lessons

Time	Topic	Specific Aims	Content and concepts	Activities, investigations, argumentation and Demonstrations	Resources
2 x 30 minutes	Shadows	To develop an understanding on the formation of shadows	Shadows Light Dark	Individual argumentation, group and class discussions	Torch Learners
2 x 30 minutes	Changing from day to night	To develop an understanding of the day and night cycle in terms of the earth spinning on its axis	The Earth travels around the Sun The Earth spins on its own axis The Earth takes about 24 hours to spin once	Individual argumentation, group and class discussions Pictures and models of Earth, Moon, Sun	Globe, models of moon and sun torch
2 x 30 minutes	Things I do at night	To identify and communicate things they do at night.	At night we: Sleep, watch television, bath, brush teeth, etc. We have to use lights to see what we are doing Water the garden	Individual argumentation, group and class discussions Interpreting pictures	Pictures
2 x 30	People who work at	Identify people that work	There are a lot of	Individual argumentation,	Pictures

minutes	night	at night	people working during the night.	group and class discussions Interpreting pictures	
2 x 30 minutes	Night animals	Understanding why some animals only appear at night.	<p>Many animals hide away or sleep during the day. These animals are called nocturnal animals.</p> <p>There are animals that come out only after dark, e.g. porcupines, bats, owls, moths, etc.</p> <p>During the day they hide from other animals that hunt during the day.</p> <p>Some of them, e.g. the owl see much better at night</p>	Individual argumentation, group and class discussions Interpreting pictures	<p>Picture</p> <p>Powerpoint Presentation</p>

3.8 Research ethics

Ethical issues are an important factor in research, especially when humans are involved. Human research should not harm or offend any participant involved in a study, irrespective of whether they volunteered to participate in the study or not (Babbie, 2010). The following actions were taken to ensure that the study conformed to the ethical standards outlined by the Senate Research Committee of the University of the Western Cape.

- Before commencing with this study the researcher obtained ethical clearance from the University of the Western Cape.
- Prior to the start of data collection, I requested permission from the principal and staff of the school where the study took place (See Appendix 1). The principal and staff granted their permission with the understanding that it does not disrupt the teaching and learning programme of the school. I committed myself to make the findings of the study known to the staff of the school.
- The identity of all learners involved in the study has been kept confidential and no names are mentioned in the dissertation. The teachers were assured of the learners' anonymity and confidentiality at all times. Instead of revealing the names of the participants, pseudonyms were assigned to all of the participants. None of the participants were disadvantaged by participating in the research project.
- The data collected in the study during the observations and interviews will not be used for any purposes other than for this study.

3.9 Validity and reliability

Multiple instruments were used to collect data to secure an in-depth understanding of the phenomenon (Stake, 1998) in question. Stake (1998) further asserts that the use of multiple instruments contributes to the validity of the study as it adds thoroughness, breadth and depth to an investigation. The data collected in this study was also valid because all the participants answered the same questionnaires and the same questions were asked of each respondent in the study.

Reliability refers to a measuring instrument's ability to yield consistent numerical results each time it is applied; it fluctuates only when there are variations in the variable that is being

measured. Basically reliability is concerned not with what is measured, but with how well it is being measured (De Vos, Strydom, Fouche, & Delport, 2005).

Reliability refers to a measuring instrument's ability to yield consistent numerical results each time it is applied; it fluctuates only when there are variations in the variable that is being measured. Basically reliability is concerned not with what is measured, but with how well it is being measured (De Vos et al, 2005:163).

The researcher ensured that the data collected through questionnaires, interviews and observation were reliable. The same questionnaires containing the same questions before and after the intervention were administered with the learners in the study. The participants in the study were also requested to answer the questionnaire on their own, which resulted in consistency of measurement.

3.9.1 Validation and Reliability of instruments

The instruments in this study were tested for validity and reliability to ensure that the study and the instruments measured what they purported to measure (Ogunniyi, 1992). To obtain valid data, the researcher approached three members of the Science and Indigenous Knowledge Systems Project (SIKSP), two colleagues at the Primary Science Programme (PSP) of the Western Cape and two foundation phase teachers at a different school who were not involved in the study to validate the instruments used in the study. It was required of the panel to comment on typos, language and more especially on the individual items in terms of clarity, ambiguity etc. They had to rank the questionnaire on a scale from 1 to 5 (Ogunniyi, 1992). Formula which represented the following:

- 1 - strongly disagree the question was relevant and clear
- 2 - disagree that the question was relevant and clear
- 3 - not sure that the question was relevant and clear
- 4 - agree that the question was relevant and clear
- 5 - strongly agree that the question was relevant and clear

All items in the questionnaire which the respondents rank under 3 were eliminated.

A disparity ratio was calculated for each item on the basis of agreement or disagreement regarding:

- the quality and clarity of the questions
- the appropriateness of the language used for grade two learners

- to see if the content was at the level of the learners, and
- whether the content is being taught in grade two.

3.9.1.1 Inter-rater reliabilities

In order to perform the inter-rater reliability test the inter-class coefficients obtainable through SPSS was performed. This statistic was used because 8 raters rated the 28 items in the Day and Night Questionnaire (DNQ), thus multivariate statistic were used instead of bivariate statistics where only two raters are involved.

For calculating the Inter-Rater Reliability (IRR), all items were rated by the 8 raters, hence a fully crossed design which dictates a two-way model. Furthermore, for this study it was important that all raters provide scores that are similar in absolute value rather than similar in rank order, hence absolute agreement was used. In obtaining the IRR, a two-way, absolute agreement, average measures model was selected in SPSS.

Table 3.4: Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.633	28

Table 3.5: Intraclass correlation coefficient

	Intraclass Correlation ^b	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.060 ^a	.006	.278	2.729	7	189	.010
Average Measures	.642 ^c	.143	.915	2.729	7	189	.010

Table 3.5 above in the case summary shows that there were 8 raters in total. shows The reliability statistic in table 3.4 shows that 28 items were rated with a scale reliability of 63.3 %. This value represents internal consistency of items as rated by the 8 raters. Since an average of the raters was chosen in the design, the average measures correlation is applicable

hence the IRR for this study is 64.2%. IRR values of between 0.60 and 0.74 are regarded as good IRR values while those between 0.75 and 1.0 are regarded as excellent IRR (Hallgren, 2012).

3.9.1.2 Pre-test results on the reliability of DNQ

The next step was to consider the scale reliability with respect to scores made by the subjects in this study using the Cronbach alpha reliability. This was performed to assess the internal consistency between the items which made up the scale of the instrument. Again, IBM SPSS 23 was used in assessing the reliability of all the questions. Since a pre-test and a post-test were performed, two sets of results are provided in table 3.6 and 3.7 below.

Table 3.6: Pre-test reliability statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.612	.660	7
N=56		

Table 3.7: Post-test reliability statistic

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.636	.662	7
N = 56		

The next set of tests are normality tests which are meant to determine the degree of skewness of the distribution of scores so as to decide on whether to use parametric or non-parametric statistics. Parametric statistics makes the assumptions that scores are normally distributed and hence uses the mean scores whereas non-parametric statistics assume that the scores are significantly skewed and thus performs their calculations based on mean rank ordered scores. To perform these tests, Kolmogorov-Smirnov normality tests are used and also obtainable from SPSS statistics package. The Kolmogorov-Smirnov normality test is used to give a measure of how significant the normality of a particular sample is (Pallant, 2001; Ogunniyi, 1992). Since we have a pre and post-test, two sets of results are reported on. Since two groups are compared, in order to safely use parametric statistics the p-value representing the confidence limit should be above 0.05 when the alpha value is set at 95%. This means that the equality of variance between the two sets of samples for the one group

and the other is assumed.

3.9.1.3 Pre-test normality result for pre-test stage

Table 3.8: Pre-tests of Normality

Question	Group	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Question 1 Pre-test	Experimental group	.193	29	.007	.891	29	.006
	Control group	.197	27	.009	.916	27	.032
Question 2 Pre-Test	Experimental group	.202	29	.004	.878	29	.003
	Control group	.148	27	.132	.929	27	.067
Question 3 Pre-test	Experimental group	.211	29	.002	.904	29	.012
	Control group	.188	27	.015	.896	27	.011
Question 4 Pre-test	Experimental group	.382	29	.000	.628	29	.000
	Control group	.423	27	.000	.597	27	.000
Question 5 Pre-test	Experimental group	.191	29	.008	.932	29	.063
	Control group	.133	27	.200*	.946	27	.167
Question 6 Pre-Test	Experimental group	.180	29	.017	.878	29	.003
	Control group	.184	27	.019	.947	27	.179
Question 7 Pre-test	Experimental group	.292	29	.000	.860	29	.001
	Control group	.306	27	.000	.836	27	.001

In table 3.8 above, the significance values for all the 7 items are significant (p-values less than 0.05) except for question 5 for the control group.

3.9.1.4 Post-test normality results for post-test stage

Table 3.9: Post-tests of Normality

Question	Group	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Question 1 Post-test	Experimental group	.301	29	.000	.820	29	.000
	Control group	.260	27	.000	.829	27	.000
Question 2 Post-test	Experimental group	.128	29	.200*	.960	29	.330
	Control group	.145	27	.153	.962	27	.401
Question 3 Post-test	Experimental group	.326	29	.000	.833	29	.000
	Control group	.281	27	.000	.863	27	.002
Question 4 Post-test	Experimental group	.389	29	.000	.694	29	.000
	Control group	.237	27	.000	.801	27	.000
Question 5 Post-test	Experimental group	.231	28	.001	.873	28	.003
	Control group	.165	27	.057	.929	27	.065
Question 6 Post-Test	Experimental group	.191	29	.008	.905	29	.013
	Control group	.145	27	.153	.936	27	.098
Question 7 Post-test	Experimental group	.213	29	.002	.887	29	.005
	Control group	.211	27	.003	.899	27	.013

Table 3.9 above shows that all the items have a p-value which is less than 0.05 which means that the difference in homogeneity between the two sets of scores for the two groups is significantly different, hence non-parametric statistics are dictated.

The questions in the Focus Group Interview Schedule (FGIS) (See Appendix B) were well thought through and were sequenced into themes which are covered in the study. Therefore a trial run was done with the interview questions using learners from another school so that I could identify any future problems that may be encountered in the main study which may compromise the validity of the study. The interview questions went through a vigorous validation process. These were given to the same panel for face, content and construct validation.

3.9.2 Triangulation

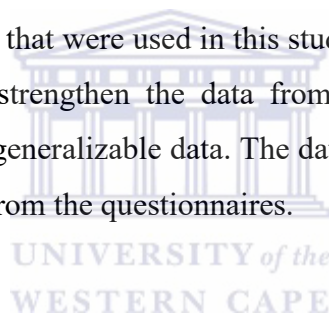
Different data sources and methods were used in this study to support each other or to triangulate with each other. Mc Millan & Schumacher (2001) refers to "triangulation as

cross-validation among data sources, data collection strategies, time periods and theoretical schemes" (p. 478). Cohen, Manion and Morrison (2007) assert that:

Triangulation may be defined as the use of two or more aspects of data collection in the study of some aspect of behaviour. Triangular techniques in the social sciences attempt to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint and, in so doing, by making use of both quantitative and qualitative data (2007: p141).

In the same vein Guion et al (2010) noted that triangulation of data strengthens research studies because it increases the credibility and validity of the data collected (Guion et al, 2010). Cohen, Manion and Morrison (2001) contend that triangulation has its merits, namely that by corroborating findings from one method with findings from another method rules out measurement bias.

The three data gathering methods that were used in this study, which included questionnaires, interviews and observations to strengthen the data from one technique to another, were employed so as to provide some generalizable data. The data from the interviews was used to support and triangulate findings from the questionnaires.



3.10 Summary

This chapter focused on the research design, the participants of the experimental- and control group of learners from a disadvantaged primary school in the Western Cape, data collection and data analysis. The chapter described how data was analysed and examined ways that were employed to reduce the threats to validity of this study while maintaining the ethical practice throughout the investigation. The findings of the study that adopted various methods to collect data, focus group interviews, learner questionnaires, and class observations will be discussed in Chapter 4.

CHAPTER 4

DATA ANALYSIS AND FINDINGS

4.1 Introduction

As described in Chapter 1 and 3 this study sought to determine the effectiveness of a Dialogical Argumentation Instructional Model (DAIM) on Grade two learners' understanding of the day and night cycle. This chapter presents the data and provides analysis of the collected information. In pursuance of the purpose of this study, three instruments described in chapter three were administered for data collection. This section further provides a description of the procedures followed by the researcher in the collection and analysis of data. In addressing each of the research questions below, the results were analyzed both quantitatively and qualitatively to provide a holistic picture of the changes that occurred as a result of the intervention. In doing so, the researcher was able to find the trends and patterns that have emerged so as to arrive at conclusive findings.

This chapter reports on two Grade two classes which completed both the Day and Night pre- and post-test questionnaire. The results of the research are displayed using tables, excerpts from the interviews, explanations and free response items to support the findings of this study. For ease of reference, the results are analyzed in terms of the following research questions:

1. What are the grade two learners' conceptions about the day and night cycle?
2. Can grade 2 learners associate daily activities to the night and day cycle?
3. Can DAIM be used effectively to enhance learners' understanding about day and night?

The data analysis and discussions which will follow will indicate whether or not the Dialogical Argumentation Instructional Model (DAIM) is a better instructional method to use in enhancing the Grade two learners' conceptions of the day and night cycle than those who were exposed to the traditional method of instruction. The objective is to determine the effectiveness of DAIM in addressing the learners' misconceptions or alternative conceptions of the day and night cycle.

4.2 Research question 1: What are the grade two learners' conceptions about the day and night cycle?

The day and night cycle is a difficult concept for learners to understand (Thurston et al, 2006). Young learners' responses about this phenomenon is mainly based on their every day experiences, influenced by others and folklore (Guest, 2003). They have different ways of explaining the phenomenon; either to themselves or to others in order to link the day and night cycle (Schwarz, Schur, Pensso & Tayer, 2010). In support of Schwarz et al. (2010), Salierno, Edelson & Sherin (2005) confirms that some young children's explanations are not scientifically accurate, yet they find these explanations plausible and accept them as the truth.

In this study, evidence of the learners' conceptions of the day and night cycle were obtained from the Day and Night Questionnaire (DNQ), interviews, learners' worksheets and classroom observations. Both the control and the experimental groups completed the same pre and post-test questionnaires to determine what their conceptions were before and after the treatment. The learners were asked to respond to the questionnaire dealing with the day and night cycle.

This research question was answered with respect to the following conceptions which learners held before and after the treatment:

- a. Conceptions of the sun,
- b. Conceptions of the shadow,
- c. Conceptions of objects which can be seen, and
- d. Conceptions of the movement of the earth.

4.2.1 Grade 2 Learners' conceptions of the sun

The answer to this research question is derived from the various instruments used in this study. Research questions 2 and 5 in the DNQ questionnaire addresses questions regarding the composition of the sun. In order for the researcher to establish what the learners' conceptions were in terms of the composition of the sun, different statements were made in the DNQ in question 5.2. The learners' responses to the statement are classified into two categories: 1 = "agree" and 2 = "disagree". The statement made for question 5.2.1 reads as follows: "The sun is a pot of gold". Learners had to make a tick (✓) in the appropriate

column. Their responses in the pre-test indicate the following results: 17(58.6%) of the experimental group disagreed, 9(31%) agreed and 3(10.3%) of learners gave an invalid answer, whilst (22)82.4% of the control group agreed, 3(11.1%) disagreed and (1)7.4% gave an invalid response. An invalid response refers to a situation where learners ticked off both columns.

Before the participants were exposed to the content on the day and night cycle, they held alternative conceptions that differ from those accepted amongst scientific community (Kambouri & Biggs, 2013). The following statements are some of the alternative conceptions held by learners during the pre-interview:

EL4_{PreInt}: Yes, it is made of light.

EL5_{PreInt}: Bright, gold circles

EL10_{PreInt}: Made of yellow paper

EL21_{PreInt}: Gold

EL18_{PreInt}: Not make of gold ... circles.

EL10_{PreInt}: It is made of circles.

EL21_{PreInt}: Made out of gold, because gold is also yellow.



In the pre-interview the learners connected the composition of the sun to light, a colour or a shape. They believed that the sun is made of 'gold', 'yellow' and 'circles'. Whilst *EL4* believed that it is made of 'light' which the sun provides during the day. However, some of the learners' views at post-test have changed, while some of the learners' views stayed the same, as indicated in the excerpts below.

EL21_{PostInt}: It's a star made of gas.

CL4_{PostInt}: We disagree, the sun is a glowing gas.

CL3_{PostInt}: The sun is gas.

EL4_{PostInt}: A big bright light.

In the excerpt below learner *EL4*'s view did not change, he retained his initial view.

EL4_{PreInt}: Yes, it is made of light.

EL4_{PostInt}: A big bright light.

