UNIVERSITY of the WESTERN CAPE

USING DIALOGICAL ARGUMENTATION INSTRUCTION MODEL ON GRADE 6 LEARNERS' UNDERSTANDING OF THE CAUSES OF THE PHASES OF THE MOON

A full thesis submitted in fulfilment of the requirement for the degree Masters in Science Education

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DECLARATION

I declare that "Using Dialogical Argumentation Instruction Model on grade 6 learners' understanding of the causes of the phases of the Moon", is my own work and that it has not been submitted for any degree or examination in any university and that all the sources I have quoted have been acknowledged by the references.

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DEDICATION

This research project is dedicated to my late mother Marther Kerubo Onyambu, who never went to school but wanted me to study. It is also dedicated to my children: Moraa (Nyamechi) and Paula Nyasaina who missed me most while I was away from home and also, to all the children of the world who like studying further.

ABSTRACT

The aim of this study was to explore ways in which a dialogical argumentation instruction model (DAIM) could be used to assist and enhance grade 6 learners' understanding of the causes of the phases of the moon.

The study was underpinned by Toulmin's 1958 Argumentation Pattern (TAP) and Ogunniyi's 2007 a & b Contiguity Argumentation Theory (CAT)

It was a case study that was carried out in a primary school in Cape Town, South Africa and a sample of thirty - five grade six learners participated. Data were collected using multiple data collection instruments including the pre- and post–achievement tests for grade 6 on the causes of the phases of the moon, an audio-taped interview schedule, focus group interview schedule, field observation schedule and classroom observation notes, all based on grade 6 learners' conceptions of the causes of the phases of the moon. Data were analysed quantitatively and qualitatively. The findings of the study were as follows:

Firstly, before DAIM, grade 6 learners held conceptions that; rain, clouds, seasons, day and night, and shadows from the planets, the stars and the sun were the causes of the phases of the moon.. Some of these conceptions arose from the learners' own science viewpoints and others from their indigenous perspectives. These conceptions were all not consistent with laws and principles of science because they were not the causes of the phases of the moon. However, after DAIM, grade 6 learners held the view that the light from the sun and the revolution of the moon round the earth were the causes of the phases of the moon. This indicates that there was a shift from the learners' pre DAIM to post DAIM thinking.

Secondly, DAIM created a platform where learners brought the knowledge or ideas they learn at home and used them to support their claims on the understanding of the causes of the phases of the moon in a science classroom. In this way, DAIM may have helped learners to resolve conflicts between what they learn at home (Indigenous Knowledge – IK) and what they learn at school (Science).

Thirdly, the learners gave narratives which seemed to indicate that they may have appreciated DAIM as a way of teaching and learning they said that it was interesting and enjoyable to

freely share ideas in class, and this may have assisted them in understanding the concepts of the causes of the phases of the moon.

Fourthly, that age, gender and geographical location did not seem to have any significant influence on the learners' understanding of the causes of the phases of the moon before and after DAIM.

The study, therefore, recommended DAIM to be used as one of the models of instruction in a science/IK classroom. The study could be utilized as a resource to guide pre and in-service science teachers in their professional as well as their content development. It could enrich the curriculum development resources set a base for further research.

KEYWORDS

Outcomes-based curriculum 2005, constructivism, indigenous knowledge, learners' alternative conceptions, dialogical argumentation instruction model, phases of the moon, Toulmin's Argumentation Pattern (TAP), Contiguity Argumentation Theory (CAT).

ABBREVIATIONS

ABET	Assessment Based Education and Training
ANC	African National Congress
ATBSS	Achievement Test for Basic Science Studies
CAT	Contiguity Argumentation Theory
CAPS	Curriculum and Assessment Policy Statement
DBE	Department of Basic Education
DAIM	Dialogical Argumentation Instruction Model
DoE	Department of Education
IKS	Indigenous Knowledge Systems
PAC	Practical Argumentation Course
PAF	Practical Argumentation Framework
SA	South Africa
SPSS	Statistical Package for Social Science
SIKSP	Science and Indigenous Knowledge Systems Programme
TAP	Toulmin’s Argumentation Pattern
TIMSS	Test of International Mathematics and Science Studies
USA	United States of America
UWC	University of the Western Cape
WCED	Western Cape Education Department

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS

CHAPTER 1: GENERAL INTRODUCTION

1.1 Introduction

This is an introductory chapter of the study. It is divided into different sections as follows:

Section 1.1 introduces the chapter, stating what each section is about.

Section 1.2 presents the background of the study, highlighting the weaknesses of Bantu Education that was provided by National Party, prior to 1994. This was designed for Black learners. Efforts made by the Department of Education to improve the curriculum and to give quality education to all learners, under the democratic government led by African National Congress (ANC) have also been summarized. Section 1.3 is about the problem statement of the study. This indicates what it is, that the study investigated and why. Section 1.4 presents the rationale of the study, pointing out the gaps that prompted this research to be done. The aims and objectives of the study are presented in section 1.5.This touched on what the study was out to achieve. Section 1.6 spells out the research questions. There were 4 research questions, which determined the specific issues that were investigated. Section 1.7 defines the theoretical frameworks of the study. These comprise of Toulmins' (1958) Argumentation Pattern (TAP) and Ogunniyi's (2007a & b) Contiguity Argumentation Theory, which were used to analyse arguments during DAIM classroom activities. Moreover, section 1.8 highlights the significance of the study, which includes the recommendations on how and where the study would be used. Section 1.9 gives the limitation of the study. This includes circumstances that prevailed beyond my means, could not allow the study to be done fully. Section 1.10 gives delimitations of the study which restricted the activities of the study to the set aims and objectives. Section 1.11 defines the operational terms, which guided the study. Finally, section 1.12 gives the summary and organization the thesis showing what each chapter is about.

1.2 Background

During the apartheid era (1952-1994) in South Africa, the government provided inferior Bantu education to the Black majority. The Bantu education curriculum under the Bantu Education Act no. 47 of 1953 provided a separate education for Black learners. The curriculum was designed to make Black learners receive only an education that was to provide them with skills that would enable them to serve in their own "Bantustan homelands" or work manual jobs for the Whites (Fataar, 1999). Black learners did not have options other than to fit into the Bantu-oriented curriculum. For the same reasons, the teachers in the Black schools were poorly equipped; this means that they could not perform their pedagogic tasks appropriately.

Another problem associated with the apartheid curriculum was that it had very little relevance to the daily experiences of learners, particularly Black learners. This was quite understandable since the curriculum did not take the learner's background and interests into consideration. Instead, the purpose of the curriculum, as mentioned earlier, was to prepare the Black learners for menial, substandard jobs in order to maintain them permanently in subjugation to the White minority population. The out-dated teaching practices due to poor teacher training and lack of in-service training opportunities for Black teachers further impacted negatively on the learning process (DoE, 2001).

However, after the downfall of the apartheid government in 1994, the newly elected democratic government started making attempts to improve the state of teaching and learning in the school system. The first thing the new government did was to design an equitable educational system that catered for all South Africans regardless of race, gender or creed (Fataar, 1999). This was enacted within the policy of growth, employment and redistribution (GEAR). The type of education that was drafted at that time (1994–1997), was encapsulated in the policy document called "The National Qualifications Framework" with an objective of creating access, mobility and progress within education, training and career opportunities (Jansen, 1997).

The need for a curriculum that focused on the future of the country also arose. This provided a platform for the then existing curriculum policy to undergo further modifications. The new policy modification gave rise to the National Curriculum Statement (C2005). This was drafted to drive the country's education into the 21st century and it operated under the philosophy of the Outcomes Based Education (OBE) (Asmal, 2000).

The OBE had 66 critical outcomes. However, there were several structural policy tensions within the OBE that resulted into open criticisms. For example, Asmal (2000) pointed out that in C2005, "teacher's content and professional preparedness were not addressed; there was no show on how the learner's creativities and skills could be tapped, and that learner-centred approach like group work and continuous assessment should have been considered" (p. 9 – 10). Therefore, there was a need for scholars' and experts' contributions towards improved curriculum.

Some of the contributors to C2005 such as Ogunniyi (1999) recommend that learning should involve both content and competency. Others who contributed towards the improvement of the curriculum include: Muller (1998), Taylor (1999), Seleti (1997), Hoadley (1999), and Malcolm (2000). Furthermore, the yearly curriculum reports that were compiled by the Department of Education (DoE) gave useful updates on the progress of the development of C2005, pointing out the strengths and weaknesses of its major innovations.

As a result of the criticisms labelled against C2005, the Department of Education (DoE) carried out several revisions which culminated in the Curriculum and Assessment Policy Statement (CAPS) designed by the Department of Basic Education (DBE, 2011).

The Department of Education (2010) indicated that one of the main features of CAPS is that it recognises Indigenous Knowledge (IK) and recommends its integration into school science. This is because IK forms prior knowledge for learning science (Ogunniyi, 2004a, 2007a & b). Further explanation on the importance of IK is given elsewhere in this study. However, the integration of IK into school science raised additional challenges. One of them being that of the uncertainty on which classroom instructional strategies would be employed to suit the noble idea of integrating IK into school science. Previously, Asmal (2000) argued that the new curriculum policies did not address the methodologies that would enhance better teaching and learning in classrooms, so that learners could achieve improved understanding of science concepts. Improved conceptual understanding could enable learners to follow careers better and become better citizens. Furthermore, one of the aims of education is to mould learners into literate citizens; truly united, democratic, creative, productive and free from discrimination (DoE, 1997a). So, it became absolutely necessary to look for new teaching approaches that could achieve to a large extent, the aspirations of the new curriculum, as the former teacher-centred instructional methods were clearly inadequate to achieve these goals.

To address the gaps cited above implies searching for instructional strategies that could: 1) enhance learners' improved understanding of science phenomena, which the old strategies did not live up to; 2) encourage learners to express their views freely as well as identify the similarities and differences between their IK and school science, and harmonize learners' school science and indigenous worldviews. These are some of the gaps, which would be filled by argumentation-based instructional method, the Dialogical Argumentation Instructional Model (DAIM). Argumentation has been found to be an effective instructional strategy for discussing conflicting worldviews, for example, IK and school science (Von Aufschneiter et al. 2008; Venville & Dawson, 2010).

The current study, therefore, investigated the use of Dialogical Argumentation Instructional Model (DAIM) and how it could assist learners to shift from their conceptions based on their own interpretation of the phenomena, which could be inconsistent with the laws and principles of science to more scientifically consistent concepts. In this way, learners could clearly explain themselves and make more accurate interpretations of the concepts related to the phenomena in the event of solving their day-to-day problems.

DAIM is an instructional strategy where learners engage each other, during a classroom activity, by making claims on what they know and by supporting such claims with convincing evidence (Ogunniyi, 2010). Diwu and Ogunniyi (2012) contend that DAIM is a form of argument instruction that helps learners to discuss freely and to reach consensus where feasible. For instance, DAIM could be used in a science class to engage learners in building knowledge through making claims or counter-claims and justifying and rebutting each other's postulations. DAIM follows the process of engaging learners at different levels such as: individual (intra-argumentation), followed by small group discussions (inter-argumentation), and finally in whole class discussions, whole class reflections and mediations facilitated by the teacher (trans-argumentation). In this way, the science teacher alone does not only transmit scientific knowledge but both the teacher and learners jointly construct it.

DAIM is underpinned by two theoretical frameworks, namely: Toulmin's (1958) Argumentation Pattern (TAP) where learners make claims and give supporting evidence or grounds; and where the evidence could be challenged or even refuted through rebuttals. The second is Ogunniyi's (2004 a). Contiguity Argumentation Theory (CAT). CAT explains that learners are engaged in argumentation which could lead to dynamic cognitive consideration of their conceptual position. As learners listen to each other's ideas, they are likely to reflect on their own ideas and could therefore change their thinking as argumentation proceeds. This movement of thoughts among learners could occur within five CAT categories, namely; dominant, suppressed, assimilated, equipollent and emergent cognitive mental states. More details about TAP and CAT will be given in Chapter Two.

As stated earlier, the central goal of this study is to investigate the use of DAIM on grade 6 learners' conceptions of the causes of the phases of the moon. In this regard, Trundle, (2002) recommend that learners in grades 5-8 should be able to explain the cause of the phases of the moon. This could be attributed to the kind of teaching and learning strategies that are used in the science classroom.

1.3 The Problem Statement

The new curriculum in South Africa was to address the challenges inherited from the apartheid curriculum, one of them being the low quality instructional methods that the teachers used. For example, dictating notes to learners, rote learning and chalk-and-talk are all described as out-dated by the Curriculum National Curriculum and Assessment Policy Statement (CAPS, 2011) because they are all not child centred. CAPS had to change to more learner-centred approaches. When an instructional strategy is not child centred, it means that, the teacher, apart from dominating the class during teaching and learning, he/she was considered to be the only knowledge producer and learners are consumers of knowledge, which was and is still not a very appropriate way of teaching and learning science.

Galili et.al (2003) indicate that because of the generally poor quality of teaching, learners are not able to have valid understanding of and consequently hold inadequate ideas about diverse phenomena (also see Kriek & Grayson, 2009). Bybee (2009) suggested that learners should be engaged in problem - solving activities to enable them to participate in their own knowledge construction. In line with Bybee's (2009) suggestion, Newton, et al. (1999) suggested that debates, discussions and argumentation should be part of classroom teaching and learning. This is because they actively engage learners. It was in light of this that this study adopted ’use of dialogical argumentation instructional model (DAIM) to explore grade 6 learners’ conceptions of the cause of the phases of the moon, more scientifically.

Also in line with aims of the Revised National Curriculum Statement and the National Curriculum (RNCS) and Assessment Policy Statement (CAPS), this study is concerned making the teaching and learning science relevant by examining the grade 6 learners’ indigenous knowledge of the causes of the phases of the moon and then aligning it with scientific views that they learn in class. It is hoped that this approach will help bridge the gap between their home knowledge and school science.

The integration of IK in science classrooms was, among other purposes, to enable learners to make sense of what they learn both at school and at home (DoE, 2002). Furthermore, Ogunniyi (2007b) argues that the integration of IK in science classrooms was an attempt to regain the knowledge and wisdom which had been lost during the past 300 years of colonial and apartheid rule (DoE, 2002). This knowledge and wisdom had helped the people now living in South Africa to survive for many centuries before the coming of the European colonisers. An advantage of integrating IK in science classrooms is that both science and IK could place a learner in a better position to solve their day-to-day problems inside and outside the classroom (Ogunniyi, 2004a).

Most importantly, it was to establish a teaching and learning strategy that could promote the spirit of unity and equality in the classroom. This could contribute to healing from the feelings of humiliation and inferiority that may have been inherited from Bantu curriculum of education under the apartheid regime. It should be borne in mind that the current learners are children of the then apartheid system of education, and chances are that, they probably feel the way their parents felt about the inferior notion attached to their indigenous knowledge and practices. It is in the light of the above that this study sought for an instructional strategy that could facilitate the integration of learners’ IK with school science. It is hoped that the strategy will assist learners in ameliorating their sense of alienation in the school science.

1.4 Rationale

The rationale for this study is to investigate how a new learning and teaching approach could create an enabling environment for the grade 6 learners to see similarities and relationships between their indigenous views about the causes of the phases of the moon and that of science. The dialogical argumentation instruction model (DAIM) adopted in this study provides an enabling teaching and learning environment which provides learners with opportunities to express their views and beliefs freely and enjoy sharing ideas without being intimidated. Similar views have been fielded by; (Erduran et.al 2004; Ogunniyi, 2004a, 2007a & b; Simon et.al 2006).

A review of literature reveals that the South African curriculum has undergone many changes since the fall of the apartheid government in 1994. The reason for these changes could be traced to several criticisms levelled against the outcomes based curriculum. The new democratic government was concerned with developing a more culturally relevant curriculum that will liberate the country from its colonial and apartheid past. The new government sought a curriculum and instructional strategies that were appropriate for emerging multicultural South African classrooms. Unlike the old Eurocentric curriculum, the new curriculum was designed to exemplify African cultural values and a holistic approach to problem solving (Siseho, 2013). Alongside the new curriculum, emphasis was placed on equipping teachers with instructional strategies compatible with the ethos of political independence and self-determination.

In other words, the traditional approach where the teachers dictate notes or write notes on the chalkboard to copy verbatim was considered inappropriate for learners. In traditional teaching, learners are rarely allowed to participate in their own knowledge construction. This is in accord with Newton et al. (1999) who agree that activities such as debating, discussions and argumentation are not common features of the classroom in British schools. Some of the old teaching and learning strategies that the new curriculum sought to replace include; the chalk-and-talk approach, lecture, question-and-answer, rote learning and dictating notes to learners, etc. These are teacher-centred instructional strategies and do not seem to give learners a chance to participate in the teaching and learning process as dialogical argumentation instruction model does (Ogunniyi, 2007 b, Osborne, 2010).

Simmons et.al. (1999) argued that classroom pedagogies need to be improved at all times. Dogru-Atay et al. (2008) suggest that the improvement of meaningful understanding of scientific concepts has long been a central goal of science education. To achieve this goal, therefore, learners need to be actively engaged in meaningful learning, seeking to relate new concept to prior knowledge using their new conceptual understanding to explain their experiences. Bricker and Bell (2008) argued that teaching and learning strategies such as argumentation allows learners to ponder on evidence at a deeper level, which helps them to venture into their ideas more spontaneously, improving their understanding through cause–effect relationships. In argumentation, learners tackle classroom science tasks by making claims and supporting them with evidences or reasons individually, in small groups, in whole class discussions and in whole class reflections making conclusions with the teacher as a co-constructor of knowledge. In this way, teacher-centeredness, which received much criticism earlier, could be minimized.

In the process of argumentation, learners listen to each other, critique each other by rebutting claims with invalid evidences in this way, they learn from each other. This process also helps learners to give improved or clearer explanations of phenomena such as the causes of the phases of the moon.

Prior to independence in 1994, indigenous knowledge was not recognized in the school system. The new science curriculum encouraged teachers to integrate IK into the school science classrooms as a way of making school learning relevant to learners' life world experiences. One of the advantages of IK is that it forms the prior knowledge of the vast majority of the Black learners and denying them this experiential knowledge will alienate them from the school science which they were expected to learn. In other words, IK is the foundation to their learning of school science (e.g. Aikenhead, 1996; Aikenhead & Jegede, 1999 and Wiggins & McTighe, 2006).

Wiggins and McTighe (2006) have argued that students possess a storehouse of conceptions based on personal experience which aids them in explaining their world. Learners come into a science classroom with many different ideas learnt through personal experiences, from family members and the community at large. So, they need to make sense of what they already know from home in relation to what they learn at school. This could be one of the ways of achieving the noble idea of enabling learners to learn from known to unknown.

However, literature indicates that the new curriculum did not give guidelines as to what teaching and learning strategies could be suitable for handling the science and IK interface in the school science classrooms (Onwu & Mosimenge 2004, Ogunniyi 2007a)

Although the curriculum provides that in the new South Africa, learners are free to share classroom, teaching and learning resources, the pedagogic strategies employed in the teaching and learning process are still those that were inherited from the apartheid era and do not seem to accommodate free sharing of ideas among learners' traditional methods of teaching do not make room for learners to learn from each other, that is why the implementation of newly researched teaching strategies are of utmost importance if the new curriculum if is to attain true success.

1.5 Purpose of the Study

The purpose of the study is to provide an overview of the use of Dialogical Argumentation Instruction Model on grade 6 learners' understanding of the causes of the phases of the moon. It is hoped that the findings of the study will, in one way or the other, provide information that could be useful for the general improvement of the science teachers (instructors), curriculum developers and science subject advisors at district, provincial and national levels, lecturers, researchers, learners, parents and the public at large.