Both the control and experimental groups' post-test conceptions show that more learners had a better understanding regarding the composition of the sun. Their responses in the post - test results indicate the following: 23 (79.3%) of the experimental group disagreed that the sun is made of gold, whilst 13.7% still held on to their previous views and 4 (13.7%) of learners had an invalid answer. In the post-test 21 (77.7%) of the control group agreed, 3 (11.1%) disagreed and 3 (11.1%) gave an invalid response.

The learners in the study held different conceptions on the composition of the sun. Their conceptions prior to the treatment ranged from alternative conceptions to partially scientific explanations based on their experiences and observations (Vosniadou and Brewer, 1990). It seems that there is some evidence that the learners' understanding of the composition of the sun had shifted to a more scientific explanation. This could be as a result of the peer talk during small group and whole class discussions as learners were exposed to different resources in understanding the composition of the sun. Schoon (1989) believes that if teachers create a space for learners to express their views in a non-threatened environment (Thurston, Grant & Topping, 2006), learners can overcome their misconceptions through class discussions. The proviso, of course is, if they believe that their existing conceptions are unsatisfactory (Schoon, 1989; Celikten, Ipekçioğlu, Ertepinar & Geban 2012). Çelikten, et al., 2012 in their study is in agreement with Schoon (1989) and believe that if teachers allow learners to engage in group discussions in order to 'revise their knowledge' (Çelikten, et al., 2012:p.93), they could facilitate the learners' understanding as well as encourage them to share their views with one another.

Scientific information shared during science lessons is often incompatible with learners' alternative conceptions; and consequently, many learners hold on to their alternative conceptions of the natural world (Kampeza & Ravanis, 2006). As in the case with *EL4* who retained his view about the sun which he had during the pre-interview. His pre-conceptions about the sun may have been more plausible (Salierno et al, 2005) than the information he received during the intervention. In the same vein, many researchers claim that learners' alternative conceptions affect their learning and acquisition of new concepts (Kambouri & Briggs, 2013).

4.2.2 Grade 2 Learners' conceptions about the function of the sun

Question 3.3 in the DNQ addressed the function of the sun. The following statement was given "The sun gives us heat and light", and learners had to respond indicating whether the statement is 'true' or 'false' and give evidence for their answers. The majority of the learners knew that the sun provides us with heat and light, but they were unable to substantiate why the sun gives us heat and light. At the pre-test, 22 (75.9%) of the learners in the experimental group indicated that it is true that the sun gives us heat and light. After the intervention, the number of learners with the latter view increased to 25 (86.2%).

The learners' conceptions about the function of the sun during the post-interview include the following:

'The sun gives us heat and light', 'our eyes are sensitive for the sun's light', 'evaporation of water', 'the sun is shining', and 'the sun gives us warmth'.

Interviewer: What does the sun provides us?

EL29_{Post-Int}: The sun gives us warmth.

EL5_{Post-Int}: I can't look at the sun, because if you look at the sun then your eyes go like this (slit her eyes). Learner means that eyes are sensitive towards the sunlight.

EL18_{Post-Int}: When it is not raining, the sun takes the water up.

CL6_{Post-Int}: In the evening there is light and in the morning there is heat.

EL21_{Post-Int}: The sun gives us heat, if we have no heat, we will die.

Interviewer: Can we live on the sun?

CL3_{Post-Int}: No, The sun is too shining. You are going to burn.

CL4_{Post-Int}: The sun is a huge glowing ball of gas. You can't even go near the sun, it is too hot, and you will burn.

The learners in the experimental group show an understanding about the function of the sun. All the learners knew that the sun gives us heat and light, but did not have the vocabulary or terminology to express their views scientifically. For example, EL29 response to explain 'heat', he referred to it as 'warmth', and this can be due to the learner's experience on a hot day. As well as CL3: 'The sun is too shining.' referring to 'too hot' and therefore concludes by saying that one can burn if one goes near the sun. This can be due to the fact that the learners' home language is Afrikaans as opposed to the language of learning and teaching which is English. Although learner EL18 knows that the sun plays a role in the water cycle, he was

unable to use the scientific terminology to explain 'evaporation'. EL5 is aware of the dangers of the sun and CL4 knows that it is impossible to live on the sun due to the amount of heat.

Language plays a vital role in the acquisition of learning (Vygotsky, 1987). The learners' language ability influenced their understanding of day and night. For example, EL18_{Post-Int} spoke about 'warmth' by referring to the 'heat of the sun'. The overlapping of word usage can be problematic; and in some instances may affect the learners' understanding of the concepts; and this in turn may result in development of alternative conceptions (Gumede & Msiminga, 2013). This can be one of the reasons why some science teachers tend to depend on the language used in the textbooks. The scientific language in school is different to the everyday spoken language of the learners in the study. Learners learn new words easily, but interpret them on the basis of their experiences. The word 'heat' is not frequently used by learners; it is used in limited contexts (Kikas, 2010), but the word 'warm' is used quite often amongst learners to describe the temperature of some object or weather condition. In many cases learners are not good at expressing their ideas, for that reason EL18 used a different term to express her understanding about the function of the sun. In some cases there were words such as 'heat', 'rotate', 'sphere' and 'axis' which learners encountered for the first time and had rarely heard about them in their day to day conversations. In this regard, it was difficult for learners to retain and recall certain concepts.

4.2.3 Grade 2 Learners' conceptions about the shape of the Earth

The data collected from the pre-test indicated that the majority of the learners were unable to give the correct word for describing the shape of the earth. The learners were provided with a table depicting four different shapes and it was required of them to circle the appropriate object which best described the shape of the earth and thereafter the naming of the shape. They described the shape of the earth as 'round', 'star', and 'cube' or 'cyclic'. In the pre-test, 7 learners from the experimental group described the shape of the earth as a 'circle', 2 learners described it as round, 1 described it as a 'cube', 2 described it as a 'star', and the rest of the learners did not attempt to answer the question. The spherical shape which the learners had chosen in the pre-test could be attributed to them either having guessed or due to the fact that they have a globe of the Earth in their classroom. This could be the reason they could associate it with the shape in the DNQ pre-post test. Nonetheless, that does not necessarily mean that they fully understood why the Earth is spherical (Vosniadou, Skopeliti, &

Ikospentaki, 2004). The table 4.1 indicates the experimental group's responses before and after the intervention. Learners had to choose from the following objects: a star, cylinder, cube and sphere, then they had to name the shape.

Table 4.1: Learners' conceptions about the shape of the earth in the experimental group

Shape	E group	Pre-test Percentage (%)	E group	Post-test Percentage (%)
Star	1	3.4	2	6.8
Cylinder	1	3.4	0	0
Cube	3	10.3	1	3.4
Sphere	17	58.6	26	89.6
No answer	7	24.1	0	0

Out of the 29 learners in the experimental group, only 58.6% learners were able to identify the shape of the earth as a sphere, 3.4% identified it as a star and cylinder, 10.3% identified it as a cube and 24.1% did not attempt to answer the question in the pre-test. After the intervention the majority of the learners (98.6%) selected the 'sphere' amongst the shapes to represent the Earth, but only eight learners were able to give the correct scientific description of the shape. The rest of the learners described the shape of the Earth as 'oval', 'circle', 'round', 'ball' as opposed to five learners who did not attempt to answer the question.

The learners' conceptions of the shape of the Earth are consistent with the learners' expressions in a related study done by Vasniadou and Brewer (1990) as well as many other studies such as Papandreou and Terzi (2011). Learners in the study have attempted to resolve these contradictions by assimilating the scientific explanation into their existing cognitive structures. The difference in the responses of the learners represents words such as 'round', 'circle' and 'ball' which do not deviate much from the scientific expression, but which may lead to misconceptions, especially in terms of the rotation of the Earth. George (2014) asserts that the conflict between how an individual understands a scientific term or phenomena and the commonly accepted scientific meaning may result in misconceptions.

The learners in the study were unable to transfer their knowledge from one subject into another. The shapes which the learners were provided with in the DNQ were shapes that they had encountered in Mathematics.

The researcher is in agreement with Vosniadou et al., 2004 that the learners' drawings do not depict the Earth as spherical, as all the learners in this study drew a circle. Their drawings did not represent a sphere, but 45% of the learners expressed it as a sphere. Researchers must be very careful when making use of learners' drawings as evidence of their understanding, because what they draw and what they communicate do not always match as can be noted in the drawing below:



Figure 4.1 EL18's drawing of the Earth

In figure 4.1 above is a picture of EL18DAIM which depicts her drawing of the Earth. A person may interpret the drawing as the sun which is on the earth. In questioning the learner about the part that is coloured yellow, she claimed that it is the sun that is in front of the Earth. For this reason Papandreou and Terzi (2011) asserts that it is important to give learners the opportunity to express themselves in various ways. In their study the learners were engaged in different activities which allowed them to express their ideas using different strategies, at different stages of the learning process. Learners' drawings on their own are not useful, if learners do not get the opportunity to discuss their drawing. Findings from studies done by Dunlop (2000), Özsoy (2012) and Papandreou and Terzi (2011) claim that drawings provide powerful tools for exploring the learners' conceptions of the earth, but the feedback given by the learners must be interpreted very careful. On the other hand, Hannust and Kikas (2012) argue that learners' drawings and models must not be the main source of information about the nature of knowledge, as it often cancels out the fact that learners regurgitate what they have learnt or they do not bring forth the correct answers due to a lack of skills.

4.2.4 Grade 2 Learners' conceptions about movement in the day and night cycle

Table 4.2 below indicates the learners' pre-conceptions about the movement of the sun. These responses are all based on the learners' responses during the pre-interview and the questionnaires from both the control and experimental groups.

Table 4.2: Pre-conceptions of learners on the movement of the Earth

Pre-conceptions of learners based on the movement of the sun and the earth	Learners and instrument
The sun and the moon moves	EL4Pre-Int;
The sun comes out during the day and the sun goes down at night	CL1Pre-Int; CL6Pre-Int
Sun is shining	CL2Pre-Int
Sun goes into the clouds	CL2Pre-Int
Sun is moving to other countries	EL10Pre-Int, EL5Pre-Int; CL5Pre-Int; CL3Pre-Int;
Sun is burning	EL18Pre-Int
The Earth is moving around the sun	EL10Pre-Int
Human activities	CL2Pre-Int;
The sun is getting hotter	EL10Pre-Int

4.2.4.1 Learners' conception on the movement of the Earth regarding day and night

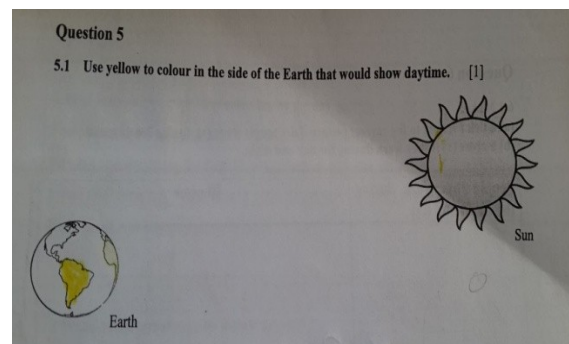
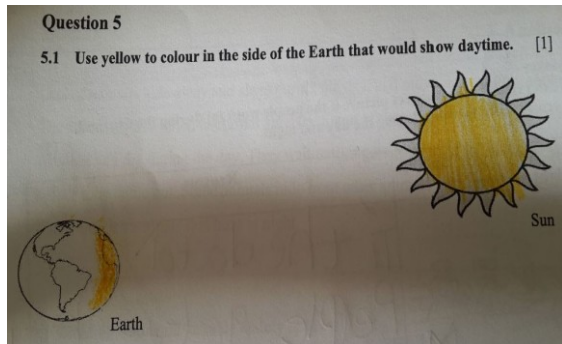
Alternative conceptions about the movement of the Earth are common, irrespective of the size of the sample, geographical location, age and educational background.

Table 4.3: Experimental group learners' conception of the movement of the earth as reflected in their pre-post test

Composition of sun	Group	N =Yes	%	N = No	%	N = Invalid or no response	%
If it is day time in South Africa, will it also be daytime on the other side of the world	Pre	26	89%	1	3.4%	2	6.8%
	Post	14	48.2%	6	20.6%	9	31%

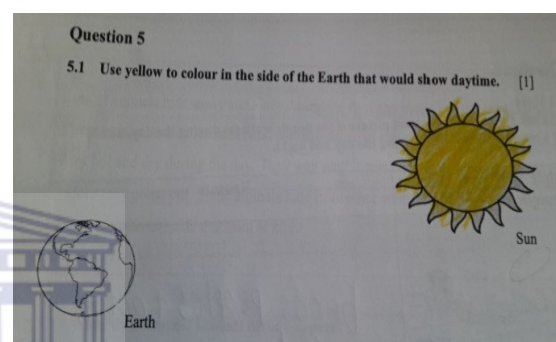
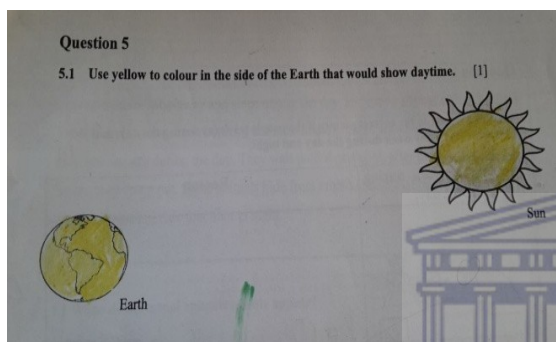
Table 4.3 presents the learners' responses to the question: "If it is daytime in South Africa, will it also be daytime on the other side of the world. Yes or No, motivate your answer." There was a clear developmental shift from the predicted initial concept of a stationary earth to an accepted view that the earth "rotates", "move" or "turns" around its axis. There were some learners who believed that the earth revolves around the moon, others believed that it moves around the sun. The experimental group's pre-test shows that only 1 learner was able to give the correct answer, 26 learners gave the incorrect response compare to two learners who did not attempt to answer it. The post-test shows a low increase in the results of the learners. Only 6 learners were able to give the correct response, and 9 learners did not attempt to do so.

Due to the learners' experiences they were aware and able to explain the phenomenon about the day and night cycle, although most of their explanations were based on their observations. Many of their observation are as a result of their demographic locations. Prior to the intervention, only two learners were aware that day and night occurs as a result of the rotation of the Earth. Although they knew that when it is daytime here and night time on the other side of the Earth, they could not indicate it in the diagram provided to them. To confirm their responses a diagram was given to the learners to shade the side of the Earth that indicates 'day'. In figure 4.2 are four of the learners' responses to question 5.1 in the DNQ.



Learner EL8

Learner EL13



Learner 27

Learner EL19

Figure 4.2: Learners' interpretation of day on Earth

EL8 has an idea that the sun is only shining on one side of the Earth, whilst EL27's understanding indicates that daytime happens at the same time across the globe. On the other hand, EL27 might have a point based on the shape representing the Earth. The shape is not a 3 dimensional shape therefore she coloured the whole Earth keeping in mind that it is night time on the other side of the Earth. EL19's response indicates that it will be night time across the globe. Learners EL27 and EL 19's can be based on their reasoning based on their everyday observation or their everyday language of the 'sun comes up' and 'the sun goes down'.

4.2.4.2 Learners' conception on the movement of the sun regarding day and night

As in other studies, most of the learners in this study displayed inadequate explanations of the day and night cycle. The learners conceptions of the day and night cycle is mainly based on their observations of changes that they see and believe when looking at the sky (Galperin &

Raviolo, 2015). For example, 'The sun comes out during the day and the moon comes out at night', 'when the sun comes up then is day', and 'when the sun goes down then it is night', etc.

In response to the question about the sun, the following statement was made during the interview: "It appears that the sun is moving. Does the sun move?" During the observation the E group responses to the question were "the sun hides", "it goes to other countries", "goes into the clouds" to describe the absence of the sun at night. Their evidence is mainly based on the fact that "we must go to sleep". There were no explanatory responses to this question as well. The learners from both sample groups gave very similar answers to this question in the pre-interviews compared to the answers they gave in the post-intervention stage.

EL4_{Post-Int}: The sun don't move, because the sun..., the earth moves and the earth moves... turns 24 hours a day and then, then after that then the earth spins again, the it is again day by us and night in another country.

EL10_{Pre-Int}: The sun is getting hotter that is why it is moving.

EL10_{Post-Int}: The sun is standing in the middle, the earth is moving around the sun.

EL18_{Pre-Int}: It is burning.

EL18_{Post-Int}: The sun is standing on one place it is the earth spins around the sun for 24 hours.

CL5_{Pre-Int}: Wherever you go, the sun comes with you.

CL5_{Post-Int}: It is the earth that moves.

In the post-interviews learners were able to give a more scientific explanation on the movement of the sun. Some of them were even in a position to provide valid evidence for the claims they made. Compared to their responses in the pre-interviews, learners EL10 and EL18 were aware that the sun is not moving, but that it is the earth that is moving around the sun.

EL24_{DAIM}: God moves the sun behind the mountains.

EL24's conception is influenced by her religious beliefs. Similar to the findings of Küçüközer and Boston (2010) learners also believed that God is the sole reason for occurrences of astronomical events.