1.6 Research questions

In pursuit of the above aim, answers were sought to the following research questions:

i. What conceptions of the causes of the phases of the moon did grade 6 learners hold before and after being exposed to DAIM?
ii. What was the influence of DAIM on grade 6 learners' conceptions about the causes of the phases of the moon?
iii. What were the grade 6 learners' perceptions and attitudes on the use of DAIM before and after their classroom teaching and learning of the causes of the phases of the moon?
iv. Were the grade 6 learners' pre- and post-conceptions of the causes of the phases of the moon influenced by their gender, age and geographical location?

1.7 Theoretical framework for the study

Two theories were used in the study to analyse DAIM classroom discourses. These were: Toulmin's (1958) Argumentation Pattern (TAP) and Ogunniyi's (2007a & b) Contiguity Argumentation Theory (CAT).

1.8 Significance of the Study

The study was judged to be of significance in the following ways:

i. The study could be a guide for establishing improved teaching and learning in science-IK integrated programmes in the classroom.
ii. It could contribute to curriculum content and professional development for teachers by adapting lessons from the findings relating to learners' conceptions of the causes of the phases of the moon and DAIM, respectively.
iii. It could be a motivation for further research because it could provide some topics of sub-topics that some scholars would like to investigate further about. Teachers, learners, researchers and guardians could use this study as a reference during their science and IK reading and writing activities.
iv. The findings of the study will contribute to knowledge building in the field of IK and science integrated programmes.

1.9 Limitations of the study

During the study, the researcher faced some difficulties. For example I was not able acquire residence closer to the University so as access library regularly and for longer hours. Operating from a location far away from the University has led to delays in completing this piece of work, thus causing psychological physiological imbalance in my reading and writing life. I have been detouched from my family for too long (6 years). This has greatly affected my power of concentration.

1.10 Delimitations of the Study

This study delimits itself to investigations spelt out by the research questions, which focused mainly on the effectiveness or otherwise of DAIM in enhancing grade 6 learners' understanding of the causes of the phases of the moon. All DAIM classroom activities were analysed by Toulmin's (1958) argumentation pattern (TAP) and contiguity argumentation theory (CAT) as espoused by Ogunniyi (2007a & b).

1.11 Definition of Operational Terms

This section defines key terms of the study as follows:

Outcomes Based Curriculum 2005 (C2005). This was a curriculum of education that was drafted by ANC government to drive the new South Africa's system of education. It had to change or further modify the then apartheid system of education, to a system education that could benefit all the people of South Africa fairly equally. The new education policy modifications gave rise to the National Curriculum Statement (C2005). This was drafted to drive the country's education into the 21st century and it operated under the philosophy of the Outcomes Based Education (OBE) (Asmal, 2000).

Constructivism. This is a theory of knowing. It is applied in the field of teaching and learning. In a learning situation, it helps learners to construct their own ideas by reflecting on their personal experiences and belief s on how things work in addition to what they learn from books, their teachers and peers. Fensham et al. (1994) state that 'constructivism helps learners to construct new knowledge from their own personal experience and from instruction e.g. listening to their colleagues, reading books or getting involved in an experiment' (p 1-6).

Contiguity Argumentation Theory (CAT). This is a theory that is used to analyse logical and non-logical arguments. It is employed when resolving misunderstandings that arise from two systems of thought are in play. For example when learners are involved in both science and IK argumentation activities in class. Their minds keep shifting back forth through five cognitive ideas namely: Dominant idea, Suppressed idea, Assimilated idea, Equipollent idea and Emergent idea. Ogunniyi (2007a & b) gives a full account of CAT.

Dialogical argumentation instructional model (DAIM). Dialogical argumentation is a type of argumentation that is based on dialogue in the process of reaching a feasible consensus" (Diwu and Ogunniyi, 2012). This is a way through which learners can communicate in class, starting from at individual level, then at small groups discussion, and at whole class level where group leaders present group views and finally at whole class reflection and mediation with the teacher as a co constructor of knowledge (see Diwu, (2010) figure 2). It presents the users with various ways of comprehending a problem or situation through the sharing of ideas where one party among participants make claims and support them with reasons on a given topic. The opposing party may rebut if they are not convinced or make counter claims with their supporting reasons. In this way, DAIM supports successful content learning in science, according to Brickhouse et al. (2002).

Alternative Conceptions. This is the information children hold about a phenomenon. Children draw their own conceptual conclusions while trying to make sense of the phenomena around them. Children's conceptions are also alternative conceptions because they are different from school science or scientists' concepts of a phenomenon. Smolleck and Hershberger (2011) have similar understanding. Fensham et.al. (1994) found that learners come to class with ideas that make sense to them. Learners need to be encouraged to voice their ideas out at the same time asked if other ideas make better sense (p 150). Such process could help learner to improve their ideas or reconstruct new ones although they don't easily let go their previous conceptions.

Indigenous Knowledge (IK). This is the knowledge of particular community which helps the people of that community to survive through carrying on their livelihood activities in a unique way. For example the ways in which they produce food, the way they access medicine, how they conserve their environment, how they carry on their recreational activities, the way they use the phases of the moon and other space bodies to guide them in carrying on their daily activities. Fakudze (2004) states that IK could also be called socio-cultural setting of the learners, therefore, as members of their communities, they come to class with what they already know.

Phases of the moon. These deal with different shapes of the moon as observed from the Earth. The moon orbits the Earth every 28 days. Differing amounts of the moon reflect the Sun's light depending on the position of the observer on the Earth's surface. As a result, Lelliott and Rollnick (2010) noted that the phases of the moon observed include: waxing crescent moon, first quarter moon, waxing gibbous moon, full moon, waning gibbous moon, third quarter moon, waning crescent moon and new moon. Others (e.g. Plummer, 2009; Halkia & Heraki, 2010; Benacchio, 2010) have given similar explanations.

Toulmin's Argumentation Pattern (TAP). This is a model which analyses formal sometimes called logical arguments. It was formulated by a British philosopher, Stephen Toulmin in 1958. TAP model states that an argument should have a claim, data, warrants, backings qualifiers and rebuttals. Naylor et.al (2007) observe that learners are usually not able to carry an argument through all the steps. In this study, arguments consist of claim and supporting reasons/grounds and sometimes rebuttals are given e.g. Erduran et.al (2004).

1.12 Summary and structure of the thesis

In this chapter, I have discussed the background of the study, problem statement, rationale, aims and objectives, research questions, hypotheses, methodology, significance, definitions of operational terms, scope, and delimitations of the study.

I also provide herewith a brief outline of what to expect in Chapter 2 and other chapters ahead.

In Chapter 2, I present a review of related literature and clarify the theoretical framework used in this study. I highlight what other scholars have identified as conceptions that learners tend to hold in science, for example, the causes of the phases of the moon. In Chapter 3, I deal with the methodology adopted for the study in terms of the research design, data collection, sampling instruments developed and the analysis data. Chapter 4 is where I examine the results and present findings using, both quantitative and qualitative method. I used mixed approaches in order to the triangulate data so as to produce more comprehensive results. Lastly, in Chapter 5, I present the conclusions, the implications and recommendations of my study. The study was about using DAIM on grade 6 learners' understanding of the causes of the phases of the moon.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The main focus of this chapter is to review the literature on studies that have been carried out on issues related to this study. The chapter is divided into five sections as follows: In section 2.2, I present the theoretical framework which underpins the study. This includes Toulmin's (1958) Argumentation Pattern (TAP) and Ogunniyi's (2004a) Contiguity Argumentation Theory. In section 2.3, I review the literature in relation to the concept of the causes of the phases of the moon (from both the school science and indigenous knowledge points of views). This is in order to match the study with the views of other scholars. This section further examines learners' alternative conceptions of the causes of the phases of the moon so as to report how and where they may have picked them from, either from home or school environment. This is important in strategizing ways in which learners could be assisted to explain themselves with better understanding of the causes of the phases of the moon, in integrated IK and science in a classroom situation. In section 2.4, I examine gender, age and geographical location issues in the teaching and learning of science and IK. This is in order to comply with the aims and objectives of the study and also to report the effect such information had on learners' understanding of the causes of the phases of the moon. Finally. Section 2.5 gives conclusion and chapter summary.

2.2 Theoretical Framework

"A theoretical framework is a set of theories that informs the background and guides a particular study" (Aloka, 2012:28). The literature reviews for this section focus on the two theories underpinning the study. Two theories were used to characterize DAIM process during the classroom discourses. These were: Toulmin's (1958) Argumentation Pattern (TAP) and Ogunniyi's (2004a) Contiguity Argumentation Theory (CAT). These will be discussed shortly.