4.2.5 Grade 2 Learners' conceptions about objects that can be seen

The objects that learners have mentioned in the pre-interview as well as in their pre-post test are indicated in Table 4.4 below. In the pre-test learners only drew the clouds and the sun as objects they see in the sky during the day, and the moon and the stars only at night. Based on their responses in the pre-test none of the learners indicated through their drawings that the moon and the stars are visible during the day, but during the pre-interview of the experimental group EL4 mentioned that the moon is visible during the day. The teacher had to probe the learners in order to find out whether they know why, and EL4 was able to give a partial scientific answer. The rest of the group was surprised to hear that the moon can also be visible during the day. To interrogate EL4's understanding the following question was posed to him:

Interviewer: Can you really see the moon during the day?

EL18_{Pre-Int}: No, because we see the moon at night.

EL4_{Pre-Int}: Yes, but it does not shine.

Interviewer: I agree, but why is the moon less visible during the day?

EL4_{Pre-Int}: The sun is shining.

Interviewer: Good.

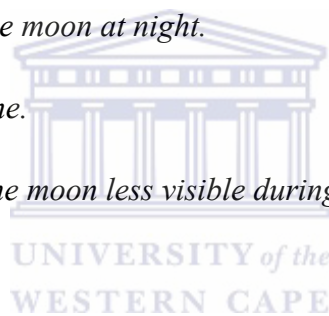
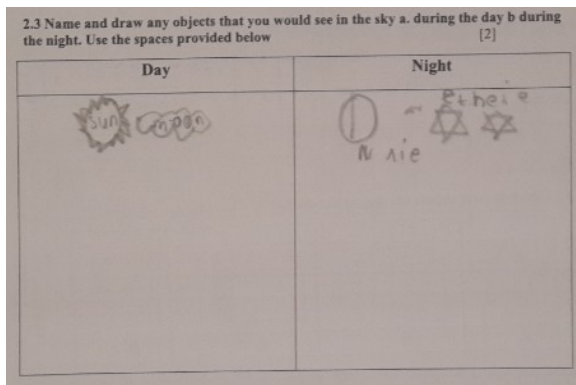


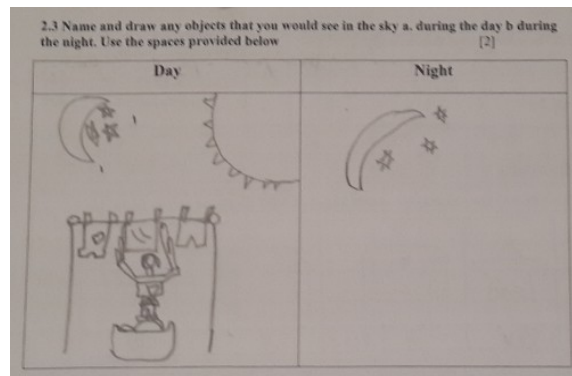
Table 4.4: Objects viewed in the sky during the day and at night

Pre-test		Post-test	
Objects during the day	Objects at night	Objects during the day	Objects at night
Sun, clouds	Moon, stars	Sun, clouds, moon, stars	Moon, stars, clouds

Based on their feedback the learners associated the stars and the moon with night time, and the sun with daytime. During the post-test only two learners of the experimental group's drawings indicated that the moon and the stars are visible during the day, as reflected in their drawings below in figure 4.3:



EL23



EL18

Figure 4.3: Objectives observed during the day and at night

In figure 4.3 it seems that learner EL23 and EL18 are now aware that the moon and stars can be observed in the sky during the night, and during the day. The learners' responses in the post-interview indicate that they are aware that the sun and the moon are visible during the night, but it does not shine brightly during the day as it would do at night time, due to the amount of sunlight during the day. The following response was given by EL21_{Post-Int}: *"The sun is shining brightly, that is why we can't see the moon clearly"*. Although EL4 indicated during the pre-interview that the moon is visible, he did not do so in the DNQ post test. Learners' explanation of scientific phenomenon is not consistent. The latter is in concordance with Kikas (2010) findings that primary school learners have difficulty to express their ideas, and that these learners' explanations are not consistent. Their explanations are often in concordance with what they have heard in their early childhood.

Learners have described the day and night occurrences based on two frames of reference, firstly the movement of the sun, and secondly based on their observations. Prior to the intervention the learners in the experimental group mainly defined the day and night cycle by the visibility of the sun during the day and the moon at night. These occurrences can thus be explained as a consequence of the movement of the sun (Galperin & Raviolo, 2015). Others have described it on the basis of the celestial bodies they observed in the sky.

4.2.6 Grade 2 Learners' conceptions about shadows

Shadows are a natural phenomenon (Chen, 2009 in Delserieys et al., 2014) which allows children to build their own representations through their every day experience. Children see their shadows and others' every day, but that does not mean that they know how it is formed (Barrow, 2012). The DNQ addressed the following themes: (1) formation of shadows, (2) position of shadows (3) movement, and (4) the usage of shadows. The graph below (Figure 4.2) indicates the learners' pre-conceptions held before and after they were exposed to the content of shadows. Their initial concepts that they had in all the themes was very low or not in line with the school science explanation, but as reflected on the graph below in figure 4.4, the post-test results show an increase in their understanding of the concept of shadows in the themes mentioned before.

Question one in the DNQ was a multiple choice question, where learners had to choose the correct answer between 3 possible answers.

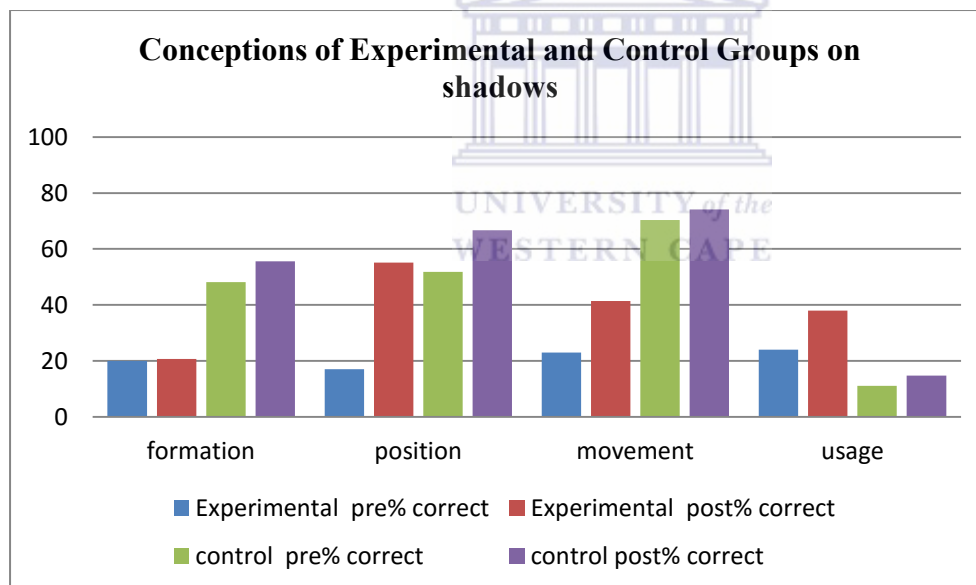


Figure 4.4: Conceptions of Experimental and Control group on shadows

4.2.6.1 Formation of shadows

Young children view shadows as semi-material property or an extension of the object that cast it, instead of understanding a shadow as a result of an object that blocks light (Massey and Roth, 2009). The results of the pre-post test of both groups indicated a low increase in understanding how a shadow is formed.

Table 4.5: Pre- Post percentages of learners with conception about the formation of shadows

Question	Group	Pre (%)	Post (%)	Gain (%)
1.1 When is a shadow formed?	E	20	21	1
	C	48	56	8

During DAIM lessons, it became evident that learners knew what a shadow is and when they can see it, but they were unable to say why it is formed; as well as what it was used for in the past. It confirms the claim made by Barrow (2012) that children see their shadows every day, but may not know how it is formed. The conceptions that learners held about the formation of shadows prior to the intervention were all alternative conceptions. The alternative conceptions below are learners' utterances made during the intervention on the formation of shadows:

Teacher: How is a shadow formed?

EL5_{DAIM}: If you stand here then your shadow is here (pointing with finger), if you walk it goes with you. It follows you.

EL26_{DAIM}: God creates the shadow.

EL27_{DAIM}: If there is light then you can see your shadow.

Teacher: When do you see your shadow?

EL9_{DAIM}: I can see it when I play outside.

EL5_{DAIM}: You can't see your shadow when it is dark.

EL18_{DAIM}: When it is light, I can see my shadow.

The claims which learners made were mainly based on observations in relation to position and light, rather than a scientific explanation. During the post interview, only one learner was able to respond to the following question: "How does a shadow form?"

EL4_{Post-Int}: When the sun is at the back of you, your shadow is in front of you.

Learner EL1 gave an explanation based on the practical activity they did during the DAIM lessons, but he was not able to give a scientific explanation on how a shadow is formed, such as "If light blocks an object, a shadow is formed." EL26's view is influenced by his religious beliefs, saying '*God created shadows*' which is not scientifically accepted by scientists.

Table 4.5 indicates that the results from both groups increased with respect to the concept on how shadows are formed. The results of the experimental group show a very low improvement (1%) in terms of the shift in their understanding regarding how shadows are formed. Their results in the pre-test indicate that they have scored 20%, compared to their results they scored during the post-test 21. The control group had much better results in both the pre- and post results compare to the experimental group. Their pre-test results were 48% and their post-test results were 56%, indicating 8% growth in their understanding of the formation of a shadow. This might be due to their daily experience they have, as EL18 said that one's shadow is following him or her.

4.2.6.2 Position of shadows

During DAIM six learners from the experimental group indicated at the beginning of the lesson that they knew or guess what the position of the shadow in relation to the sun is . This also reflects in the results of the pre-test. During the pre-test only 17% of learners got the answer correct. Since this was a multiple choice question, learners had to respond to the following question: When the sun is behind you, your shadow is.... Learners had to choose from the following possible answers:

- a. behind you
- b. above you
- c. in front of you

During the pre-test six learners chose the a, six learners chose b and 17 learners chose c. Table 4.6 below represents the pre-post test results of both the experimental and control group.

Table 4.6: Pre- Post percentages of learners with conception about the position of shadows

Question	Group	Pre (%)	Post (%)	Gain (%)
1.2 When the sun is behind you, the shadow is...	E	17	55	38
	C	52	67	15

Their post-test results show a significant improvement (38%) in understanding the position of a shadow in relation with the learner. This can be due to the different activities that they had during DAIM. The first activity was an outdoor activity where they had to determine where their shadow is, and then they had to try and jump on their shadows on the teacher's instruction. The researcher gave them multiple opportunities instructing them to change directions. The second activity was a group activity where they had to investigate the position of the shadow using a torch and various objects. The third activity was an activity with different pictures, where they had to match the shadow with an object (refer to Appendice D), thereafter they got another activity where they had to circle the objects in the picture where the shadow is on the correct place, and then they had to make a cross (X) where the shadow in not on the right place. Learners then had to indicate that they understand the concept by drawing the shadow of the bush on the activity sheet (refer to Appendice E). The group activity brought out lots of discussions amongst the group members.

The work that the groups have presented was all correct, except for one group who had drawn the bush on the wrong side.

4.2.6.3 Movement of shadows

Table 4.7: Pre- Post percentages of learners with conception about the movement of shadows

Question	Group	Pre (%)	Post (%)	Gain (%)
1.3 When does your shadow move?	E	23	41	18
	C	70	74	4

Young children often play a game where they chase and jump on another's shadow, but only 12 (23%) learners knew that their shadows are moving when they are moving from one place to another in the pre-test. The post-test results indicate an increase from 23% to 41% in the learners understanding. The increase in understanding can possibly be as a result of the interactive activities that the learners played during the DAIM lesson. The control group's pre- and post test results show that more learners understand the concept of the movement of a shadow than the experimental group. The control group gained 70% in their pre-test and 74% in the post test, which mean that there are 4% more learners who have now a better understanding about the movement of one's shadow.

4.2.6.4 Usage of shadows

Both groups' results have improved after they have been exposed to the content of shadows. The learners in the experimental group had a much better understanding about the concept of shadow prior to the intervention and treatment. The experimental group's results for the pre-test were 24% compared to the control group's results (11%). According to Table 4.8 more learners have gained an understanding about the usage of shadows, as their post-test results indicate in Table 4.8.

Table 4.8: Pre- Post percentages of learners with conception about the usage of shadows

Question	Group	Pre (%)	Post (%)	Gain (%)
1.4 Long ago people used shadows ...	E	24	38	14
	C	11	15	4

The learners' alternative conceptions on the usage of shadows are based on their indigenous knowledge. Some of the concepts that learners hold prior to the intervention can be identified as myths, and one can assume that it is knowledge that has been passed down by parents or an adult. The following alternative conceptions about the usage of shadows were held by learners in the experimental group prior to the intervention:

EL24: The shadow is a bogeyman. Like, uhm...if you don't want to sleep then the boogie man will come and catch you.

EL4: (Very serious) No, Miss. I disagree with EL24, when the sun shines then you see your shadow.

EL17: To play with.

EL15: It looks like it is protecting you, when you walk. When you walk it is following you.

EL19: You can make different kinds of animals with your fingers. Like this. (Using is hands and fingers shaping it into what looked like a horse's head)

During DAIM none of the learners had an idea about the fact that shadows were used to read the time. Therefore, I assume that learners must have guessed their responses in the pre-test. Learner EL24's response imply that the usage of shadows are used as punishment, or to scare the children. EL4 did not agree with EL24. EL24 personify shadow '*the shadow*', he gave character to a shadow. His conception above is what lots of parents tell their children in order for children to behave. It is normally said before bedtime when children refuse to go and sleep. In America, the bogeyman is identified as a scary evil that is usually thought of as a scary person, that hovers under your bed. In Europa, Asia and India, he is identified as a man with a sack that will catch disobedient children; and in some cases he either keeps you or he gets rid of you by eating you up. Maybe it is for that reason that some children fear their own shadows (Breyer, 2014).

Learner EL4's response is a valid reason, because this is what he might observe or even join other learners in games with shadows. There are a number of shadow games that learners play, and often learners play some of these games during their break time. Due to the fact that some learners fear their shadow, it was surprising to notice that EL15 see it as a protector that follows a person everywhere one goes.

In general learners know about shadow in terms of colour, shape, size, light and position. The learners in this study explain shadows mainly based on position, light and colour. Their responses were mainly influenced by their experience in relation to themselves, but not in relation to other objects. Learners in this study find great difficulties in trying to understand how a shadow is formed. Not everyone knew that shadows are created when light is blocked by an opaque object. At the beginning of the study few learners knew that light plays a role in the formation of shadow, but they only viewed shadows as objects. It is important for learners to have conceptual understanding of light, as it supports the learners' understanding that constructing scientific knowledge through observation of the world may be different from their reasoning (Magnusson & Palincsar, 2005).

Although learners play various games with their shadows, I found it strange that their conceptual understanding about the position of the shadow was poor. This might be due to the fact that they might never have given it a thought. Their gain in knowledge regarding the position of a shadow might be ascribed to the different activities they were doing during the lessons. Regarding the usage of shadows, none of the learners from both the control and experimental group were aware of the use of shadows as a clock. It seems as if some learners fear their shadows. This can be ascribed to the purpose for what the parents are using it.

4.2.7 Summary

The concepts tested in research question one was based on the day and night cycle in terms of the conceptions of:

- The composition of the sun,
- The movement of the earth and the sun in the day and night cycle,
- The shape of the earth,

- The movement of the day and night cycle,
- The objects in the sky during the day and night, and
- The shadows

The learners in this study held different conceptions of the day and night cycle. Prior to the intervention the learners in the study displayed inadequate understanding about the day and night cycle. Their views were mainly based on their observation, experiences and indigenous knowledge. According to (1997) these every day experiences can be termed indigenous knowledge systems (IKS). Generally the learners in this study explained the phenomenon from their position as terrestrial observers based on what they perceive what they see in the sky (Galperin & Raviolo, 2015). The following conceptions were held by learners in this study:

Composition of the sun: The learners based their responses on a colour ('gold' and 'yellow'), shape ('circles') and light ('bright light').

Shape of the earth: The learners described the shape of the Earth as 'round', 'circle', 'ball', 'star', 'cube' and 'sphere'.

Movement of the day and night cycle: Movement of the earth and the sun in the day and night cycle: 'the earth moves around the sun, the sun moves around the earth, the sun goes behind the clouds, the sun comes up and it goes down, during the day we go to school and at night we go to bed, the sun moves to different countries, 'the sun goes into the clouds' and 'God makes the sun moves behind the mountain'.

Objects in the sky during the day and night: The findings revealed that learners knew the objects that appear in the sky during the day and at night. The explanations were mainly based on what was visible with the naked eye. The majority of the learners did not know that the moon is visible during the day.

Shadows: Learners view shadow as a 'black thing', 'statue' and 'ghost'. Their conceptions about the formation of a shadow were, 'when they move' and 'God causes shadows'.

It is important to note that these alternative conceptions held by learners are very important, because what learners are learning in school influences the process of concept development which they gain through everyday experience and vice versa (Cakir, 2008). Vygotsky, 1978 see the connection and interaction of the learners' existing knowledge with the knowledge taught at school as very important. When learners are confronted with the scientific conceptions, then they can interact with their prior knowledge to make the connection with the new knowledge.

An analysis of the pre- and post-test data shows that the learners have gained knowledge as a result of the DAIM to which the experimental group was exposed. After the learners were exposed to the content of the day and night cycle their explanations ranged from alternative conceptions to partially scientific explanations and to scientifically correct explanations. For example, *'the sun stand still and the earth is moving around the sun'*, *'the earth is moving around the sun for 24 hours'*, and *'the earth rotates on its axis for 24 hours'*. In some instances, as in the study done by Galperin and Raviolo (2015), it became evident that the learners' everyday perceptions are sometimes stronger than the scientific explanations.

One can also mention that some learners in the study did not necessarily abandon their IK views, but retain both the scientific and IK view, which Ogunniyi (2007) refers to as an equipollent cognitive state. Teachers often consider this topic as easy and obvious, and therefore do not go into greater depth (Galperin & Raviolo, 2015) as they assume learners know how the day and night cycle occurs, not knowing learners' alternative conceptions.

The findings from this study seems to indicate that the Dialogical Argumentation Instructional Method as a teaching strategy benefitted the learners and assisted them to enhance their understanding of the day and night cycle. The different stages within DAIM make it possible for learners to engage with the same content in different spaces, for example at the intra-, inter- and trans-argumentation. The conversation amongst the learners during inter-argumentation plays a vital role in knowledge constructions and the cognitive shifts in world views (Ogunniyi, 2007 a&b). During classroom observation, it became apparent to me that there are some learners who really benefit from the conversations and discussions during the inter- and trans-argumentation activities. The learners who hardly speak during the whole class discussions are more involved and engaged in the activities. Their contributions to the discussions are valuable and it is valid by the group members.

What struck me was the vocabulary that some of the learners used during their discussions, as well as the knowledge that the learners came to class with. Prior to the intervention their vocabulary was limited to everyday knowledge and expressions, but after exposing the experimental group to the content of the day and night cycle through argumentation they were able to describe the day and night cycle using the scientific language. This can be due to the fact that a word list was developed in conjunction with the learners. Learners used the word list as reference to communicate their understanding.

In conclusion, establishing the learners' alternative conceptions prior to instruction can help the teacher planning the lessons. Acknowledging, the learners' prior knowledge can help to establish a strong basic foundation for learners' achievement and outcomes (Jegede, 1995, Ogunniyi, 1998).

4.3 Research question 2: Can grade 2 learners associate daily activities to the night and day cycle?

This section focuses on the views of the learners from both the control and experimental group in terms of their conceptual understanding on the association of daily activities with the day and night cycle. Research question two is aimed at finding out if learners can associate daily activities to the night cycle. The pre-post test results of the DNQ which tested their conceptual understanding was used to report on the association of daily activities with the day and night cycle.

The research question will be answered with respect to a) Associating learners' activities to day and night b) Associating others' activities to day and night, and c) Animal activities according to the day and night cycle.

4.3.1 Grade 2 learners' association of their own activities according to the day and night cycle

The learners' responses to question 2.1 and 2.2 in the DNQ were used to answer this question. Learners responded to the following question:

Write down any two activities which you could do in the spaces provided below:

- (a) during the day, and

(b) at night. Give reasons for your answer.

Learners wrote or drew a range of activities performed by children during the day and at night. The number of activities learners drew in total in the pre-test were three activities performed at night and seven activities performed during the day, and in the DNQ post-test they drew three activities performed during the day and three at night. The table below (Table 4.9) is an indication of the two activities that learners are more likely to perform during the day and night:

Table 4.9: Activities learners perform during the day and at night

Activity	Group	Day	Night	Reason
Play (soccer, netball, etc.)	C	22 (81%)		I like to play. Because it is day time. I love to play soccer. I love to play netball.
	E	19 (66%)		
Sleeping	C		22 (81%)	I must go sleep. Because it is night. I can see the moon.
	E		14 (48.2%)	

This is one of the questions that all learners responded to, because it links to the activities they perform every day. In the pre-test, 22(81%) learners from the control group and 19(66%) learners from the experiment group indicated that they play during the day. Other activities which were indicated in this activity were eating, going to school, going to the beach, watching television, bath, wash washing, going shopping, visit family and friends, brushing teeth and cooking food.

Learners were comfortable answering this question because daily activities are part of their routine. Young learners notice the differences and similarities between activities that can be associated with day and night skies (Trundle, et al., 2012). They observe the passing of time

through the changing of pattern during the day. They start noticing that at night they need to sleep, and during the day they must eat, can play, attending school, and so on. Because the foundation phase learners are egocentric, it is appropriate for teachers to start with activities focussing on the learners, and connecting it with their everyday experience before progressing to others' activities. As Bosman (2006, p. 97) asserts that,

"Learners in the foundation phase are egocentric and view things and situations from their subjective perspective. Even when provided with set criteria, they are not capable of objectivity...".

If teachers start with things which learners are familiar with, learners can relate to the phenomena in question, and they will be able to participate in group and class discussions sharing their ideas. Learners will also feel a sense of achievement and might develop a positive attitude towards science. Furthermore, Bosman (2006) explains that achievement of scientific literacy depends not only on the acquisition of scientific knowledge, but on the values and skills relevant to effective science learning as well.

4.3.2 Grade 2 Learners' Association of other Peoples' Activities according to the Day And Night Cycle

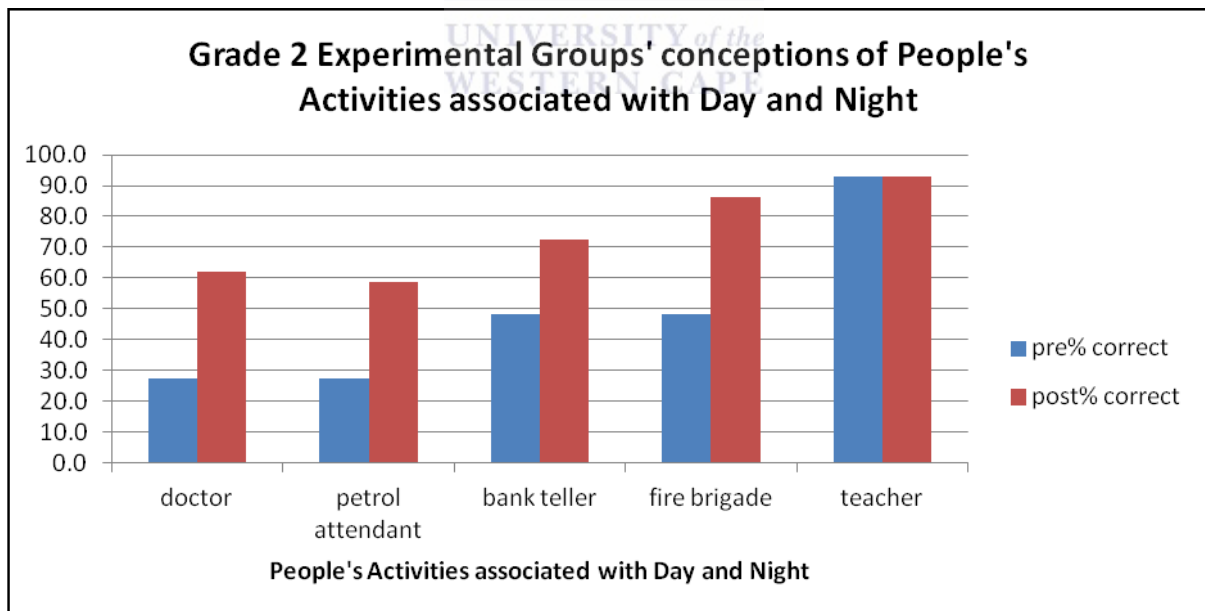


Figure 4.5: Grade 2 Experimental group's conceptions of people's activities associated with day and night

4.3.2 Grade two learners' association of others' activities according to the day and night cycle

The items in question 6 addressed the different jobs people are doing at different times of the day, included the following (a) a doctor, (b) petrol attendant, (c) bank teller, (d) fire brigade, and (e) teacher. Learners had to indicate with a tick (√) to say whether the people in the pictures work only during the day and with a cross (x) if they are working both day and night. The results in Figure 4.5 of this study show that less than 50% of learners are not too familiar with four of the professions or trades portrayed in the DNQ. They were unable to indicate whether people are working a) during the day, or b) during the day and at night. Although learners do not have regular contact with these types of professions, they knew what their job descriptions entail. The pre-test results of question 6.1 were very disappointing because I expected the learners to know that doctors and nurses work both day and night. The experimental group achieved a high score of (93.1%) with question 6.5. This can be due to the fact that the school forms part of the learners' daily routine.

In order for learners to get a better understanding about the time of day the different people are working, learners got involved in planning and preparing for a role play activity. Each group got a flash card then, they had to discuss the following in their groups: a) what kind of work do they do, and b) when are they working. The role play was performed by learners in the different groups to the rest of the class.

While learners were discussing I walked around to the different groups and listen to their arguments. Wherever I find that learners are struggling to keep the discussion going, I asked probing questions to elicit discussions. Very interesting discussions emerged as learners were busy preparing for the role play, especially the group who had the flash card reading 'fire brigade'.

EL6_{DAIM}: Mommy!!!! Mommy!!! The candle fell over. The curtain is burning.

EL9_{DAIM}: Bring water!!! Make quick.

EL13_{DAIM}: Call the fire brigade.

EL18_{DAIM}: Are they still awake? Oh yes, they work day and night. (Laughing)

The rest of the class then had the opportunity to ask questions and contribute any other information that they felt is relevant after each presentation. The learners asked questions to the rest of the group.

EL23_{DAIM}: Why did you ask for water?

EL9_{DAIM}: To put the fire out.

EL23_{DAIM}: When there was a fire in the bush, the boys used trees to hit the fire, then the fire brigade came to put the fire out.

Fires often occur in informal settlements during winter especially when a lamp or candle fall over and setting the house on fire, which in many instances has caused a whole area to burn out. The learners in this group are aware of what to do in a situation when a fire occurs. They also know who to contact and are aware that fire men work day and night. Through the role play it became evident that the learners in the groups know who the people are that work during the day and during the day and night. To clarify learners' understanding they asked questions to the members of the group.

It became clear why EL23 asked what the water was used for. His contribution was very valuable when he shared his experience with fire. EL23 stated his views and IKS-based practices that are used to extinguish a fire. These observations are aligned with Dar es Salaam (2013) who stating that if fire poses a threat to a property and lives of the people in Tanzania, traditionally it is collectively put out. It is important that learners are aware of the people who work during the day and at night as well as the services they provide to the communities, because if learners face a dangerous situation, they will know what to do and who to contact.

The reason why learners did not do so well in the pre-test with question 6.2 might be ascribed to the fact that not all the learners' parents own a vehicle. Although the majority of the learners make use of public transport to get to school on a daily basis, only 26.7% knew that that the petrol attendant works both day and night. After the intervention the DNQ post-test shows a significant improvement in their results (58.6%). It seems as if the role play presented by the learners had given the learners a better understanding on why petrol attendants have to work during the day and at night.

It became apparent that the learners in this study are not aware of the services that the banks are providing to their clients other than "we can get money at the bank". This statement by one of the learners in the experimental group might indicate that we can borrow or withdraw money from the bank. Prior to the intervention it seemed that their parents only withdraw money from the auto teller machines (ATM), therefore one can assume that learners associate the bank with the ATM. One can also assume that for most of the learners the bank as an institution is not part of the learners' frame of reference.

To establish whether learners have scientific explanation as to why certain activities are performed at specific times during the day, the following diagrams were included in the DNQ:



Picture 1

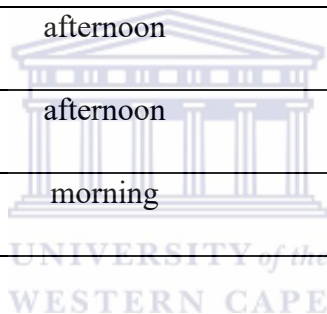


Picture 2

Figure 4.5: Day and night activities

Table 4.10: Times and reasons for doing activities at a particular time of day

Learner	Picture	Time of Day	Reason
EL26	1	Saturday in the day	No reason
	2	Friday	No reason
EL4	1	In the day	Because it is afternoon
	2	Afternoon	Because it is afternoon
EL12	1	morning	No reason
	2	Evening	Because the sun is out
CL12	1	afternoon	Because people can steal it
	2	afternoon	Plants must grow
CL13	1	afternoon	Because it can dry
	2	morning	So that it can grow.



The above responses (in Table 4.7) to the pictures ranging from morning to Saturday were interesting, and reasons provided are based on observations ranging from no reason to partially scientific conceptions to correct scientific conceptions. With regards to times for which certain activities are performed, most learners' responses were correct except for EL26 who indicated a specific day regarding picture 2 and EL4 for picture 2. The answer by CL12 states: *"People can steal washing."* suggesting that she may be staying in an area where the occurrence is likely to happen or she might have heard about it from adults. Whilst, CL13 and CL12 reasoning is partially correct: "Because it can dry." Both of them provided scientifically sound evidence why plants need water, but not enough reason as to how it relates to the day and night time. What they did not mention though is that, all this happen when the sun is shining.

4.3.3 Grade two learners' association of animals activities according to the day and night cycles

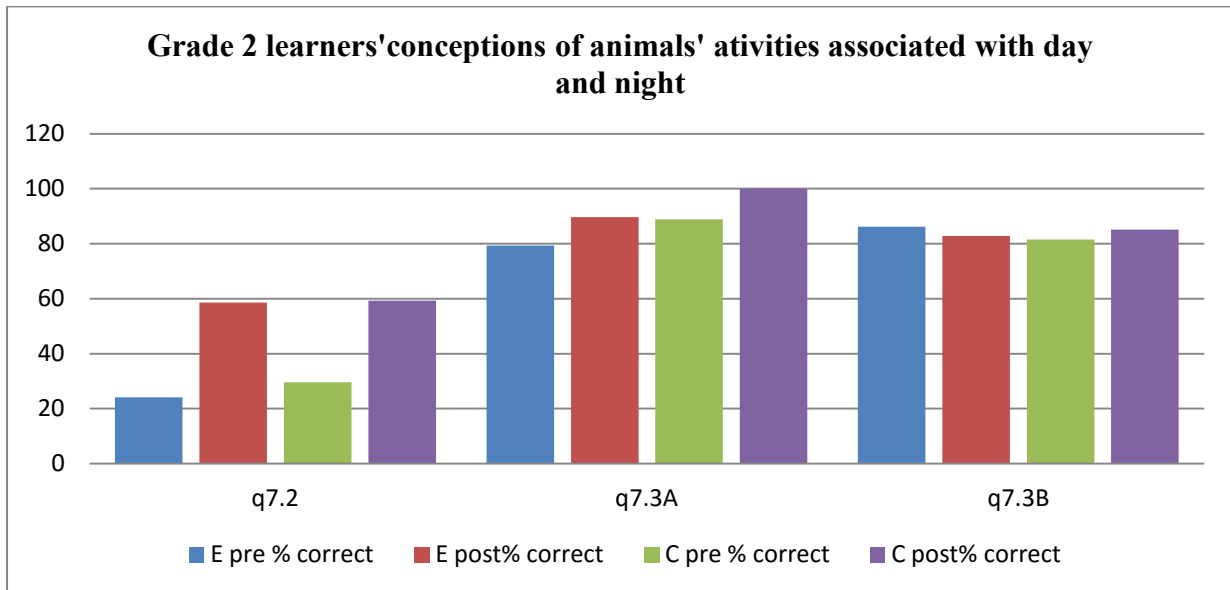


Figure 4.6: Grade 2 learners' conceptions of animals activities associated with day and night

Question 7 DNQ addresses the activities performed by animals. Figure 4.6 above highlights the results of the pre-post test of learners in the experimental group. Question 7.1 sought to find out whether learners know what nocturnal animals are. The results of the DNQ pre-test indicates that 18(62%) of the learners knew what nocturnal animals are and 11(38%) of the learners did not know what it was, but after they dealt with the content of nocturnal animals there was a shift in some of the learners' understanding, as the post-test indicates that 21(72%) learners know what nocturnal animals are, and (8)28% of the learners still don't know.

During the interviews learners had to respond to the following question: "What do we call animals that appear at night?" Only one learner of the control group knew what it was. Three of the learners in the focus group interview either knew what nocturnal animals are and after their explanations, one learner was able to give an example.

EL18_{Pre-Int}: Night animals.

CL1_{Pre-Int}: Animals that wakes us at night and sleep during the day.

EL29_{Pre-Int}: Bats.

Examples of nocturnal animals and reasons why they appear included the following: that learners gave includes the following:

CL1_{Pre-Int}: A cheetah is the fastest animal in the world.

CL2_{Pre-Int}: Owl. He doesn't like the sun.

EL4_{Pre-Int}: Owl is scared of the sun.

EL29_{Pre-Int}: They are making a noise at night.