2.2.1 Toulmin's argumentation pattern. Many researchers (see Diwu, 2010; McCroskey, 2007; Naylor & Keogh, 2007 and Ogunniyi, 2007b) have recognized Toulmin's Argumentation Pattern (TAP) as a useful tool in constructing knowledge in science classrooms. According to Naylor and Keogh (2007), TAP is a model typically used for analysing formal arguments in a school setting. Quingnard (2002) gives an explanation that an argument consists of a ‘claim’ with a reference to; “data” which are facts that have led to the claim being made. This is illustrated in Figure 2.1: below:

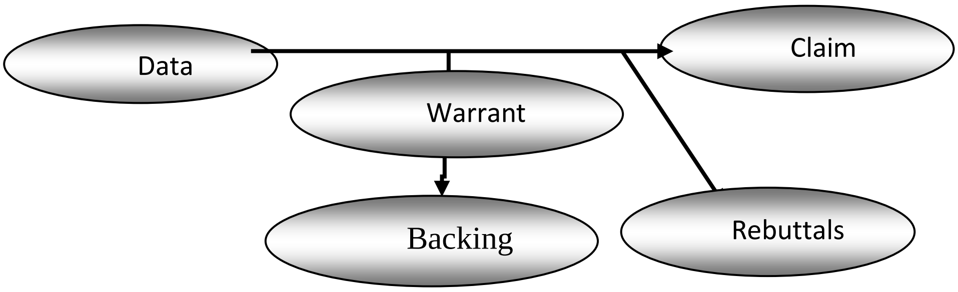


Figure 2. 1: Toulmin’s Model of Argumentation. Adapted from Toulmin (1958), cited in Lunsford, (2002)

Essentially, TAP involves the following aspects as observed by various scholars. For example;

- processing of **data** – which are the facts or evidence used for supporting a claim;
- **Claims** – are the statements or belief about a phenomenon whose merits are in question; the claim is an assertion that has been supported by these facts or a conclusion whose merits are to be established. Ogunniyi (2007b) contended that a claim is an assertion put forward publicly for general acceptance.
- **Warrants** – are statements used to establish or justify the relationship between the data and the claim (Quingnard, 2002). In other words, the warrants are the reasons that establish the connections between the data and the claim;
- **Backings** – which are the explicit assumptions underpinning the claim; They refer to the theoretical assumptions on which the warrants rest
- **Qualifiers** – which are the conditions governing the claim, establish the boundaries of a claim or specific conditions under which the claim is made.
- **Rebuttals** – which are statements that show the claim is invalid. They attempt to refute the elements of an argument. Rebuttals may seek to invalidate a claim, or the ground that supports it if it is considered questionable. A good rebuttal is the one which is justified and which can stand up to oppose where the evidence is strong and the warrants legitimate. According to Simon and Maloney (2006), rebuttals are exceptional circumstances that might undermine the force of supporting arguments. List drawn from Ogunniyi (2009).

Erduran et al. (2004) emphasized that the structure of an argument is based on two major assumptions. Firstly, a high quality argument must contain grounds (i.e., data, warrants, or backings) to substantiate a claim because developing rational thoughts is reliant on the ability to justify and defend one's beliefs. Secondly, arguments that include rebuttals are of better quality than those without, because oppositional episodes without rebuttals have the potential to continuing forever with no change of mind. It should also be borne in mind that not all learners seem to arrive at the same level of argumentation. This could be as a result of differences in mental capabilities among different learners or some other causes.

Studies made by Osborne et al., 2004; Naylor et.al 2007 and Ogunniyi, 2009) just to name a few, have shown that the level of argumentation during classroom discussions does vary in strength. Some arguments could be stronger or weaker than others. In these studies, the strength of an argument depends on the extent to which learners provide justifications for their claims and more especially on the degree to which rebuttals are present. Osborne et al. (2004) classified arguments into five levels. This version was modified by Ogunniyi, (2009) to six levels; level one being the weakest and level six the strongest. This version is shown below:

Table 2.1: Levels of TAP's arguments in classroom discourse (Source: Ogunniyi, 2009; modified after Erduran et al. 2004)

Level 0	Non–oppositional argument
Level 1	Argument involves a simple claim versus counter claim with no grounds or rebuttals
Level 2	Argument involves claims or counterclaims with grounds but no rebuttals
Level 3	Argument involves claims or counterclaims 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 backings) supporting the claim.
Level 5	Argument involves multiple rebuttals and at least one rebuttal challenging the rounds
Level 6	Argument involves multiple rebuttals challenging the claim and/or grounds

Kwofie and Ogunniyi (2011) have attached the roots of argumentation to the period before 500 BC, arguing that argumentation has been used as a rhetorical and instructional tool since time immemorial and that it was a common rhetorical tool used by pre-Socratic natural philosophers before 500 BC as well as the succeeding generations of scholars to the present day. This model can be used to analyse arguments to show the reasoning that has taken place to support and establish a claim. Toulmin's (1958) identifies claim, data, warrant, backing, qualifier and rebuttal as the essential elements of arguments.

Naylor et.al (2007) warn that learners are not usually able to present that entire range of TAP categories during classroom argumentation activities. Sometimes, learners do not master all the steps (data, claim, warrant backing, qualifier and rebuttal) because they see it as being technical (Simon et.al 2002). They are of the view that teachers should take time to teach learners the steps of argumentation because if learners master those steps, it can fit well with all or most of the steps in Toulmin's (1958) model. Therefore; researchers and classroom teachers will find arguments are worth time spent on developing it.

Erduran et.al (2004) collapsed the TAP levels of data, warrants and backing to 'grounds' due to the practical difficulties of reliably differentiating between these argumentation components.

The current study, therefore, used the modified version of TAP where learners made claims and supported them with reasons (grounds). Some of the claims and reasons given by some learner about the causes of the phases of the moon faced opposition and were refuted through rebuttals. A teaching and learning schema was applied (see figure 3.1) where learners were engaged in argumentation activities at individual level (intra-argumentation), at small groups level (inter-argumentation), whole-class discussion level (trans-argumentation) and whole-class reflection and settlement with the teacher (Nhalevilo & Ogunniyi, 2012).

2.2.2 Contiguity Argumentation Theory (CAT). In the early1980s to mid-90s, literature had raised acute concerns about the lack of a solution to the understanding of the phenomenon of border crossing between learners' indigenous knowledge and school science. Ogunniyi (2006) argued that the issue of border crossing between learners' indigenous knowledge and school science had to be sought because learners were trapped in persistent failure to explain and account for the phenomena. In the early 1990s, Ogunniyi examined the effectiveness of several behaviourists' and cognitivists' theoretical models for explaining the phenomenon of "learners' border crossing". Examples of such are:

- Behaviourists theories are Thorndike's "connectionism" (1890s-1930s) and Guthrie's "contiguous conditioning" (1935s-1942s)
- Cognitivists theories such as Piaget's "developmental learning theory" (1920s-1950s) and Freud's "psychodynamic theory of learning" (1920s-1930s)
- The combination of behaviourist and cognitive theories such as Brunner's "cognitive development theory" (1950s-1970s) and Vygosky's principle of relations of generality (1920s-1930s) and many others.

Ogunniyi (1995) identified a gap where all these models fell short in enhancing the understanding of the phenomenon of border crossing. He developed contiguity learning hypothesis by expanding the constructivist theories like Piaget's and Vygosky's and married them with contextual constructivism and critical constructivism in order to determine interactional patterns between learners' indigenous knowledge and school science.

The Contiguity Learning Hypothesis — later on known as Contiguity Argumentation Theory, suggested that ideas could shift back and forth in the learner's mind from one cognitive idea to another and one worldview to another as they try to interpret natural phenomena such as the causes of the phases of the moon. The observed phenomenon may be interpreted in terms of the IK worldview from a cultural perspective if the learner had been told stories about it at home, or from the school science worldview which they learn at school. Depending on the context, the learner then chooses which worldview to base her/his argument on, thus, the contiguity learning hypothesis.

Ogunniyi and Hewson (2008) have traced contiguity theory to Platonic and Aristotelian era also, when it was used to determine changes when two or more states of mind were applied as in the case of science and indigenous knowledge.

According to Ogunniyi (2007b), the Contiguity Argumentation Theory recognizes five types of conceptions that could occur within a non-western learners' thought system when faced with counter-intuitive school science, namely;

i. **Dominant conception**: A concept or idea is dominant if it is most adaptable in a given context.

ii. **Suppressed conception**: A suppressed concept is one which is found to be weaker than another idea in the same context.

iii. **Assimilated conception**: A concept becomes assimilated if it becomes part of another dominant idea.

iv. **Emergent conception**: An idea is said to be emergent if an individual has no previous knowledge of a given phenomenon.

v. **Equipollent conception**: This occurs when two competing ideas or worldviews exert comparably the same intellectual force on an individual. (Adopted from Siseho 2013).

Ogunniyi and Hewson (2008) contended that the role of dialogue space is to facilitate the process of re-articulation, appropriation and negotiation of meanings of the different worldviews. This is important to learners because they are expected to negotiate the meanings across two distinct thought systems in order to integrate them. The theory proposes that there are ways in which conceptions can move within learners' minds during classrooms instructions.

Dominant conceptions are experienced by learners when they make a claim concerning a phenomenon, and back it up by the use of observable empirical evidences or use of convincing explanations. For example, a learner may make a claim that *"the moon has a changing shape because it dies at times, and then later resurrects"*. They then back the claim by showing how the moon seems to reduce in size, to depict *"dying"*, and that when moon seems to increases in size to depict *"resurrecting"*. At times, the dominant conception may become suppressed or assimilated by a dominant thought system.

However, emergent conceptions exist in situations where there are no well-established cognitive structures in learners' minds and a new one has to emerge to cope with a challenging task at hand (Ogunniyi & Hewson, 2008). The individual, therefore, has no prior knowledge of a concept, and this is quite common among learners.

The equipollent conceptions on the other hand, occur when two competing ideas exert equal intellectual force on a learner (Ogunniyi, 2007b). These two opposing ideas may exist in learners' minds and they may live with them without having any conflicts.

The theory holds that claims and counter-claims on any subject matter within fields like science and the indigenous knowledge systems can only be justified if neither thought system is dominant. The theory presented a framework for resolving the incongruities that normally arise when two or more competing thought systems are placed together, that is, the different views that a learner holds have to be exposed and resolved so that the conceptual understanding could be enhanced. In this study, there are learners' alternative thoughts about what cause the phases of the moon. These thoughts may have been acquired from their daily life experiences, from their beliefs and indigenous knowledge that they may have acquired from their communities, which may not have been clearly explained to them concerning the phenomenon. Therefore, a dialogue from this perspective during classroom instruction would help learners to unlock the differing other perspectives.

CAT is used in the current study to analyse the scientific and indigenous conceptions on the causes of the phases of the moon held by the grade 6 learners before and after they were exposed to DAIM during the classroom argumentation.

2.2.3 CAT and TAP in the classroom. From the two theories (TAP and CAT) already discussed above, there are evidences that argumentation in classrooms can enhance understanding of scientific concepts. Argumentation can also help learners to experience scientific practices that situate knowledge in original context, including language, culture and social interactions in the process of knowledge construction. For example, Diwu (2010) carried out an investigation on the effects of DAIM on grade 10 learners' concept of fermentation. He studied how their understanding of fermentation was affected by dialogical argumentation instruction model. The results showed that the experimental group explained the phenomenon with a much higher understanding than the control group.