During the post-interviews learners seemed to have a much better understanding as to what nocturnal animals are. They all knew that they are animals which appear at night, but could not give acceptable answers for reasons why these animals appear at night. Below are some of their responses after they had dealt with this topic.

EL29_{Post-Int}: It is animals that come out at night, like the lion. He is looking for food at night.

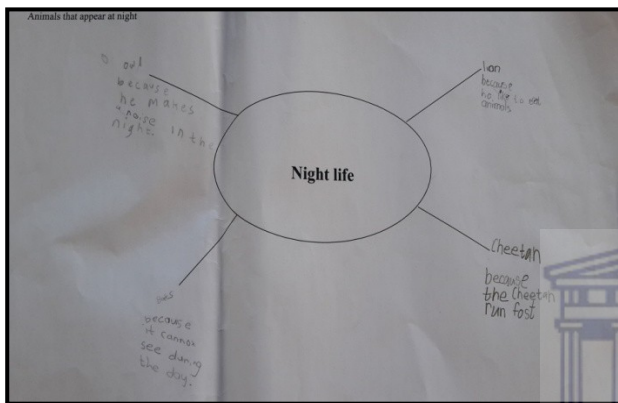
EL5_{PostInt}: It is animal that appear only at night. The mouse comes from the bushes, because the people are sleeping, then he looks for food in their houses.

EL19_{DAIM}: (Raised hand): Mice also bring money if we put our teeth in our shoe.

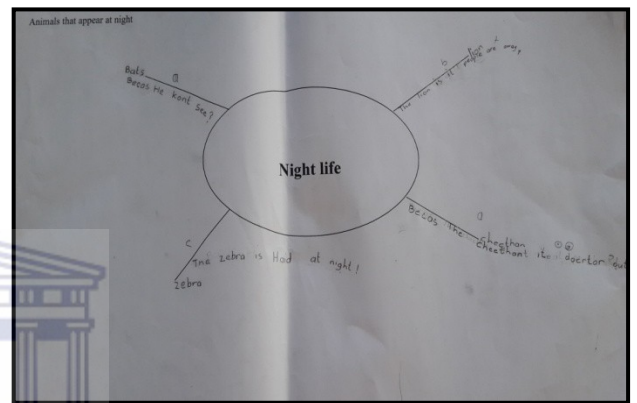
Learner EL19's explanation on the appearance of mice at night is based on his IK belief that mice purchase children's teeth in exchange for money. This myth is often used by parents to comfort children in the loss of their tooth. Letting the tooth be eaten by mice or rats will ensure that the child will grow sharp, strong teeth. Globally, there are lots of ancient folk methods of disposing of lost teeth. The tradition of leaving a tooth under a pillow or in a shoe for a tooth fairy or mouse to collect is practiced in various countries (Cecil Adams, 2004).

The results of the pre-test indicated that most of the learners of both the control and experimental groups did not have a clue about nocturnal animals, and reasons why they only appear at night. In question 7.2 learners were supposed to give reasons why nocturnal animals appear only at night, but only 30% of the control group and 24 % of the experimental group were able to give reasons why animals only appear at night. The following reasons were given by learners before and after the treatment. The following excerpts are responses of the pre- and post tests:

The mind maps in Figure 7.1 are examples of the responses of the group 6 and 3learners' views on animals at night during small group discussions which were presented to the class during trans-argumentation. These are responses of the experimental group who was allowed to discuss their conceptions with one another to reach a consensus so that they can present it to the class. Their views range from partially scientific knowledge to scientific knowledge. Compare to the group 3 whose views are based on animals in general. One of their responses is, 'The lion is it people are away'. This can imply two possible reasons (a) the lion hides away of people, therefore one can assume that the group meant that they fear people, or (b) the people are not around at night.



Group 6



Group 3

Figure 4.7: Mind maps developed during inter-argumentation session

Table 4.11: Reasons why animals appear at night

Example of nocturnal animals	Reasons as to why animals appear
Owl	Sounds - make people aware that they are around
Bat	Sensitivity to light - vision
lion	Feeding; fear for people

Their in appropriate answers are examples of diurnal animals with valid reasons, for example the 'cheetah'. The ground that group 3 made with regards to the zebra is a misconception held by the learner. After much discussion, questions and answers, the group agreed that the



zebra is not a nocturnal animal. In an analysis of their responses in the post-test it shows that learners have learned more about nocturnal animals, because there is a significant improvement in both groups'. The experimental group, as well as the control group's results increased to 59%.

Table 4.12: Responses of the learners' post-test as to why animals appear only at night

Reasons	Responses of the Control group	Responses of the Experimental group
Feeding	CL8 Because they want food	EL24 They must hunt for food and eat.
Hunting	CL13 Because they can hunt CL21 Because they are looking for food. CL23 Because they hide for food at night	EL7 Because they hunt animals, while other animals are sleeping EL16 Because they want to hunt the other animals. EL19 Because they want to hunt for food because they are hungry.
Vision	CL14 Because the sun is too bright for their eyes.	EL13 Because they do not get cold at night EL22 Because the sun is very hot and make the other animals eyes burn. EL3 Because they get very hot during the day, that is why lions always lie under a tree.
Fear	CL10 Because they don't want the people to see them. EL23 They hide CL4 Because some animals are scared	EL18 Lots of animals hide-away and sleep, then they move around at night. EL27 Because there are other animals hunting during the day. EL15 Because they scared of the sun
Sounds	CL19 They are making sounds	EL7 Because they make a noise and scare the people.
Daily activities		EL14 Because the sleep during the day, so that they can hunt at night.

The learners' responses were categorized into six categories based on the learners' conceptions as to why animals only appear at night. The following emerged: fear, sound, daily activities, feeding, hunting and being sensitive to the sun. It is worth noting that some of the learners in the experimental group provided grounds for their claims during the post-test. This is an indication that argumentation can play a role in understanding a new phenomenon. In Table 4.12 EL14 made a claim saying, *they hunt animals,* and provides grounds '*while other animals are sleeping*' for why he are saying so. EL18's response can possibly mean nocturnal animals are hiding away during the day and then they can move around at night. Or, it can mean that the diurnal animals hide-away and sleep at night then they can move around at night, possibly to hunt other animals.

7.3 Make a tick (✓) in the correct column and give a reason for your answer. (4)

Animal	Day	Night	Reason
<p>(a)</p> 			
<p>(b)</p> 			

This question was well answered by both groups during the pre-test and post-test, but it lacked reasons as to why they only appear at night time in the pre-test. The results of the experimental group question 7.3 (a) during the pre-test were 79% and the post-test results were 90%, and the results of the control group were 89% during the pre-test and in the post-test it was 100%. The results for question 7.3 (b) for the post test for the experimental group were 86% and there was a decrease in their post-test results (83%) as indicated in Figure 7.1. Compared to the experimental group the results of the control indicate an increase in the learners' results in the post test. Their results are as follow, 81% for the pre-test and 85% for the post. In the post-test more learners provided reasons for why they say the animals appear at night or during the day. Here are some of the experimental group learners' responses of the reasons they provide in the pos-test for 7.3 (a) and 7.3 (b):

Table 4.13: Experimental group's pre-test responses to why animals appear during the day or at night.

Question	Reason
7.3 (a)	EL26: At night the moon and star is shining. EL13: Because the owl can't see during the day. EL1: The owl makes a noise EL4: Because it is blind. EL9: Because he can see at night. EL10: Because the owl's eyes can burn. EL27: Because the moon is shining. EL11: Because it can bite. EL6: Because the owl wants to make a noise.
7.3 (b)	EL26: The butterfly is not sleeping. EL13: Because it likes to play. EL1: The butterfly is flying when the sun is shining. EL4: I will see it during the day. EL9: Because the sun is shining EL10: Because the butterfly gets cold at night. EL6: Because they want to be nice. EL17: He can't see at night EL6: The butterfly can't see in the night. EL9: Because she wants food. EL18: Because they sit on the flowers.

Learners in the experimental group associate the animals in the DNQ with the different celestial bodies visible during the day and at night. For example EL26 and EL27's response that refers to the moon and the stars that shine at night, and the EL1 and EL9's response that refers to the sun that is shining. The owl is associated with night time and the butterfly in question 7.3 (b) is associated with day time. EL4 and EL9's response imply that owls are blind. But according to Mayntz (2014) owls are not blind, they can see during the day, but their eye sight function incredibly well at night. She further noted that not only do owls hoot, but they make different sounds, such as growling, screeching, rattling, barking and whistling. In most Native American tribes owls signify death and the call of the owl is considered as a bad omen. Some of the tribes believe that the sound of an owl is messengers and companions for the gods of death (Supernatural Fox Sisters, 2014), but in actual fact, Mayntz (2014) explains that it is during the nesting period that you hear the sounds of owls, especially those high pitched sounds of female owls that you can hear miles away.

The experimental group is familiar with different types of animals, but did not have any idea of what a nocturnal animals were, after one of the learners were gave a definition, the rest of the learners were able to associate animals that appear at night. This can be due to their experiences and observation with animals in their environment. Prior to the intervention learners had different views about nocturnal animals regarding their appearance at night. During the whole class activity, learners' conceptions were based on the sensitivity of their eyes, feeding, a fear for other animals or people, and the different sounds of the animals, specifically the owl. Based on their responses in the post-test they were able to correctly identify the animals that appear during the day and at night. After the intervention learners had a better understanding as to why animals appear at night time. The majority of the learners in the study believed that the nocturnal animals' vision, feeding habits, different activities, for example hunting, sleeping during the day, etc. is the reason why they only appear at night time.

4.3.4 Conclusion

Question 2 addressed the learners conceptions regarding the activities associated with the day and night. This question was answered focussing on:

- Learners' activities,
- Reasons why certain activities needs to be done at specific times during the day,
- Work people do during the day and at night, and
- Nocturnal animals

Learners' activities: Learners could identify activities, 'such as play', 'attending school', 'going to the beach' at day time, versus night time activities 'sleeping', 'watching television', 'bathing', and 'eating'.

Reasons why certain activities need to be done at specific times during the day: Learners were able to give reasons why certain activities are performed during the day, but in some instances they were unable to do so, e.g. why do we do water plants in the morning or in the evening. Reasons learners gave includes the following: 'because the sun is out', 'plants must grow', and 'its afternoon'.

Work people do during the day and at night: Learners were able to identify which people are working during the day and during the day and night, but were unable to provide reasons why certain people work during the day and night.

Nocturnal animals: Learners were able to give various reasons why some animals appear only at night. They were also able to identify animals that appear only at night. The majority of the learners were not familiar with the term 'nocturnal'.

The learners in this study are egocentric in their views. Bosman (2006) explains egocentricity as natural and explainable. She further noted that learners find themselves in a strange world filled with phenomena that affect them personally. They interpret the phenomena according to how those phenomena affect their daily lives, such as the impact of the day and night cycle on the daily jobs of people and why certain activities must be done at a certain time of the day. The majority of the learners associated the auto teller machines (ATM) as the bank, because their parents might only use the ATM to get access to their money.

After learners were exposed to the content of the day and night cycle, learners were able to say why certain activities must be done at a certain time, but did not offer any reasons as to why. The learners are all familiar with the water cycle, but could not connect how the washing that hangs on the line also contributes to the water cycle. Learners' prior knowledge impact the way learners learn, understand and apply scientific concepts, skills, and phenomena. Smolleck & Hershberger (2011) corroborate that learners rely on their prior conceptions and experiences to express their understanding. It is clear that learners' preconceptions and past experiences are important tools in the development of learners' conceptions and alternative conceptions with science (Smolleck & Hershberger (2011)).

Nocturnal animals were not foreign to them, but the term 'nocturnal' did not ring a bell to any of them. The majority of them are familiar with the term 'night animals', which they can identify with, and immediately associate animals with the term. Science has its own language, which makes it difficult for learners to participate (Probyn, 2006) when using the traditional mode of teaching. The majority of the learners in the experimental class' home language is isiXhosa, but DAIM provided them the opportunity to interact with their peers in discussions, and often when I check with the groups, some of them speak in their vernacular. This allow

the learners to respond freely (Philander, 2012) and learners also gain better understanding of the phenomenon in question.

4.4 Research question 3: Can DAIM be used effectively to enhance the learners' understanding of day and night?

This research question aimed at finding out if there was any difference between the changes in the understanding of the day and night cycle by the learners who were exposed to a dialogical argumentation instructional method (experimental group) compared to those who were not exposed (control group). This question was firstly answered quantitatively using the DNQ which determined the learners' preconceptions and post-conceptions after they were exposed to the content of the day and night cycle. Secondly, a description of the qualitative data collected during the study is provided. The responses of the learners before and after the treatment were analysed using CAT and TAP as units of analysis.

The null hypothesis was that there was no difference between the performances of the two groups. In comparing the experimental and the control groups, the pre-test and post-test results of the DNQ which tested the learners' understanding of the concept of the day and night cycle in the natural science taught in grade two as prescribed by the South African Department of Education were compared. Below are the inferential statistics using the independent samples t-test to compare the performance of the learners understanding of the day and night cycle.

Table 4.14: Independent samples t-test results for E and C groups

	Group	N	Mean scores	Std dev	df	t-value	Sig. (2-tailed)	Remark
Pre-test	E	29	13.6	3.3	54	-2.36	.023	C group significantly better than E group
	C	27	16.6	6.0				
Post-test	E	29	21.7	4.4	54	2.86	.006	E group significantly better than C group
	C	27	18.1	5.1				

Alpha confidence limit = 0.05

The results in Table 4.14 show that at the pre-test, the control group (M=16.7, SD = 6.0) did significantly better than the experimental group (M=13.6, SD=3.3; $t(54)=-2.36$, $p= .023$). The magnitude of the differences of the means was very small (eta squared [η^2] =.095). However, at post-test, the experimental group (M=21.7, SD=4.4) significantly outperformed the control group (M =18.1, SD=5.1; $t(54)=2.86$, $p = .006$). The magnitude of the differences in the means was moderate ($\eta^2 = .13$).

The results above indicate that the experimental group which was exposed to the Dialogical Argumentation Instructional Model (DAIM) showed a significant improvement in their post-test compare to the results of the control group. This was based on their understanding of the day and night cycle in the pre- and post-test results of the DNQ. Both groups wrote the same test. Therefore, this seems to show that the experimental group learners learned the concepts of the day and night cycle better than the control group. The experimental group learners, who were exposed to DAIM, participated actively in all the activities and argued their viewpoints freely. As opposed to the experimental group, the control group learners were always expected to give the correct scientific answers. This seemed to have had a negative effect on the learners' performance as shown by the results (Ogunniyi et al, 1995).

To further compare the performance of the two groups, the pre-post results of the two groups were compared using the t-test for paired samples. These results were captured in the table below:

Table 4.15: Paired samples t-test results for E and C groups

Group	N	Pre-test mean scores	Std dev	Post-test mean scores	Std dev	t-value	Sig (2-tailed)
E	29	13.6	3.3	21.7	4.4	-12.7	.000
C	27	16.6	6.0	18.1	5.1	-1.7	.09

Alpha confidence limit = 0.05

The paired samples t-test in Table 4.15 was used to compare the pre-to-post performance of the E and C groups as indicated above. The results show that at the pre-test stage the E group obtained mean scores of (M=13.6, SD=3.3) and mean scores of (M=21.7, SD=4.4) at the

post-test stages resulting in a t-ratio of $t(28) = -12.7$, $p = 0.000$ which is less than $p = 0.05$, thus a significant difference. This may suggest that the intervention might be the reason for the effect in cognitive shifts. On the other hand the control group at the pre-test stage obtained mean scores of ($M=16.6$, $SD=6.0$) and mean scores of ($M=18.1$, $SD=5.1$) resulting in t-ratio of $t(26) = -1.7$, $p = .09$ which is greater than $p = 0.05$. These results show that the E group significantly outperformed the C group. Furthermore, the effect size for the E group is high ($\eta^2 = .85$), thus a considerable DAIM effect. These results suggest that the DAIM was probably more effective in enhancing learners' understanding of the concept of day and night than the traditional methods of teaching employed in the C group.

The results suggest that the intervention, in this case DAIM could most probably have accounted for the difference in the performance of the learners. DAIM, an enquiry method, involves learners actively constructing knowledge through argumentation activities. Research studies have shown that learners who are taught within a dialogical argumentation framework acquire higher and more permanent gains (Diwu, 2010; Philander, 2013; Hlazo, 2014). In the tests conducted above, the experimental group performed significantly better than the control group. The experimental group was exposed to the DAIM and hence, it can be concluded that the DAIM might have been responsible for the higher performance of the experimental group.

4.4.1 Grade 2 learners' understanding about day and night according to TAP

A dialogical argumentation instructional method developed through the Science and Indigenous Knowledge Systems Project since 2004 was used during the intervention. Using this model, classroom activities usually start with individual argumentation (intra-arguments), to small groups (inter-arguments) and finally into a whole class argumentation session. It is during the final stage that a consensus may be reached where feasible with the support of a facilitator (Ogunniyi, 2007 a&b). The findings from this study are consistent with the findings from Philander (2013) which showed that young learners are capable of constructing arguments through collaboration, verbal interaction by making claims, providing evidence and coming up with rebuttals (Ogunniyi & Hewson, 2008) in small group discussions.

This study is underpinned by Toulmin's Argumentation Pattern (TAP) (1958) as well as Ogunniyi's Contiguity Argumentation Theory (CAT) (2008). TAP consists of a claim,

evidence (data), warrant, backing, rebuttal and a qualifier. A claim, evidence and a warrant are the core of an argument, whilst the backing, rebuttal and qualifier may or may not be necessary in the justification of a claim. Erduran, Simon and Osborne (2004) categorized TAP into seven levels of argumentation in order to determine the degree of an argumentation process.

Table 4.16: Levels of TAP's arguments in classroom discourse.

Quality	Characteristics of an argumentation discourse
Level 0	Non-oppositional
Level 1	Argumentation involves a simple claim against a counter claim with no grounds or rebuttals.
Level 2	Argument involves claims or counter claims, with grounds but no rebuttals.
Level 3	Argument involves claims or counter claims with grounds but only a single rebuttal challenging the claim.
Level 4	Argument involves multiple rebuttals challenging the claim but no rebuttal challenging the grounds (data, warrants, and backing) supporting the claim.
Level 5	Argument involves multiple rebuttals and at least one rebuttal challenging the grounds.
Level 6	Argument involves multiple rebuttals challenging the claims and grounds

Erduran, Simon and Osborne (2004)

The table (Table 4.16) above describes the different levels of argumentation which are used to analyze the learners' arguments during the interviews, pre- and post-test and classroom observations. Extant literature (Diwu, 2010; Erduran, 2004; Ogunniyi, 2007a) also acknowledges that a lot of time is required to fully induct learners into the different elements of TAP. The characteristics of argumentation described in the table above were used to classify the responses that were made in various instruments mentioned in Chapter 3.

4.4.1.1 Grade 2 learners' understanding about day and night according to TAP Level 0

TAP Level 0 includes arguments that only have claims. In the table below are examples of claims made by learners during group discussions based on their understanding of the occurrence of the day and night cycle.

Table 4.17: Grade 2 learners' understanding about day and night according to TAP Level 0

Learner/Group	Claim	Grounds	Counter claims	Reason/Grounds
Learner 1	The earth is moving around the sun.			
Learner 2	The sun is shining			
Group 1	The earth moves 24 hours around the sun.			
Group 2	The sun is shining during the day.			

During the small group activity learners 1 and 2 of the experimental group made the above claims. After much deliberation the learners had to write down their individual claims to reach consensus on what they were going to report to the whole class. Learner 1's claim of the day and night occurrence is based on a scientific world view, whereas Learner 2 still held an alternative view. According to TAP Learner 1 and 2's arguments are at level 0 since they only provided a claim without any grounds. Learner 1 conception of day and night might be based on his observation made about the visibility of the sun during the day. He might have had this view at the beginning of the study or he might have gathered the information during the small group activity where learners had to present their claims to the group and argue about the different views held by learners.

During the small group activity, each learner had the opportunity to present his answers to the rest of the group. The group would then argue and discuss each presentation. After much deliberation the group then, reaches a consensus on what they are going to present to the class. The rest of the class then had the opportunity to ask questions which helped them to clarify their misunderstandings. Table 4.17 above are the transcripts of claims made by Group 1 and Group 2 that refers to the occurrence of the day and night cycle during their discussions in the small group activity. Due to the fact that the groups only gave a claim, with no grounds or counter claims their discussion reached an argumentation level of 0. Group 2 still held an alternative conception about the day and night cycle. Group 1 on the other hand had an idea that the Earth is moving around the sun, they were even able to say the number of hours it moves around the sun.

The following statements are made by a learner from the control group who was not exposed to DAIM referring to the statement: *"It appears that the sun is moving during the day, do you agree or disagree?"* According to both her arguments below, her level of arguments are both at level 0, because she only provides a claim, with no grounds or counter claims.

CL5_{Pre-Int}: The sun goes down and the moon comes up.

CL5_{Post-Int}: Wherever you go the sun comes with you (shaking her head).

Generally people, especially children hold the view that the sun goes down and the moon comes up as in the case of CL5. This can be due to many factors, such as, the learner could have read it in a story, his mother or father, or the teacher could have communicated the view while teaching the content on the day and night cycle. Learner CL5 still holds an alternative view that the sun is moving. It seems as if she does not hold the scientific view that the Earth is moving around the sun, therefore, she claims that it is the sun that moves.

4.4.1.2 Grade 2 learners' understanding about day and night according to TAP Level 1

TAP Level 1 discussions include a claim and a counter claim. The following is a snippet of the interview prior to the treatment based on the discussion regarding the visibility of the moon during the day.

Interviewer: Can we see the moon in the sky during the day?

EL3_{Pre-Int}: No, because the moon is on the other side of the world.

EL6_{Pre-Int}: No (moving his head from left to right).

EL5_{Pre-Int}: Yes, we can see the moon.

Different views were held by learners of the experimental group about the visibility of the moon during the day. Contrary to learner EL5, learners EL6 and EL3 are not aware that the moon is visible during the day. EL5 is aware that the moon can be seen during the day, but did not give any grounds for his claim made during the pre-interview. According to TAP this discussion can be classified as level 1, because EL3 and EL6 made claims, and EL5's response is a counter claim.

The excerpt below is an expression made by EL5 during the post-interview based on the question what nocturnal animals are. Except for one learner, the rest of the learners did not have any idea what a nocturnal animal is, but they were able to give some examples of such animals.

EL5_{Post-Int}: It is an animal that appears only at night. The mouse comes from the bushes, because the people are sleeping, then he looks for food in their house.

Learner EL5 was not able to give any answer in the pre-interview, but he could give an example. It is noted in terms of TAP that after the intervention EL5 could explain what a nocturnal animal is and he was able to support his claim with evidence. According to TAP the level of his argument is a level 1 argument.

4.4.1.3 Grade 2 learners' understanding about day and night according to TAP Level 2

TAP Level 2 arguments or discussions include a claim or counterclaim with grounds. The following is the response of EL18 to the interview question on the following statement: "It appears that the sun is moving during the day, do you agree or disagree".

EL18_{Pre-Int}: It is burning.

EL18_{Post-Int}: The sun is standing on one place it is the earth spins around the sun for 24 hours.

In the post interviews EL18's arguments were at level 2 in terms of TAP. She provided grounds for the claim, "...it is the Earth spins around the sun..." and she provides a warrant to strengthen her argument by stating the time that it takes the earth to spin around the sun, "...for 24 hours". Her claim prior to the intervention was based on her life world experience on the heat of the sun. Although she does not explicitly state it, one can speculate that she believed that the sun is burning out, and as the sun is burning the day changes into night. Her argument suggests that when it is dark the sun has burnt out. Her claim reflects that she is aware that the sun is standing still and that it is the Earth that is moving around the sun. Her level of argument in terms of TAP is pitched at level two as she made a claim and provided evidence to strengthen or support her claim.

4.4.1.4 Grade 2 learners' understanding about day and night according to TAP Level 3

TAP Level 3 arguments have a claim, counter claim with grounds. The following discussion took place during the intervention in small group activities where learners made their claims and at the same time defended their claim in order for the group to reach consensus on what they were going to present to the class. The learners in the different groups had to respond to the following statement: "The sun is a star".

EL13_{DAIM}: I don't think so.

EL6_{DAIM}: No it is not a star. How can the sun be a star?

EL9_{DAIM}: Ur...It then shines at night.

EL22_{DAIM}: Yes, it is. It gives us light like the sun, but it shines in the night.

EL9_{DAIM}: No. It can't be a sun, it is then so small.

The above discussion can be classified as a Level 3 because it contains claims (*No it is not a star, Ur..., No.*), grounds for the claims (*It then shines at night, it is small, It gives us light like the sun*) and a counter claim (*Yes, it is*). EL6 also asked a question to get an understanding as to why the sun is a star.

The expressions below are explanations of learners after they have been exposed to DAIM. EL5 and EL3 were able to adjust their alternative views and provided a valid scientific view arguing that the sun's brightness overshadows the visibility of the moon. EL6 still holds an

alternative conception about the day and night cycle. Their level of discussion is categorised as a level 3 according to TAP, because their discussion includes claims (*The moon is in the sky during the day*), grounds (*but we can't see it clearly, because the sun shines too bright*) for their claims and a counter claims (*We see the sun when it is day*).

EL6_{Post-Int}: We see the sun when it is day, then the moon comes out then we must go sleep.

EL3_{Post-Int}: The moon is in the sky during the day, but we can't see it clearly because it is too light during day time.

EL5_{Pre-Int}: Because the sun shines too bright that is why we can't see the moon.

4.4.2 Grade 2 learners' understanding of the day and night according to Contiguity Argumentation Theory (CAT)

Ogunniyi (2007a) refers to contiguity as the place or area of commonality between two distinct ideas. It is at that symbolic location or intellectual space where ideas or worldviews overlap that cognitive processes occur resulting in conceptual conflict, elaboration, accommodation, integrative reconciliation and adaptation (Ogunniyi et al, 1995; Ogunniyi, 2004, 2007a and b). CAT suggests that when two distinctively different worldviews (such as in school science and IKS) interact together, they will tend to attract or repel each other in the learners' cognitive structure resulting in the learner adopting a particular cognitive stance which is most favourable or plausible. CAT recognises 5 categories into which conceptions can move when dealing with conflicting worldviews of science and IKS or between learners involved in dialogues on an issue at hand. The five categories exist in a dynamic state of flux and may change from one form to another as the context changes. The categories of CAT used as a unit of analysis are as follow dominant, suppressed, assimilated, emergent and equipollent. (Ogunniyi, 2007a).

Grade 2 learners' cognitive mental shifts according to CAT

This section focuses on the views of the experimental group's in terms of the day and night cycle after they have been exposed to DAIM. Contiguity argumentation theory was used as a framework to analyse the learners' claims to determine the cognitive shifts they made. When comparing learners' pre- and post responses of the interviews conducted, it is evident that learners made cognitive shifts. The Contiguity Argumentation Theory (CAT) describes

possible ways in which ideas shift in the mind of an individual, moving from one context to another. In other words, it attempts to reflect cognitive shifts, due to contextual changes and thus showing the dynamic nature of worldviews (Ogunniyi, 2007a).

4.4.2.1 Learners' cognitive views according to CAT - Dominant views

Dominant ideas are those that are most favorable between competing ideas. The learners' ideas are dependent on their context or socio-cultural background when they are exposed to a new idea. Dominance is usually determined by overwhelming evidence in support of the new ideas or claims.

CL5_{Pre-Int}: The sun goes down and the moon comes up.

CL5_{Post-Int}: Wherever you go the sun comes with you (shaking her head).

During the pre-interview CL5 held an IK view in terms of his understanding about the movement of the Earth. In terms CAT learner CL5 did not make any cognitive shifts, she is still of the view that the sun is moving from one place to another, which means that she held on to her IK dominant worldview. After the treatment, based on the treatment, she is still of the view that the sun is moving from one place to another, which is an indication that she did not make any cognitive shifts, therefore one can claim that she holds a dominant IK view.

EL6_{Pre-Int}: No (moving his head from left to right).

EL6_{Post-Int}: We see the sun when it is day, then the moon comes out, then we must go sleep.

The above responses were made during the pre- and post interview on the visibility of the moon during the day. Young learners based their understanding on what they can see, as in the case of EL6 in this study. He believed that the moon is not visible during the day and the sun is not visible at night, because he is not able to see it, therefore one can assume that he associate the sun with day, and the moon, as well as the activity sleep with night. EL6 kept his original idea and strengthen his claim in the post-interview on the objects which are clearly visible in the sky during day and night. After the treatment he did not make any cognitive shifts, therefore one can say that he still holds a dominant IK view.

Various researchers found that learners held alternative views on the day and night cycle when they enter the classroom (Galperin & Raviolo (2015); Kampeza & Ravanis (2006); Celikten & Ipekcioglu (2012)). It is not easy for learners to abandon their views (Jegede,

1996), because their views might be more plausible than those offered by other learners and teachers.

4.4.2.2 Learners' views according to CAT - Emergent views

Emergent ideas are those ideas that are new and have no rival or opposing ideas (for example, new concepts in school science) in the learners' existing cognitive structure. The following is a snippet of some of the learners' responses to the interview question on the following statement: "It appears that the sun is moving during the day, do you agree or disagree".

ELL18_{Pre-Int}: It is burning.

EL18_{Post-Int}: The sun is standing on one place it is the earth spins around the sun for 24 hours.

EL5_{Pre-Int}: The sun is getting hotter.

EL5_{Post-Int}: The sun is standing in the middle and the Earth is moving around the sun.

Both learner EL5 and EL18 based their life world experiences on the heat of the sun. Prior to the intervention EL18 believed the sun is burning out, and as the sun is burning the day changes into night. His argument suggests that when it is dark at night the sun has burnt out. In terms of CAT, EL 18 held an IK worldview in the pre-intervention stage. But after he was involved in peer talk during small group and whole group discussions he came to the conclusion that the sun is actually not moving, but it is the earth that spins around the sun.

Both EL5 and EL18 views have changed to a more scientific view in terms of CAT. According to CAT their initial view was based on their IK worldviews which after much exposure to DAIM changed to emergent scientific world views.

EL29_{Pre-Int}: They are making a noise at night.

EL29_{Post-Int}: It is animals that come out at night, like the lion. He is looking for food at night.

It is evident in this study that some of the learners have never heard of the term 'nocturnal animals'. During the pre-interview EL29 was only able to state that nocturnal animals are making a lot of noise at night. This learner associated nocturnal animals with animals that make a noise at night, and it is not only nocturnal animals that make sounds at night. In the post interview his IK worldview shifted to favour of the school science worldview (Ogunniyi,

2007 a&b) which may be as a result of him having gained new knowledge about nocturnal animals. After the treatment, he was able to give an example as well as reasons as to why lions would come out at night, therefore it seems that the cognitive shift he has made had shifted to an emergent scientific worldview.

EL19_{DAIM}: (Raised hand): Mice also bring money if we put our teeth in our shoe.

EL19_{Post-Test}: Owl, because his eyes are sensitive to bright light.

Learner EL19's explanation during the intervention was based on his IK belief that mice purchase children's teeth in exchange for money. This myth is often used by parents to comfort children in the loss of their tooth. Letting the tooth be eaten by mice or rats will ensure that the child will grow sharp, strong teeth. There are lots of ancient folk methods of disposing of lost teeth. The tradition of leaving a tooth under a pillow or in a shoe for a tooth fairy or mouse to collect is practiced in various countries (Adams, 2004). In the post test learner EL19 revealed that his IK world view has shifted to an emergent scientific world view.

EL3_{Pre-Int}: No, because the moon is on the other side of the world.

EL3_{Post-Int}: The moon is in the sky during the day, but we can't see it clearly because it is too light during day time.

During the pre-interview the experimental group had different views about the visibility of the moon during the day. The cognitive shifts which the learners might have made after the treatment might have resulted that their views have shifted to favour school science explanations. In the pre-interview EL3 did not believe that the moon is visible during the day. His initial view was based on what he is able to see in the sky during the day. EL3's initial view that the moon moves to other countries, accommodated the newly acquired knowledge based on the sunlight which makes the moon partially visible. His explanation during the post interview indicates that his IK view has shifted to an emergent scientific view.

4.4.2.3 Learners' views according to CAT - Equipollent views

Ideas in the equipollent stage tend to co-exist, without possibly resulting in any conflict (Ogunniyi, 2007a; Ogunniyi & Hewson, 2008). For example, the scientific view of the day and night cycle, and the religious view of the creation according to the Bible can co-exist in a learner's mind, and used in school or personal contexts without any conflict. Learners operating in this cognitive state tend to come to class with alternative conceptions.

Depending on the context some learners are able to tap into the appropriate thought system, where as other learners are not able to do so. In the case of EL23 in his responses on how does day and night occur, he was unable to separate his religious view with that of the scientific view during the post interview.

EL23_{DAIM}: God made day and night.

EL23_{Post-Int}: God makes the earth moves around so that it can be day and night.

EL13_{Pre-Int}: When the sun is shining, it is day and when the moon shines it is night and dark.

EL13_{DAIM}: The earth spins on his axis, and when the earth is facing the sun then it is day, and on the other side the moon is shining, then it will be night there.

Generally people associate the day and night cycle with the presence of the sun and the moon in the sky. This view that learners have can be as a result of their observation of the objects that is visible in the sky during the day and night. In this study, many learners such as EL 3, 5, 6 and 10, hold this view. In the excerpts above EL13 based his argument on commonsense saying that, *when the sun is shining, it is day and when the moon shines it is night*. After he was exposed to the content of the day and night cycle, he mentioned that the earth spins on his axis, but did not exclude the presence of the sun and the moon. This argument suggests that he holds both an IK and scientific view at the same time. In terms of CAT, learner EL13's response falls into the equipollent science-*IK* world view.