An argument can support learners in developing different ways of thinking (Kuhn, 1993). Thinking activities show how learners are different and have different perceptions of a particular issue. As learners get involved in tasks with each other, each one has something to learn from one another and this broadens their learning generally. Thinking comes with practice and training and consistent arguments could enhance critical thinking which could be a good step in learning and knowledge construction process.

Other positive relationships of argumentation have been highlighted by Von Aufschnaiter et al (2008) who explained that when learners engaged in argumentation with a constructivist perspective, they are more likely to be engaged with the subject matter, and thus it would be reasonable to expect enhanced learner understanding. Learners' understanding of the causes of the phases of the moon, for example, could be enhanced through the use of argumentation teaching and learning strategies.

Just as it is assumed that an understanding of science is essential for students to develop quality arguments, it is also assumed that students' involvement in relevant real-world argumentation is more likely to contribute to understanding (Grady et.al 2010). With argumentation, being the voicing out of their inner thoughts, it is easy to perceive how much understanding of science learners hold. The facilitators could then assist in strengthening and buildings on what learners already know; and they can reconstruct where necessary. Hence, argumentation could enable the facilitators to choose the appropriate methods and materials that will be needed for enhancing further understanding and mending of the areas which need reconstruction. The facilitators could also find out how to nurture the indigenous knowledge that comes out during the argumentation process or how to handle words, voice, gender, age difference, materials and cultural understanding of time and space which are attached to science.

Cross et.al (2008) tested the hypothesis that argumentation impacts conceptual understanding, believing that engaging in arguments leads not only to more secure understanding of pre-existing concepts, but also allows learners to hear new ideas that extend their existing knowledge and possibly help in altering some elements of their alternative conceptions about a phenomenon. Argumentation broadens the minds of learners; it creates an atmosphere of free exchange of ideas and leads to concretizing of the existing knowledge. The new ideas from peers spill over from peer to peer, and hence naive science are dropped and school science is picked up at a quicker and cheaper rate and hence quality learning of science concepts is facilitated through the use of argumentation.

Despite the advantages mentioned above, argumentation may not be all that popular in Asia and the Pacific areas, as expressed by Chang Shu - Nu (2007), who reveals that the existing models of argumentation of Toulmin's Model (Toulmin's 1958), Means & Voss's Model

(Means & Voss, 1996 and Lakatos 1978) scientific research programmes may not be congruent with the cultural practices where respect and authority takes a greater preference, where learners are expected to sit quietly and listen attentively to the teacher (Chang & Chiu, 2005b). In addition, there seem to be many more models that have not been identified because it is difficult to arrive at a fully exhaustive research which could guarantee Chang's assumption. I therefore, recommend further research for that matter.

2.3 Concepts of the causes of the Phases of the Moon

The literature in this section focuses on two areas. Firstly, it starts with studies of the causes of the phases of the moon from a school science point of view and secondly, the studies of the causes of the phases of the moon, from indigenous knowledge perspective.

2.3.1 The scientific worldview concept of the causes of the phases of the moon. The concept of the causes of the phases of the moon is one of the topics that should be taught to and learned by grade 6 learners according to Curriculum 2005. The moon is ranked as the Earth's satellite, with a diameter of 3,476 km, and about 384,000km away from the Earth (Moor, 2004). The Earth has one moon, orbiting around it, and it takes 27.3 days to complete its revolution around the Earth. When the moon is observed from the Earth at different times of the month, it is perceived to have different changing shapes.

When the moon appears roundish, it is called a full moon, and when only part of the moon can be seen, it is called a half moon. A crescent moon looks like a big bite has been taken out of moon, while new moon occurs when there is a complete shadow and we cannot see it at all. The moon's orbit is not circular, but a slightly squashed circle known as the ellipse. It was also observed that when the moon rises, it seems to be bigger than when it was high in the sky. Whilst the moon is orbiting the Earth, the Earth is constantly moving because it is revolving the Sun. The moon, therefore, travels slightly more than 360° to get from one new moon to the next. According to Moor (2004), the moon orbits the Earth at an average speed of 3,683 kilometres per hour.

The moon travels at different speeds during different parts of its orbit. It moves slowest when it is at the furthest distance from Earth and it rises and sets at specific times, according to which phase it is in. The new moon rises and sets at approximately the same time as the Sun.

The first quarter moon rises at mid-morning and sets at midnight. So, it's at its peak around dusk, not in the middle of the night. The full moon rises at Sunset and sets at Sunrise. The full moon is the only moon that will be overhead in the middle of the night, while the last quarter moon rises at midnight and sets at mid-morning. The moon moves fastest in its orbit when it is closest to Earth.

According to Lelliott, and Rollnick (2010), observers are able to observe the phases of the moon on Earth because as the moon orbits the Earth over a 28-day period, differing amounts of the moon’s surface reflect the light from the Sun. When the moon is on the opposite side of the Earth from the Sun, we can see one whole side of the moon that is lit. This is known as the “full moon”. While on the other hand, whenever the moon comes between the Earth and the Sun, we do not see any moon for up to three nights, this is known as the “new moon”. Between these two extremes, the moon has completed a proportion of its orbit and a half or crescent moon is observed.

Lelliott, and Rollnick (2010) further observe that immediately after the new moon, the sequence of the phases of the moon is as follows: ‘The waxing crescent moon, the first quarter moon, the waxing gibbous moon, the full moon, the waning gibbous, the third quarter moon, the waning crescent moon and the new moon (Lelliott, and Rollnick 2010), This makes the complete moon circle round the Earth which takes one month.

Learners could have difficulties in explaining these phases. They would need to be assisted to achieve a clearer conceptualisation of the causes of the phases of the moon. When learners are not able to explain phenomenal conceptualisation in the science classroom, their future career opportunities are minimised as well.

Plummer (2009) studied an early elementary learners’ development of astronomical concepts in the planetarium aimed at assisting learners in understanding the apparent celestial motion. A pre- and post-interview was used for data collection. The sample of the study comprised 63 early elementary students. The data was analysed qualitatively. The result showed a significant improvement in the knowledge of all areas of apparent celestial motion covered by the planetarium’s programme. There was also a demonstration of the value of both kinaesthetic learning techniques and the rich visual environment of the planetarium for the improved understanding of celestial motion.

Galili and Cohen (2003) investigated the interpretation of the concepts of the sky and visibility distance by learners in Israel. The data were collected through interviews. The sample used comprised 60 elementary school pupils. The test question was divided into Q1 to Q4 which was concerned with the nature and the shape of the sky. Learners demonstrated a good understanding of the motion of the moon in relation to its size and shape.

At the University of Johannesburg in South Africa, Lelliott (2007) conducted a study titled 'learning about astronomy: a case study exploring the experiences of grade 7 and 8 students in informal learning sites in South Africa'. He observed thirty-four 12-to-14-year-old students at science centres. Interviews were used in the data gathering about astronomic concepts including those of the changing phases of the Moon. It was found that learners enjoyed working individually and collectively. This could be similar to small group discussion and whole-class presentation during classroom argumentation activity.

2.3.2 The indigenous knowledge conceptions of the causes of the phases of the moon from cultural point of view. Many communities use the phases of the moon in various ways. Since the grade 6 learners come from those communities, they also hold their indigenous knowledge as they come to the school science classrooms. Scholars have reported some examples of the indigenous knowledge of the causes of the phases of the moon available in communities.

As already mentioned elsewhere in the study, indigenous knowledge is the unique skills, practices and attitudes of a given community that have helped them to survive for many centuries and that this has been handed down from generations to generations. Other researchers have referred to IKS as: Socio-cultural setting, (Fakudze 2004); Indigenous knowledge systems, (Ogunniyi, 2004a. Onwu and Ogunniyi, 2006) and Non-Western Knowledge, (Brown et.al 2006). A complex set of knowledge, skills and technologies existing and developed around specific conditions of populations and communities indigenous to a geographical area. (NRF, in Brown et.al 2006).

One of the objectives of the Revised National Curriculum Statement (RNC,2005), for the natural sciences is to help learners to acquire scientific and indigenous knowledge, (Ogunniyi, 2004a), indicating that the dual could place the learner in a far much better position in solving her/his day-to-day problems, both inside and outside the classroom. This includes resolving the misconceptions they held about the changing phases of the moon, which is the task at hand in this study.

Science teachers need to be aware that learners belong to two worlds: 1) The communities where they come from, and 2) the school where they come to study. The two worlds are the custodians of indigenous knowledge systems (IKS) and school science. Onwu and Ogunniyi (2006) argued that the prospective and practicing science teachers need to understand the school and indigenous knowledge systems as well as their views about how the two worldviews could be related or integrated in the science classroom. This is in order for them to assist and redirect learners to reflect and resolve their own misconceptions as those of the causes of the phases of the moon, arising from either worldview. Above all, it is not possible to separate learners' two worldviews and deal with them independently. Each should be a base to understand the other better. More often than not, the lack of such awareness among the teachers limits them in the way they handle learners' misconceptions by either giving them little or no attention at all.

According to Webb (2011), in IKS, there are concepts, ideas and principles that cannot be easily translated into another language or fully understood from a different cultural viewpoint. They are inter-twined in the social-cultural and economic well-being of those particular people. IKS does what any other sector of knowledge does for human beings and it is as old as them. In a broader sense, IKS is power through which each community finds viable solutions to their problems.

Mokeleche and Vhurumuku (2009) researched the nature of science and indigenous knowledge systems in South Africa. Their aim was to explore and locate the research done in South Africa within the international programmes. Their discussion showed that the research done in South Africa is attuned to the contemporary international research agenda, theoretical paradigms and methodological tests. Their descriptions also identified some major impetus behind their research that informs the implementation of South Africa's new science curricula.