It is also evident in the response of EL23 whose *IK* view based on his religious views during to the treatment. EL23 response during intervention showed that his religious view is deeply embedded by saying that "God makes the Earth move around so that it can be day and night". Therefore, one can claim that during the post-interview he held both an *IK* and scientific view, because he used both views to respond to the question. According to the CAT categories, his view falls into the equipollent science-*IK* world view. Ideas or views that are in an equipollent stage are said to co-exist, without any conflict (Ogunniyi, 2007a).

4.4.2.4 Learners' views according to CAT - suppressed views

Depending on the context a dominant thought system might assimilate or become assimilated or suppressed by a thought system. These two cognitive stages differ from one another in the

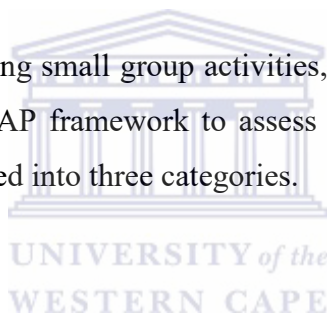
sense that the suppressed view might become dominant in another context, and the assimilated view remains subservient to the dominant worldview.

EL19_{DAIM}: The sun is shining like gold.

EL19_{DAIM}: The sun is a huge ball of gas that looks like gold.

During the intervention none of the learners had any idea what the composition of the sun was, but after they have been exposed to the content of the day and night cycle during the science lessons, they became aware of what the sun consists of, such as the learner EL19. At the beginning of the lesson she was of the view that the sun is shining like gold, and after the treatment and intervention she said that it 'is a huge ball of gas that looks like gold'. It is clear in her response that she had suppressed her IK world view, because she is still of the opinion that the sun looks like gold, and at the same time assimilated the scientific view that 'the sun is a ball of gas'.

The claims made by learners during small group activities, and whole class discussions were analyzed in accordance of the TAP framework to assess the level of argumentation of the learners. The claims were classified into three categories.



4.5 Summary

Both the experimental (E) and control (C) group's knowledge have been expanded on the day and night cycle after they were exposed to the content of the day and night cycle. The E group was taught using DAIM and the C group was taught in the traditional fashion. The C group achieved much better results in the DNQ pre-test than the E group. The reason for this could be attributed to the fact that the C group was taught by an experienced teacher as opposed to the E group which had just received a novice teacher¹ which the researcher had to mentor over a period of two years. After the experimental group has been exposed to DAIM it significantly outperformed the control group in the DNQ post-test. Since both groups had the same treatment in terms of content and equal teaching periods, the significant result could largely be attributed to the DAIM intervention strategy. The latter statement is further supported by the fact that the control group had an upper hand in terms of having a experienced teacher. While not underestimating the need for experienced teachers, the findings seem to suggest that the role played by learners in the co-construction of their

¹ A novice teacher in terms of the Western Cape Primary Science Programme (Western Cape Primary Science Programme, 2014) refers to a teacher who is teaching in between one and three years.

knowledge is vital in enhancing the teacher's ability to teach. In this case, argumentation lessons embedded with the DAIM approach seem to have stimulated the learners' ability to engage with the content, thus also developing critical thinking skills (Diwu & Ogunniyi, 2012; Erduran, 2006; Erduran, Simon & Osborne, 2004).

The different activities within DAIM allowed learners to externalize their thoughts, clear their doubts and some alternative conceptions which they held on the day and night cycle, thus a change in their initial conceptions. It seems as if argumentation had a positive influence on the learners' understanding of the day and night cycle. It is evident that DAIM has the potential helping learners' to navigate between their alternative conceptions and those of the scientific conceptions and be in a position to utilize whichever worldviews might be plausible at a given point (Gunstone & White, 2000).

This study reveals that grade two learners are able to make claims and counter claims. At the beginning of the treatment learners were unable to give evidence for the claims they made, but the more they were exposed to DAIM, the more confidence they gained to provide evidence. Based on the arguments of learners in this study it appears that their argumentation levels according to TAP operates mainly on level 1 (arguments involving a simple claim against a counter claim with no grounds or rebuttals) or level 2 (arguments with claims or counter claims, with grounds, but no rebuttals).

Based on the CAT framework, the learners' world views were diverse in their explanations. Their initial views were mainly based on IK dominant views or alternative views, which have shifted to the different cognitive stages amplified by CAT. The shifts they made include for example, assimilated, emergent, equipollent, suppressed and dominant views.

Argumentation can be used as a scaffold to connect learners' every day knowledge with what they learn at school. Using argumentation as a methodology to teach astronomical phenomenon can develop an interest and a love for science.

Having presented and discussed the results in this chapter, the next chapter concludes the present, outlines its implications and presents recommendations.

CHAPTER 5

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides an overview of the major findings derived from the data presented in Chapter Four. The purpose of the study was to determine the effectiveness of the Dialogical Argumentation Instruction Method (DAIM) on Grade two learners' understanding of the day and night cycle. This study was done as a means of finding empirical evidence that will enable the researcher in making a case for the method so that it can be used as a strategy to increase the learners' interest in science and possibly improve learners' achievement in the subject. This chapter highlights some implications of the findings for various role players as well as providing recommendations and suggestions for further research.

5.2 Main findings

5.2.1 Research question 1

What are the grade two learners' conceptions about the day and night cycle?

5.2.1.1 Grade two learners conceptions of the day and night cycle

The findings of this study supports the hypothesis made in chapter one that the subjects in this study do not have valid conceptions of the day and night cycle, and that their conceptions are based mainly on their observations and experiences. The learners in this study have many ideas about the phenomena of the day and night cycle. Some of conceptions were alternative conceptions and common with other learners' views in studies that were done globally. Some of the alternative conceptions held by learners regarding the day and night cycle include the following:

- The sun is moving.
- The earth is stationary.
- The earth is a ball.
- God makes day and night.

The day and night cycle questionnaire (DNQ) was used to collect data from the two groups that are involved in the study. The results of the study reveal that learners held alternative conceptions on the day and night cycle which are not scientifically accurate. However, the post-test results showed that there was an improvement in both groups and that the experimental group significantly outperformed the control group. The improvement of the learners' post-test results in the experimental group could be attributed to the dialogical argumentation instruction method (DAIM) intervention.

The conceptions held by learners are often entrenched in their thinking and sometimes they do not often realize that they are incorrect. This becomes a challenge for teachers, because learners tend to resist instructions, as it requires learners to replace or re-organize their knowledge to understand and to accommodate newly acquired knowledge. Although it may seem that their conceptions are a barrier to learning, they should not be ignored as they could be beneficial in building a more robust understanding (Lucariello & Naff, 2015) of new concepts. If their alternative conceptions are not corrected, they will retain these conceptions and it will become deeply rooted on their thinking such that they will become more difficult to change. Teachers must identify and utilize the learners' conceptions as a catalyst to teach and develop learners' scientific knowledge.

In support of Smolleck (2005), I agree that learners' pre-conceptions are valuable tools that can be successfully used by teachers to adapt their teaching strategies. In this study their pre-conceptions were used to connect with the new knowledge of the day and night cycle. Through argumentation they were able to use their pre-conceptions to guide their perceptions about what they previously observed and experienced in constructing scientific concepts. Argumentation allowed the learners to compare their existing knowledge with other learners' conceptions and with what they have learnt in the class. Learners often depend on their pre-conceptions, and if they are confronted with their own conceptions in learning new knowledge, learning becomes more meaningful.

5.2.2 Research question 2

Can grade 2 learners associate daily activities to the night and day cycle?

5.2.2.1 Grade two learners' association of daily activities to the night and night cycle

The study showed that the level of conceptions varied between the different concepts with regards to daily activities of individuals and others. The learners' responses during the interviews and their responses in the pre- and post test were egocentric. They were able to identify daily activities relating to their daily routine. Children who are in the egocentric stage speak, draw or write about things revolving around what their experiences. According to Piaget, egocentrism is a primary characteristic of children's thought processes until the ages of 6 to 7 years, or when they are able to form mental representations during problem solving (Louw et al., 1984).

Most learners in this study have pets such as dogs and cats. If they do not have a pet, they may still have some experience or knowledge about pets and other animals. The majority of the learners (18) in the experimental group knew what nocturnal animals are, and they were able to give examples, but were not able to give sufficient reasons why these animals only appear at night. This can be due to egocentrism or that they genuinely did not know.

I feel that DAIM creates the space for learners to apply their egocentrism during the individual activity where learners can draw from their experiences. Thereafter learners got the opportunity to listen to each others' views, and either agreed or disagreed with each other during the small group activities. Hill and Lapsley (2009) refers to cooperative learning and group discussions as well-suited strategies to introduce situations where cognitive conflict can be managed and where learners can develop a better appreciation for each others' views. The stages in the dialogical argumentation instructional model support learners to accommodate each other's views in a better way through discussions/arguments among each other.

In terms of the activities that others do and the reasons they do them, learners could only indicate the possible time that an activity could be done, but were unable to give reasons why. It is now clear to me why learners were unable to give reasons as to why others do certain activities based on time. In support of latter, Hill and Lapsley (2009) states that egocentrism makes it difficult for the young children to understand the reasons for rules other than for those which serve their own interests.

5.2.3 Research Question 3

Can DAIM be used effectively to enhance the learners' understanding of day and night?

5.2.3.1 The effectiveness of Dialogical Argumentation Instructional Model in enhancing the learners' understanding of day and night

The dialogical argumentation instructional model adopted for this study seemed to increase the learners' understanding of the day and night cycle. Learners involved in the study demonstrated their understanding by means of the day and night questionnaire, pre-post interviews and classroom observation. The post-test in the DNQ indicated that both groups had improved their results. However, the experimental group which was exposed to DAIM out-performed the control group which was taught using the traditional teaching method. The traditional method of teaching and the observation by learners are not sufficient to help learners to understand the phenomenon in discussion (Plummer & Krajcik, 2010).

DAIM gave learners the opportunity to work collaboratively and to gain knowledge from each other. The use of this model made it possible for learners to improve their thinking and reasoning abilities, allowing them to externalize their views, clearing their doubts and made other learners take on each other's views. Interaction, group discussions and debates occurred between the teacher and learners when they were using DAIM. The learners in the study were actively constructing their own knowledge. As in the study of (Philander, 2012), learners acquire knowledge through interacting with their peers and teacher.

During the intervention the experimental group was confronted with their alternative conceptions in a learning environment where they were able to ask questions and disagree with one another. DAIM provides learners a bridge or scaffold between the learners' alternative conceptions and the scientific views. The learning environment was non-threatening and the learners freely expressed their views. In doing so, learners got to understand the values embedded within their indigenous knowledge. Compare to the control group who were dependent on the teachers' support throughout the lessons. In most cases learners were not allowed to talk to one another unless they were asked to do so. Their alternative conceptions were not taken into consideration, and it seemed like the learners did not feel free to share their answers with one another.

Due to the learning environment which was created for the experimental group of learners, they became more confident to share their views with the rest of the class irrespective of whether they were scientific or not. Their attitudes towards one another also changed because they were reminded to value and respect each other's views. To clear their doubts learners started to ask questions based on the day and night cycle. The class teacher reported that one of the learners' parents told her about a difficult question her child had asked her, and how she needed to search for the answer on Google. One of the learners brought books based on Astronomy to school and was able to share the content with the class. I was very proud of him as I also learnt from his presentations. I came to the conclusion that if learners get a platform to share their views it can also deepened their understanding.

In addition to the learners' understanding of the day and night cycle, their communication skills and writing skills have also developed. Prior to the intervention, learners find it difficult to express their ideas they only responded in phrases or one word answers. As in Kikas' (2010) study learners in this study would also often repeat fragments of sentences they have heard from their peers during discussions. An analysis of the transcripts indicates that grade two learners are able to construct arguments through collaborative interaction. The results indicated that the more they were exposed to argumentation they started showing the ability to make claims which were backed with grounds or evidence. In some instances learners were able to make counter claims. Their argumentation levels based on TAP have also increased from level one to level two and three. They were able to make claims and justified them with evidence. Learners in the E group were given ample opportunities to improve their arguments through cognitive harmonization. The different stages within the DAIM allowed learners to learn collaboratively and co-constructing arguments based on the day and night cycle to more coherent arguments (Philander, 2012).

In their responses during the post-test interviews learners' views indicated that they had made cognitive shifts in terms of Contiguity Argumentation Theory. The learners' IK dominant worldviews, alternative conceptions or everyday knowledge have shifted to emergent, equipollent and suppressed worldviews, and in some instances learners retained their worldviews. The understanding of learners in both the experimental and control group have shifted from alternative conceptions prior to the treatment to more scientific conceptions after the treatment.

As the facilitator during the DAIM constructed lessons, I found the group discussions valuable yet time consuming.

5.3 Implications

This study has shown that DAIM can be considered as a teaching strategy to integrate school science with IK in the classroom. Various studies have shown DAIM to be a useful tool for integrating school science and IK in the science classrooms (Langenhoven, 2009; Diwu, 2010; Philander, 2012; Riffel, 2013). Teachers need to rethink how to teach science in the new era (Upadhyay & De Franco, 2008) in the foundation phase. In order for teachers to change their existing pedagogical practices to incorporate argumentation as a teaching strategy, they need to adopt different dialogical approaches (Mortimer & Scott, 2003). The strategies in DAIM involve learners in discussions with their peers to encourage and develop argumentation skills.

If teachers intend to incorporate argumentation as a teaching strategy, then their roles in the classroom will have to change. They will then (a) take on a facilitator role to guide learners during argumentation, (b) they must be trained on how to use argumentation as a teaching strategy, as to ensure that teachers implement argumentation effectively, and (c) they will have to structure and plan their tasks thoroughly. The success or failure of argumentation depends largely on the teacher.

Teachers need to support learners during argumentation as they struggle to argue scientifically. This necessitates a teacher to plan his or her activities in such a way that learners can argue scientifically while using their alternative conceptions about the phenomenon in question. This implies that teachers should become more aware of the pre-conceptions held by their learners in order to plan their teaching. Their planning must connect the learners' IK which derives from their experiences with the scientific information to promote conceptual change (Cinzia & Perucchini, 2013). In the process they should not ignore the learners' pre-conceptions (Smolleck & Hershberger, 2011), but use them as a tool to design activities for argumentation among learners and to facilitate knowledge construction (Kambouri, 2013).

Teachers often do not have time to focus on the learners' preconceptions (Kambouri, 2013) due to the fact that they have a curriculum to complete. Another reason why teachers do not do justice to the content of Earth and Beyond in the CAPS curriculum can be due to the fact that the Department of Basic Education (DBE) does not assess primary school learners knowledge in natural science. More time needs to allocated

Due to the lack of suitable IKS integrated Science materials, teachers are challenged to develop their own materials. Teachers play an important role by developing lessons and materials around the learners' community and everyday experiences (Castiano, 2009). Should DBE consider adopting an Argumentation Based Instruction as a tool to facilitate the integration of IK and Science, then the publishers of textbooks will have to take cognizance of the learners' preconceptions.

5.4 Recommendations

Teachers, curriculum advisors and pre-service teachers should be trained on how to integrate IKS and science knowledge, as well as the development of materials. In participating in training workshops teachers will be able to link school science with the learners' everyday experiences. It must not be assumed that teachers in foundation phase do have the scientific knowledge regarding the content of the curriculum therefore I would recommend that teachers must increase their scientific knowledge during pre-service training.

The curriculum should make the IKS content explicit, and assess learners on IKS to ensure that learners are able to use their everyday knowledge to learn school science. This will not only improve the results of the learners in science, but it will also encourage learners to pursue careers in science.

Teachers should be encouraged to use a constructivist approach in teaching IKS integrated school science. Constructivism can play an important role to understand the world. The constructivist approach acknowledges learners' preconceptions. Using the approach, learners will be able to see that their prior knowledge does have value in science (Bello, n.d.).

What I highly recommend is that teachers use different strategies (such as word walls and mind maps) to highlight the scientific vocabulary in order for learners to familiarize

themselves with the spelling, pronunciation and meaning of the words. Using argumentation as a strategy can improve the learners' language abilities, and in the process their use of the scientific vocabulary becomes richer (Philander, 2012).

A 'hands-on', 'minds-on' and 'words-on' approach to science teaching give learners multiple opportunities to engage with the same content knowledge and thus make science learning meaningful for learners.

If teachers intend using the DAIM as a teaching strategy to teach the science curriculum, then more time needs to be allocated. Natural science needs to get the same recognition that Mathematics and Literacy receive in terms of time allocation.

5.4.1 Recommendations for further studies

This study reveals a strategy by which an integrated IKS science curriculum can be designed to enable teachers to meet the expectations of the curriculum, as well as enhancing learners' understanding on the day and night cycle. While this study investigated the concepts that learners held, ignoring the concepts that teachers held on the day and night cycle, it will be useful to find out the conceptions that the teachers hold. Pine et al., (2001) imply that teachers can also have alternative conceptions about science which can be an indication of the concepts held by learners. A study in this direction will give us a much better idea why learners explain the day and night cycle as "*When the sun comes up, it is day time, and when the sun goes down it is night time*".

It will also be interesting to find out what conceptions the learners in the intermediate phase (grade 4-6) hold about the day and night cycle, and compare their findings with those of the grade 2 learners to see whether their conceptions are similar or different.