An interesting observation that came out of their analysis was that for both nature of science and indigenous knowledge systems research, the primary and secondary school levels were clearly under-researched. However, this study should have given a clearer analysis on which of the two levels has been researched more than the other. The secondary level is a more critical level where learners are either prepared to join colleges for skills training or further their studies, so it has been a little bit more researched than the primary level. The results on the performance of matriculates have received more analysis and the media has always made it public. This study will, therefore, contribute in filling the gaps that could exist at the primary school level, which could alleviate some of the problems cited at matric level.

2.3.3 Learner's alternative conceptions of the causes of the phases of the moon.

Learners' alternative conceptions have been defined as incorrect ideas based on personal experience, used to make sense of an object or event (Martin et.al 2002). The term misconception was described by Smolleck and Hershberger, (2011) as a situation in which students' ideas differ from those of scientists about a concept. Children develop alternative conceptions or misconceptions through their everyday experiences including observations, religious or ethical teachings, and/or science teachings that do not adequately resolve learners' alternative conceptions. Smolleck and Hershberger (2011) further noticed that learners' alternative conceptions are not easy to come to extinction because they may coexist alongside conceptions.

According to Vosniadou (2002), people have different interpretations about one concept based on their scientific and/or indigenous knowledge systems experience. On the one hand, some of those interpretations are right, while on the other hand, they could be wrong and thus be regarded as learners' alternative conceptions. This current study investigates the grade 6 learners' conceptions as well as their alternatives of the causes of the phases of the moon. Wiggins and McTighe (2006) found that learners possess a storehouse of conceptions, correct and incorrect and they cling to them because they are based on personal experiences and it aids them in explaining their world.

Learners' alternative conceptions are already in their minds and therefore, needed to be changed where possible so that learners could possess the right knowledge in explaining the phenomena such as changing phases of the moon. Coble and Koballa (1996) agreed that students' alternative conceptions are strongly held and traditional instructions will not lead to any substantial conceptual change. Providing opportunities for learners to share their understandings with other learners in a face-to-face discussion could prove effective in constructing or reconstructing some of their alternative conceptions.

The concept of the moon is found in the topic of light at the primary science syllabus in grade 6 in South African schools. Learners always come to class with several ideas, beliefs and alternative conceptions as has been mentioned elsewhere in the study, explaining for example the causes of the phases of the moon and these come about due to their interactions with others at home, friends and even parents. According to Olson (2007), learners have numerous alternative conceptions about the causes of the phases of the moon. Among the alternative conceptions about the causes of the phases of the moon held by learners are the notions that clouds cover parts of the moon that we cannot see; others hold the view that the planets cast shadows on the parts of the moon we cannot see. Some even believe that the Sun casts a shadow on the moon, blocking our view of it all; and still other learners believe that the shadow of the Earth falls on the moon, blocking our view.

All of the above beliefs represent the alternative conceptions that learners have, while from the scientific viewpoint, the phases of the moon are meant to be explained in terms of the portions of the illuminated side of the moon visible from the Earth. In addition, most class readers and books that contain the diagrams of the moon are two-dimensional and this further complicates the understanding of learners when they are in the science class.

Dogru-Atay, Tekhaya (2008) recommend that the improvement of meaningful understanding of scientific concepts has long been a central goal of science education. To achieve this goal, learners must be actively engaged in meaningful learning, seek to relate new concepts to prior knowledge and use their new conceptual understanding to explain experiences they encounter. In our case, it is my hoped that DAIM could enhance the understanding of meaningful science concepts regarding the changing phases of the moon and be able to explain them at school either to pass their science tests and examinations, or in the society as part of their indigenous knowledge for their survival. The next paragraph examines the conceptions that learners hold at elementary school level.

Smolleck and Hershberger (2011) investigated the conceptions and misconceptions of young children (aged 3 – 8) in relationship to science concepts, skills and phenomena. This study took place in Pennsylvania, in the United States of America (USA). The study used qualitative research where qualitative data was collected from 63 children from three separate early childhood educational sites. The research uncovered learners' conceptions and misconceptions.

Starakis and Halkia (2010) studied primary school students' ideas concerning the apparent movement of the moon. The aim of the research was to observe and explain the Sun-Earth-Moon system from an educational reconstruction model so as to understand the link between learners' perspectives and the interpretation of scientific content, to enable the designing of new teaching and learning sequences. The research was carried out in five schools in Greece with a sample of 40 grade 5 and 6 students. The results revealed that the students thought that the apparent movement always took place at night and the simultaneous process of the Sun and moon occurred mainly around Sunset and Sunrise. The ideas were found to be barriers for the construction of the scientific view concerning the relative positions of the Sun-Earth-Moon system since three-quarters of the students had the idea that the Sun and the moon were at opposite sides of the Earth.

Lofgren and Hellden (2008) studied how students from age 7 to 16 use their experiences when developing their ideas about transformation of matter at the University of Iceland. Interviews and learners' reflections were used in collecting data. The researchers attributed learners' misconception that matter disappears through burning or decomposition to the limited knowledge of gaseous state. The study was aimed at investigating how the students use their experiences when they develop and express their ideas about decomposition, burning, evaporation and condensation. The study found that learners held conceptions and alternative conceptions of the phenomenon.

Saylor et.al (2010) tested children's intuitions about entities that bridge the contrast between living and non-living things. They noticed that as children progress through childhood, they elaborate their understanding of basic perceptions of their environment. This research suggests that as children emerge from infancy period, they distinguish between robots and living things. The aim of the study was to establish whether the children had the tendency to equate the robot with the other entities changes across development. There were 36 participants.

The findings of the study showed that 3- and 4-year-olds differentiated between a girl (living thing) and a robot (non-living thing). Both age groups were more likely to attribute the properties of living things to the girl than to the robot or camera and were more likely to attribute the features of a machine to the robot and camera. The study further found that younger children could fail to generalize properties to new exemplars because their understanding of such artefacts is still emerging and that understanding of more sophisticated concepts increase with maturity.

Yurd and Olgun (2008) aimed at assisting grade 5 learners to resolve their science misconceptions by using the Know-Want-Learn (KWL) strategy accompanied by problem-based learning. A sample of two classes of grade 5 learners was used. Pre/post-tests were administered in the first and the fifth week, within which, there was a KWL intervention on the removal of light and sound misconceptions. Data collected was quantitatively analysed. The findings of the study showed that most of the misconceptions of the experimental group were removed, implying that the understanding of the experimental group was better than that of the control group.

2.3.4 Assisting learners to acquire scientific explanations of the causes of the phases of the moon. Providing opportunities for learners to share their understanding among themselves in a face-to-face discussion, could help them in constructing or reconstructing their day-to-day concepts in science at school and what they learn from home. This could be revealed in their power of explaining the phenomena that they face in their day-to-day ventures through the help of their internalized knowledge. Barnes and Todd (1995) emphasize Vygotsky's belief of internalizing learning, which occurs in the social sphere. For example, in an environment where learners communicate ideas with other, some of them could display opposing beliefs. These could compel others to rethink, gather additional facts, re-evaluate their stance and either reform their thinking or completely change their viewpoint about a phenomenon.

Classroom discussion, when freed of any confrontational frame, can play an important role in learning. This is especially when a discussion concerns problematic situations where learners are strongly engaged and where the impact of reformulation may be most unclear. This means that, since students possess a storehouse of conceptions, correct or otherwise, they tend to cling to them because they are based on personal experiences and it aids them in explaining their world (McTighe Wiggins, 2006). In other words, it could be difficult for learners to replace what they already know with new knowledge unless find meaningful or convincing evidence of giving up such concepts in favour of emerging one.

2.3.5 Argumentation strategy to address learners' explanations of the causes of the phases of the moon. Argumentation is an activity that involves establishing specific types of relationships between the propositions being discussed and other sources of knowledge, the establishment of which is meant to influence the epistemic statuses of these propositions (Erduran & Jiménez-Aleixandre 2008). Argumentation is a systematic logical thinking process that involves the speaker and recognized opposers. The logic must flow in a consistent way if it has to be a good argumentation. According to Diwu (2010), argumentation is the act of forming reasons, drawing conclusions and applying them to the case or issue being discussed.

Early philosophers like Socrates, Plato, and Aristotle used argumentation to challenge each other's intellectual ideas. This is a philosophy of education that has been adopted in many countries. South Africa, for example, adopted Outcomes Based Education (OBE) which required the teachers to use inquiry-based approaches in their instructional processes. These processes do involve group discussions and argumentation.

Stephen Edelston Toulmin (1922-2009), a modern philosopher as has been mentioned elsewhere, theorized the Toulmin's Argumentation Pattern (TAP). This pattern has laid down logical argumentation steps that require that participants make claims, supporting them with reasons or grounds. TAP will be elucidated further on in this chapter.

Simon and Maloney (2006) mapped the children's discussion as evidence in science to assess collaboration and argumentation. The aim of their study was to evaluate the development of children's skills of interpreting and evaluating evidence in science. The study involved four collaborative decision-making activities to stimulate group discussions. Each activity was carried out with evidence of possible choices and judged whether their evidence was sufficient to support a particular conclusion or the rejection of alternative conclusion. The conclusion was that suitable collaborative activities that focus on discussion of evidence can be developed to exercise children's ability to argue effectively in making decisions. This study, therefore, opened the opportunity for learners to make their own judgment which means sound decisions as to whether their evidence was enough to support or refute arguments. Indeed, this could mould them into becoming independent thinkers, and at the same time, develop their confidence in whatever they do.

According to Chin and Brown (2000), when learners used a deep (as opposed to a superficial) approach, they ventured their ideas more spontaneously; gave more elaborate explanations which described mechanisms and cause-effect relationships or referred to personal experiences; asked questions which focused on explanations and causes, predictions, or resolving discrepancies in knowledge; and engaged in on-line theorizing.

2.4.6 Integration of indigenous knowledge (IK) into school science.

The phases of the moon were used as a calendar, which marked major events in their religious functions, among them, the start and the end of Ramadan fasting and worship activities. This was supported by Uxio, Lires and Solin (2008) who wrote the lunar calendars such as the Muslim calendar are not guided by the position of the Sun but by the phases of the moon, lasting twelve phases in total. These authors further observed that the moon's phases are used to mark the start and the end of the seasons. This indigenous knowledge of the moon's phases has helped and is still helping a massive Muslim population schedule their seasonal and yearly activities throughout generations. The Buddhist culture also uses the moon's phases in a similar way.

In connection with this, a poet, Haiku, (2008), has comparable views on the importance of the causes of the phases of the moon to humanity that goes as follows:

1. *Wind blows and wolfs howl beneath the hoary ice moon in January*

2. Frigid winter day snow moon in February may bring heavy storms

3. When sap moon appears crows begin to fly and caw March is the month

4. Pink moon in April harbinger of rosy blooms the Earth welcomes spring

5. Silver circle orbit shinning it month of May corn moon, time to plant

6. On June eighteen time of the month for full moon the strawberry moon!

7. Astronomical totally phenomenal buck moon in July

8. Good time to catch fishing hot and humid weather under sturgeon moon

9. Warm September days the air is clear without haze night's harvest moon ablaze

10. Cold October nights shining silver in the sky gibbous hunter's moon

11. Jack Frost come calling November's leaves turn golden chilly nights; beaver Moon

12. Daylight is shorter December nights are longer under the cold moon

13. This December, there are two full moon's second one called the blue Moon

This poem evidences how, the indigenous knowledge of a particular community, in relation to the moon's phases help those people to survive. Particular phases of the moon show them when to plant crops, harvest, fish or hunt, a storm is coming, etc. Such livelihoods could include all edibles, water, clothing shelter, medicine recreational items and space, just to mention few. When learners' livelihood activities run smoothly in their communities for example there is enough food, then they (learners) can learn classroom activities with much longer concentration span.

Aikenhead (2001) emphasizes the importance of teachers including learners' indigenous knowledge in a classroom situation so as to enrich multi-perspective of science and its applicability in learners' really live situations. This could encourage learners to take good care of their environment, which in turn could be a cheap way of reducing and preventing disasters like floods, Ozone layer destruction and others.

In this regard, therefore, scholarly studies carried out do suggest that, attempts are being done actually lead to the improvement of teachers' perception of science-indigenous knowledge curriculum in science classrooms. For example, Ogunniyi and Hewson (2008) investigated the effects of an argumentation-based course on teachers' disposition towards a science-indigenous knowledge curriculum in South Africa. The purpose of the study was to find out how the new South African curriculum statement could integrate school science with indigenous knowledge systems, a call that had been made to teachers by the curriculum C2005 & CAPS.

In the study, the researchers used argumentation-based course to enhance teachers' understanding of the nature of science and the nature of Indigenous Knowledge Systems and their ability to integrate the two in their classrooms. The participants in the study consisted of nine teachers for over a period of six months. The instruments for data collection included questionnaires and interviews. The teachers' conceptions about the nature of science and the nature of indigenous knowledge systems were assessed before and after the course. The findings revealed that after the course, the teachers were more willing to accept the indigenous knowledge systems as a potentially legitimate aspect of science curriculum. The teachers were more able to distinguish between science and the indigenous knowledge systems, and, finally, they were aware of the appropriate context to use in scientific or the indigenous knowledge systems worldviews than was the case before the course. In my view, similar research should be done at primary and secondary levels so that observations could also reveal how the implementation would be perceived by learners and which relevant resources could be used and how the argumentation-based method could fit into the whole system.

McCartney et.al (2010) reported on promoting scientific literacy and examined issues in schools, particularly, where science teaching and learning take place in the teacher's and learner's second language. The literature supporting the premise that promoting reading, writing and talking while doing science plays a vital role in effective teaching and learning of the subject was highlighted. One of the first programmes that explored the integration of languages and science instruction introduced a science-content reading programme, emphasizing inquiry activities, science progress and comprehension of written information provided a topic at hand. The results were that both reading and science score improved as well as student attitude towards science.

Further efforts, which included science writing in a large number of elementary and middle schools where a sample of over 1 100 students was used in California, USA, revealed significant improvements in the writing of English by grade 4 and 5 pupils. They used the qualitative design to analyse their data. The research consistently revealed positive evidence that learners greatly benefited from this science writing heuristic across science topics and all education levels.

Ogunniyi (2007b) investigated the teachers' understanding of, and awareness about the nature of science and IKS. The purpose of the study was to determine the possible perceptual or cognitive shift that might have occurred in teachers' understanding of the nature of science (NOS) and IKS in the context of a Science-IKS curriculum because of their exposure to the Practical Argumentation Course. The study used a sample of 4 teachers whose demographic information was well elaborated. Some of the personal information indicated includes their age as follows: Ch-38 years old, Mo- 37, Pa- 41 and Ad-51. The instruments used for the study were questionnaires and interviews. Data were analysed qualitatively by Practical Argumentation Framework (PAF) and Contiguity Argumentation Theory (CAT).

First-hand knowledge constructed by the teachers through the interviews was shown. The results showed that age did not hinder Practical Argumentation Course (PAC) from enhancing the participants' further understanding of the nature of science creating awareness of IKS and appreciation of the integration of the two world views in a science classroom. The study further recommended the Practical Argumentation Course as an instructional model, which would equip teachers to handle the integration of science/IKS.

2.4 Gender Issue in Science Classroom

Oludipe (2012) investigated the influence of gender on junior secondary students' academic achievement in basic science in Nigeria. The study used a sample size of 120 junior secondary students. The study employed a quasi-experimental research design. The instruments of the study included a pre-/post-test and delayed post-test achievement for basic science students (ATBSS). Data was analysed using descriptive and independent samples with t-test statistical methods. The findings of this study revealed that there were no significant differences in the academic achievement of male and female students at the pre-test, post-test and delayed levels respectively. The study suggested that science-oriented courses, intervention and occupations should be made more interesting.

Glasser (2008) applied grounded theory to investigate learners' grades and the discursive practices of argumentation in an all-boy and an all-girl science classes in the USA. This was to explore whether the boys and girls learned the same science. The instruments of the data collection were questionnaires, interviews and field notes. The data analyses were done quantitatively and qualitatively. The results showed no significant difference between the girls' and the boys' grades in argumentation science class. Both boys and girls argued fairly equally.

Nuthukrishna and Kwela (2008) investigated whether there was a significant gender gap in mathematics achievement in Kwazulu-Natal. A sample of 70 grade 6 learners was used for the study. An achievement test, questionnaires and interviews were used for data collection. The data was both quantitatively and qualitatively analysed. The findings of the study revealed that there was gender achievement gap in favours of girls in Mathematics. The study recommended that there is need to give both boys and girls exactly the same opportunities in class activities. Further to that, the teacher's professional programs that will make the teaching of mathematics gender-bias-free should be introduced.

In summary, Dialogical argumentation instructional model give equal opportunities to both boys and girls to voice out what they know and they gather the knowledge such as that of the causes of the phases of the moon. The findings from the current study and from literature reveal that when both boys and girls are exposed to argumentation, their voices instantly manifest their understanding about a phenomenon. So, it could be easy to deal with learners' inconsistencies on the spot, which sets a base for equal learning chance for both boy and girls.

2.5 Chapter Summary

Literature agrees that the learners are faced with phenomenal conceptualisation difficulties in a classroom situation. Some of the teaching and learning strategies seem not to help learners to reassess their naïve, science so as to scientifically correct explanation of a phenomenon such the causes of the phases of the moon. Literature also found that learners learn a lot very useful information from their homes and communities. The information, which is also called Indigenous Knowledge (IK), helps them to deal with survival issues in their communities such as food production, recreation, environmental conservation and others. Such information could be integrated into their classroom discourses. Implementation such integration seems to be taking long because traditional teaching and learning need to be either revised or changed.

Literature, therefore, reveals that DAIM has been researched and found that it could be one of the teaching and learning strategies that could enhance learners' conceptualisation of the phenomena that they encounter, in their daily lives. DAIM could harmonize what learners learn at home with what they learn at school. DAIM offers equal learning opportunities for both girl and boys in class.

This chapter dealt with the review of literature that is related to the current study. The study investigated the use of DAIM on grade 6 learners' understanding of the causes of the phases of the moon. The next chapter deals with research methodology.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The current study investigated the using of DAIM on grade 6 learners' understanding of the causes of the phases of the moon. This chapter presents the research methodology. It gives a clear description of the participants, the research design, the sampling plan, data collection procedures and research instruments. This is consistent with the findings of Graziano and Raulin (2007). A brief summary of each of each of these is presented below.

3.2 Research Context

The study was carried out in a grade six class at Kwanguchai Primary School (not the real name), situated within Central Business District of the city of Cape Town, in the Western Cape Province of South Africa. The centre of the city is a multicultural area. This means that learners from such an area represented many races from the various communities of Cape

Town such as Indians, Coloureds, Blacks and Whites. The advantage here is that chances for collecting more diverse data were higher. The school adopts English language as a medium of instruction. The school has classes running from Grade 1 – 6. Most of the teachers in the school were Coloureds. I was allowed to teach two science lessons a week for six weeks in one of the two grade 6 classes.

3.3 Participants of the Study

The participants of the study consisted of grade six learners at the schools where I did both the pilot and the main study. For the latter, there were 36 grade six learners, 17 both boys and 19 girls whose age ranged between 11 and 14. The majority were black, followed by Coloureds. There were few whites and Indians. This meant that there was no option of allowing me to apply selection criteria such random selection. I only accepted what was allocated to me.

I divided the class into 4 groups for ease in class management. The participants were given colour-number names, to avoid using their really names. The groups were named: Blue (B), Green (G), Red (R) and Yellow (Y). The participants were identified by the numbers assigned to them in class. For example; Y7 indicated that the participant was in yellow group and number 7 according to the class list.