5.5 Limitation of the study

This study was limited to one primary school therefore the results of this study cannot be generalized for all South African schools. The learners' language had influence their responses during the interviews, since the majority of the learners' home language is isiXhosa, but their language of learning and teaching is English.

The amount of time spent on a Natural Science lesson in the Foundation Phase is normally between 15 - 20 minutes, more time was needed to accommodate an argumentation instructional methodology.

The way in which formal assessment tasks (FAT) and annual national assessment ANA are being conducted was a major challenge regarding time, and the reading abilities of some of the learners. For reliable and valid answers I had to conduct the pre-post in the same manner that the ANA and FAT is being done. It required the researcher to read each question twice then the learner had to write down their answers.

5.6 Conclusion

The aim of the study was to explore the effectiveness of the dialogical argumentation instructional model when teaching the day and night cycle. It was also expected to determine the concepts learners held before and after the treatment about the day and night cycle. The conclusion made from this study is that learners do hold different conceptions which are not aligned with the scientific conceptions. The findings also indicate that DAIM is a useful instructional model to teach an integrated IKS Science curriculum effectively, as well as enhancing the understanding of the learners in the study about the day and night cycle.

This study also highlights the importance of the learners' preconceptions in the learning of school science. Learners rely on their prior knowledge (Smolleck & Hershberger, 2011) to express their views, and the intervention in the study allowed learners to connect their prior knowledge with scientific knowledge which made their learning more meaningful. Teacher must be aware of learners' alternative conceptions to tailor their teaching strategies and activities around it. If the alternative conceptions are not addressed, then learners will retain them for a long time (Wandersee et al., 1994) and sometimes throughout their adulthood. In line with other studies, this study also revealed that learners in the foundation phase are egocentric; therefore, views learners hold are centered around their observations and experiences.

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Appendices

Appendix A: Day and Night Questionnaire

Day and Night questionnaire

Name: _____ **Age:** ____

Make a tick (✓) in the correct box: Girl Boy

Home Language: Afrikaans English IsiXhosa Zulu Other

Question 1

1.2 Look closely at the picture Study the picture and answer the questions that follow.



A shadow is a dark area or shape that is coming between the sunlight and a surface of an object.

Circle the correct answer.

1.1 When is a shadow formed?

- a. When the light is turned on.
- b. When the path of light is blocked by an object.
- c. When an object falls on the floor. [1]

1.2 When the sun is behind you, your shadow is....

- a. behind you
- b. above you
- c. in front of you [1]

1.3 When does your shadow move?

- a. when you are standing
- b. when you are moving from one place to another
- c. when you sit in the dark

[1]

1.4 Long ago people used shadows ...


- a. to scare their children
- b. to play with
- d. to determine the time

[1]

Question 2



2.1 Write down two activities that you can do during the day and night? Give a reason for your answer.

[4]

	
Activity:	Activity:

Reason:	Reason:
---------	---------

2.2 What time of the day do you think will people do the following activities? Provide your reasons on the space provided.

	
<hr/> <hr/> <hr/>	<hr/> <hr/> <hr/>

2.3 Draw and name anything that you can see in the sky during the day and night. [2]

Day	Night

--	--

2.4 If it is daytime in South Africa, will it also be daytime across the world? Yes or No and motivate your answer in the lines provided below. [2]





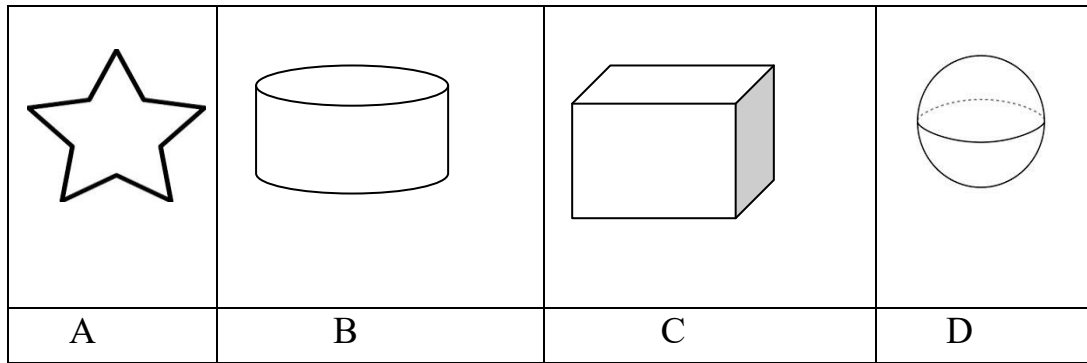
Question 3

3.1 Fill in true or false. Make a tick (✓) under the correct column. Motivate your answer. [3]

	True	False	Reason
1, The sun is a star.			
2. The earth is bigger than the sun.			
3. The sun gives us heat and light during the day.			

Question 4

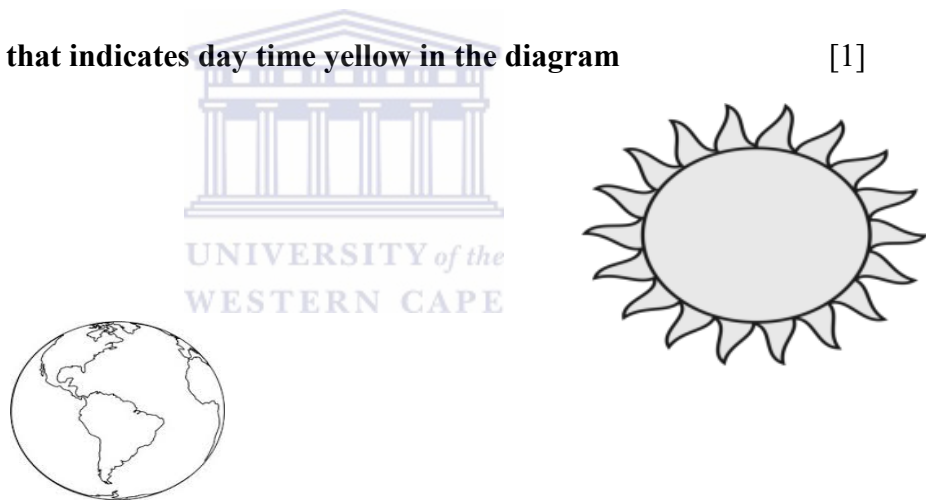
4.1 Which of these objects are shaped like the sun and the moon? Circle the correct letter. [1]



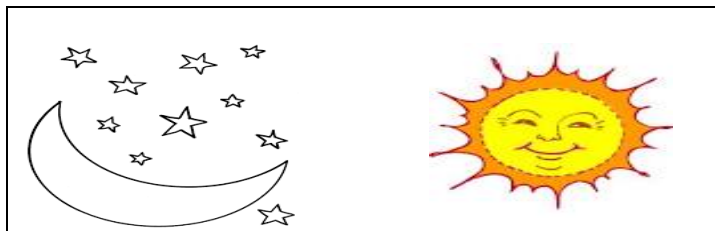
4.2 What is the shape of the earth? _____ [1]

Question 5

5.1 Colour the side that indicates day time yellow in the diagram [1]



5.2 Do you agree or disagree with the following: [10]




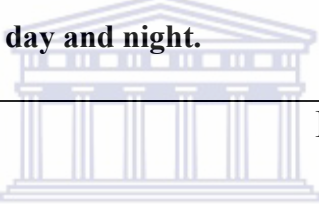

Tick (✓) the correct answer.


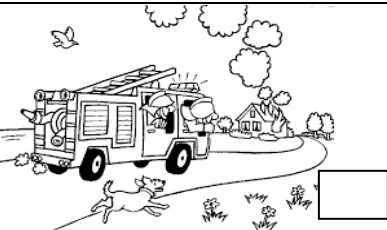
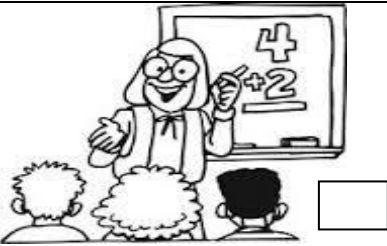

Questions	Agree	Disagree	Motivate your answer
-----------	-------	----------	----------------------

1. The sun is a pot of gold.			
2. Stars were used to guide travellers at night.			
3. The sun is a huge ball of gas.			
4. God created the earth, moon, stars and animals.			
6. People can live on the sun.			

Question 6

6.1 Make a tick (✓) next to the correct picture if the people work during the day and a cross (x) if they work during the day and night. [6]

People that work during the night and day.	Reason
 <input data-bbox="523 1393 596 1442" type="checkbox"/>	 UNIVERSITY of the WESTERN CAPE
 <input data-bbox="523 1662 596 1711" type="checkbox"/>	

Question 7

UNIVERSITY of the
WESTERN CAPE

Lots of animals hide away and sleep during the day, and move around only at night. These animals are called nocturnal animals. Some of these animals live where it is very hot and dry during the day. They wait until it gets cool, after the sun goes down, before they come out. Some animals hide from other animals that hunt during the day. There are also animals that hunt at night.

7.1 When do nocturnal animals mainly appear?

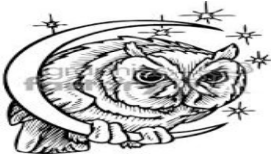
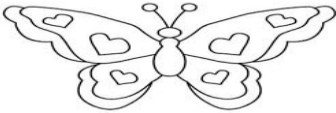
[1]

- a. during the night
- b. when the sun is shining
- c. at night

7.2 Why do some animals only come out during the night?

[1]

7.3 Make a tick (✓) in the correct column and give a reason for your answer. (4)

	Day	Night	Reason
			
			

Thank you for completing the questionnaire



Appendix B: Learners' interviews

1. Why do we have day and night?

2. Name some objects that you see in the sky during the day?

2. Why can't we see the moon during the day?

3. "During the day the sun appears to move across the sky." Explain why you say Yes or No

4. Which is bigger: The sun or the moon?

5. Can you give me some examples of nocturnal animals?

6. Give one reason why the animals you named are more active at night?

7. Why do some people associate an owl with bad luck?

Appendix C: DAIM Classroom Observation Schedule

Observation Schedule

Grade _____

Number of learners _____

Lesson _____

Date: _____

Item	Comment
<p>A. Grouping Arrangements Used</p> <ul style="list-style-type: none"> <input type="checkbox"/> Individuals working on same task <input type="checkbox"/> Individuals working on different tasks <input type="checkbox"/> Small groups working on same task <input type="checkbox"/> Small groups working on different tasks <input type="checkbox"/> Whole Group <input type="checkbox"/> Grouping arrangements were appropriate for the instructional goal and activity 	
<p>B. Learner Behaviors Observed</p> <ul style="list-style-type: none"> <input type="checkbox"/> Interacting with others <input type="checkbox"/> Working alone <input type="checkbox"/> Working in teams to challenge and defend claims <input type="checkbox"/> Applying scientific knowledge to real world problems 	
<p>C. Information and Communication Skills</p> <ul style="list-style-type: none"> <input type="checkbox"/> Sharing claims and listening to others share their thinking <input type="checkbox"/> Provide evidence for claims <input type="checkbox"/> Communicating ideas: demonstrations, models, drawings, and arguments <input type="checkbox"/> Helping to clarify each other's learning through discussion/modeling 	

E. Learner Involvement

- Majority of learners demonstrated interest/were engaged and on task
- Most learners take initiative in classroom discussions
- Majority of learners uninterested or apathetic
- Majority of learners were frequently off task

F. Learner Attitudes Demonstrated

- Dependent on others
- Cooperation
- Persistence
- Responsibility
- Confidence
- Enthusiasm
- Objectivity
- Critical thinking
- Self-directed
- Curiosity



Appendix D: Shadow activity 1

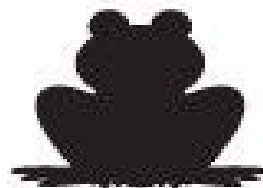
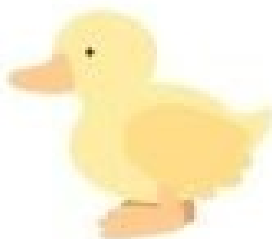
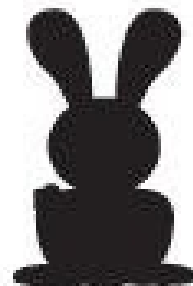
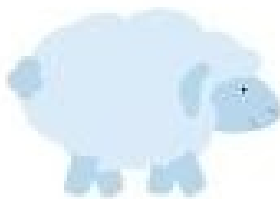
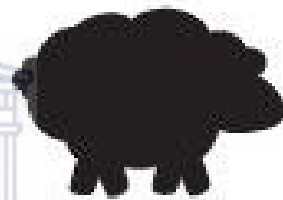
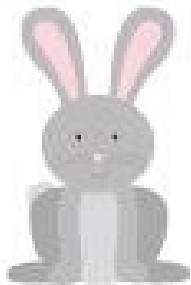
Grade 2__

Matching Shadows

Name: _____

Date: _____

Match the picture with shadow.



Appendix E: Shadow activity 2

Grade 2 _____

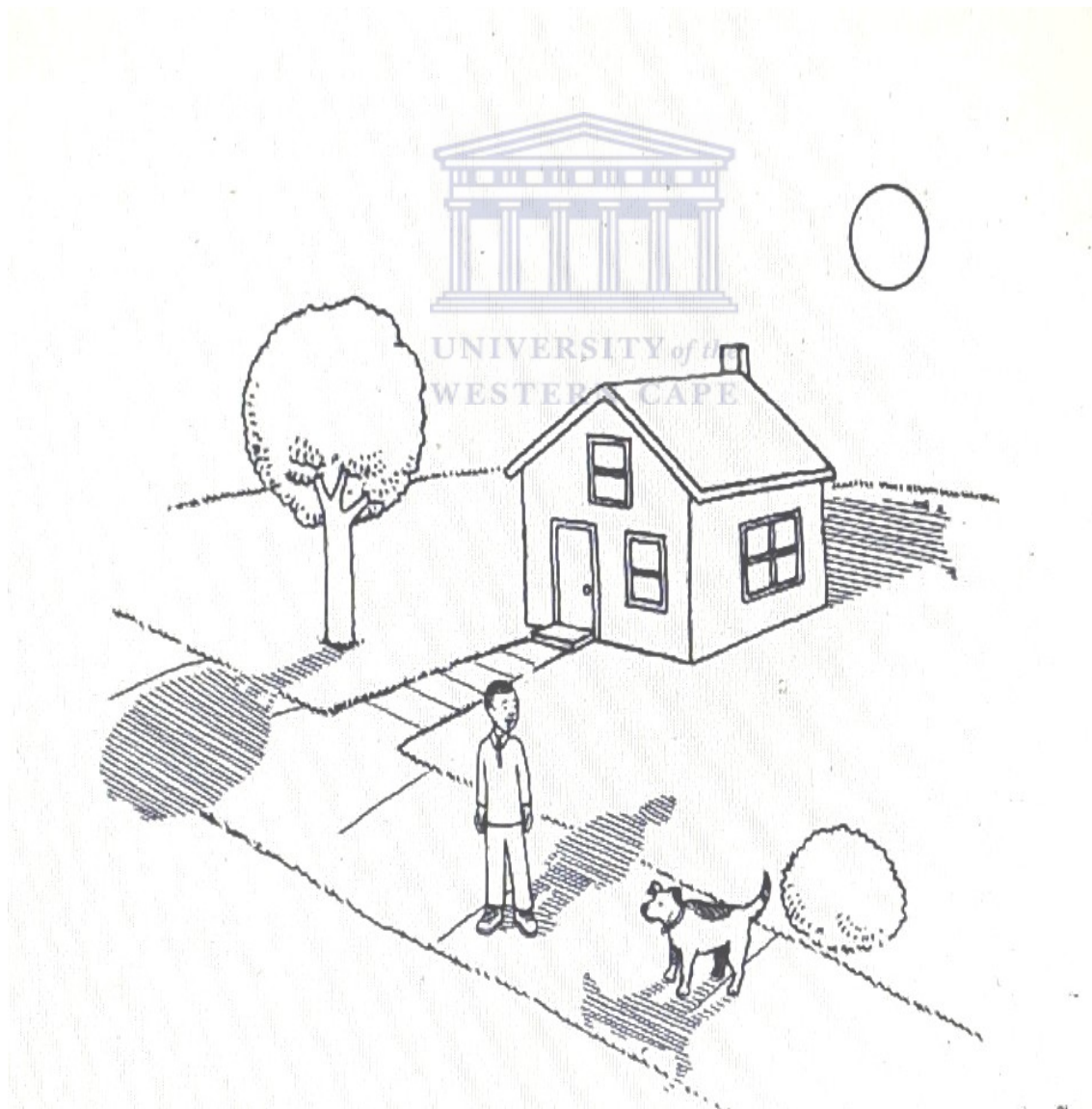
Shadows

Date: _____

Name: _____

Making Shadows

Look at the picture and notice where the sun is. Then circle each shadow that is in the correct place. Mark an X through the shadows that are not in the correct place. Draw a shadow made by the bush.



Adapted from Foresman Scott (n.d)