3.4 Research Design

This investigation used a case study design with a single study group. This meant that the study did not make use of a control group. In data collection and analyses, the study employed both quantitative and qualitative approaches. A mixed methods (Qual-quan) research approach was employed in the study. Data were collected before and after DAIM classroom interventions. Two categories of findings were reported: (i) the findings that emanated from data that were collected before DAIM classroom interventions; and (ii) the findings from data that were collected after DAIM class room interventions. Comparisons between these two sets of findings were used to draw conclusions which provided answers to the research questions of the case study. Below is a diagram representing the process of this case study:

A1 XXXXX A2

A1 represents (pre- DAIM) assessments that were done at the beginning of the first week of the study before DAIM was implemented. XXXXX represent the treatment (DAIM classroom discourses). DAIM classroom intervention was implemented for six weeks. A2 represents post- DAIM assessments

3.4.1 Case Study. A case study is one of the recognized methods of doing research. Cohen et.al. (2010) describe a case study as one that deals with contemporary events, which rely on direct observation of events being studied. They claim that a case study is a decision or a set of decisions, that show why they are and how they were implemented and with what results. They further state that it is an empirical inquiry that finds out [the participants' understanding of the phenomena] in depth and with a real life situation especially when the boundaries between what is being studied and its environment are not clearly defined.

Cohen et al. (2010) further explain that: a case study illustrates a more general principle in a bounded system, for example, a classroom situation. It involves real people in a real situation, enabling the readers to understand the idea being investigated, more clearly. It helps the readers to understand how ideas and abstract principles can fit together.

3.4.1.1 The strengths of a case study. The strengths of a case study, among others, include the following:

- It makes it possible to study some topics especially in cases where there is no possibility of controlling some variables for example, astronomy topics.
- It avails the richness of data collected from variety of real- life sources. This may makes it possible for the readers to easily follow the participants' contextual experiences of the phenomena.
- It could be a flexible method which would accommodate triangulation of data, for example, qualitative and quantitative, during the collection and analyses.
- It can deal with unique events, for example using DAIM on grade 6 learners' understanding of the causes of the apparent phases of the moon.
- In a case study, it may be possible for the readers to draw their conclusions from the participants' ideas.

3.4.1.2 The Weaknesses of a case study. The weaknesses of a case study among others include the following:

- It tends to lay more emphasis on qualitative knowledge production as opposed to qualitative design and therefore lacks balance between the two designs.
- Either the researcher or the reader may misinterpret the ideas in the context of the participants.
- Its results may not be generalized.

3.4.1.3 Writing up a Case Study. According to Cohen et.al (2010), the writing up of a case study is organized in one of the following six forms (criteria): Suspense structure, Narrative report, Comparative structure, Chronological structure, Theory generating structure and Un-sequenced structure. The selected criterion for writing up in this case was chronological structure. Cohen et.al (2010) defined the chronological structure as the principle of reporting issues or events one after another, for example, interpretations of and explanations for, summaries of emerging issues as events unfold. This case study therefore observed chronological structure as an organizing principle in my write up, harmonization of discussion and ends with the conclusion, implications and recommendations.

The case study findings are presented in form of tabulated inferential statistics and learners' narratives. Learners' narratives included their conceptions, perceptions and cognitive ideas such as shifting to and from dominant ideas, suppressed ideas, assimilated ideas, equipollent ideas and emergent ideas. CAT and TAP provided the theoretical frameworks for the case study. The instrument for data collection will be presented shortly.

3.5 Instruments for Data Collection

Quantitative and qualitative approaches were used for data collection for the study so as to provide answers to the research questions. A variety of instruments were used to collect both quantitative and qualitative data. The instruments for data collection for the study included audio-taped interviews schedule (ATIS) (see appendix P); Pre-post-test questionnaire (PPTQ) (see appendix G); Classroom observation schedule (COS) (see appendix E); Field observation schedule (FOS) (see appendix K); Learner questionnaire (LQ) (see appendix M); classroom interview schedule (CIS) (see appendix O); and Focus group interview schedule

(FGIS) (see appendix N). Table 3.1 below aligns each instrument to the corresponding research question that it provided answers for.

Table 3.1: Instrument and the research question it collected data for

Research Instrument	Research Question 1	Research Question 2	Research Question 3	Research Question 4
Instrument (INST).	Pre-post-test (PPTQ) Appex. G	Pre-post-test questionnaire (PPTQ) - Appex. G	Audio-taped interview schedule (ATIS) Appex.. P. -	Pre-post-test questionnaire (PPTQ) -Appex. G.
INST	Audio-taped interview schedule (ATIS) Appex. P	Audio taped interview schedule (ATIS Appex. P) - , group and focus interview schedules (FGIS) Appex.. N &I	Classroom observation schedule (COS) Appex. E	Focus group interview schedule (FGIS) Appex. N&I
INST	Focus group interview scheduled (FGIS) Appex. N&I		Field observation schedule (FOS) Appex K	
INST			Learner questionnaire (LQ) Appendix M	

3.5.1 Pre-/Post-Test Questionnaire (PPTQ) (Appendix G). This questionnaire had 17 items covering grade 6 learners' understanding of the causes of the phases of the moon. This pre-test pre-post-test was based on grade 6 science syllabus and was administered to learners **before** and **after** DAIM intervention. Learners gave written responses which were scored out of 100%. After six week the post-test was administered to the learners and was marked out of 100%. The two percentiles were processed through SPSS. The results which were mainly Mean scores, standard deviations and significances provided quantitative-based answers for the relevant research questions and were also used to test research hypotheses regarding independent variables such as age, geographical location and gender.

3.5.2 Interview Schedules. Three different interview schedules were used to collect data during the study. They were the individual interview schedule (ATIS), group interview schedule (GIS) and the focus group interview schedule (FGIS). All these were used to collect qualitative data which were categorized into themes that were codes and processed through SPSS and the results were used to answer their corresponding qualitative research questions as indicated in table 2. On the implementation of the interviews, learners were informed about the audio taped interview a day earlier and given an option of not attending. Interviews were in two phases; **before** and **after** DAIM interventions.

Learners' responses to the interview schedules were recorded on audiotapes. All the interviews were carried out by the researcher. During the interview, the participants were given the opportunity to voice their experiences in response to the questions on the interview schedule. For example; making claims and giving supporting reasons on their understanding of the phases of the moon, giving their experiences on whether or not DAIM helped them to improve the understanding of their scientific and indigenous conceptions of the causes of the phases of the moon regardless of age differences, gender or their place of residence. Each interview schedule was used to collect specific data. For example:

- Audio Taped Interview Schedule (ATIS) (appendix P) had 7 oral items, 5 of the 7 items were oral followed up on learners understanding of the phases of the moon, which they responded to in a written, pre-post-test (quantitative instrument) This helped ascertain conformability whether learners are saying what they wrote. The last 2 out of 7 items on ATIS collected data on learners' perceptions of argumentation before and after DAIM interventions. Learners' responses were audio taped.
- Group Interview Schedule (GIS) (appendix M) was used to collect data on learners' perceptions of DAIM at small group level in class. The instrument had five items which learners responded to orally. Learners' responses were audio taped.
- Focus group interview (FGIS) (appendix N). The instrument had 5 items. Eight voluntary participants responded to this instrument. They orally gave their experiences of DAIM before and after the intervention. Their responses were also audio taped, later they were arranged in themes and then coded and processed through SPSS. Their results were used to answer the relevant research question.

3.5.3 Classroom Intervention Observation Schedule. I was allocated two lessons of 45 minutes per week for 6 weeks as mentioned earlier, for the intervention. The aim of the intervention sessions was to establish; the effectiveness of DAIM as a teaching and learning strategy, to find out if DAIM could assist learner to understand and resolve their scientific and Indigenous Knowledge conceptions about the causes of the phases of the moon, to find out whether or not, DAIM improved learners' understandings of science and indigenous conceptions of the causes of the phases of the moon. to find out learners' views about DAIM and lastly, to find out whether or not learners' gender, age or place of stay influenced DAIM classroom activities about causes of the phases of the moon.

The DAIM intervention was carried out by the researcher while the class teacher, who had been trained by the researcher, did the observation and collection of the required data.

3.5.4 Field Observation Notes (Appendix K). In this inquiry, learners were asked to conduct daily moon observations. They recorded their observations on a given schedule. For each entry, learners included a sketch of the shape of the moon observed, the date and time of observation and the causes of the shape of the moon observed. This was provided as part of the practical activity that learners did at home with the assistance of their parents and/or their older siblings. The safety precaution instructions were attached. The participants were warned not to make the moon observations in the late hours of the evening outside their homes unless their guardians accompany them. The moon observations and recordings were made alongside classroom lessons.

3.5.5 Learner Questionnaire (Appendix M). The researcher used the questionnaire to assess how learners responded in classroom argumentation process and how they responded towards the teaching and learning of science and indigenous knowledge. It was administered before and after DAIM.

3.5.6 Validity and Reliability of Research instruments.

In the current study, the researcher constructed the instruments. The items were selected from the grade 6 science syllabus. They were given to five subject experts who were trained on how to rate each item on each instrument by selecting one of the five responses as follows; 5) strongly agree; 4) Agree; 3) Un-decided; 2) Disagree or 1) strongly disagree. This kind of rating is called Likert's specific procedure cited by Gliem and Gliem (2003). After the rating, the instruments were then piloted to ascertain their validity and reliability before they were finally used in the study.

3.5.6.1 Validity of the Research Instruments. Validity indicates whether the instrument truly measures that which it was intended to measure or how trustworthy the research results are. The researcher presented the instruments to a group of experts to the SIKSP group based at the UWC and to subject teachers at a primary school to ascertain whether they were valid or not. Of the five reviewers, three recommended the instruments with some adjustments. Instruments were then piloted for 6 weeks in a school with similar resources as the one where the study took place. The reason for piloting was to check and corrects any error on the instruments before they could be used in the actual study.

The aim of trustworthiness in a qualitative inquiry was to support the argument that the inquiry's findings are "worth paying attention to" (Lincoln & Guba, 1985). "In a qualitative research project, four aspects of trustworthiness demand attention: credibility, transferability, dependability, and conformability. Credibility is evaluation of whether or not the research findings represented a credible conceptual interpretation of the data drawn from the participants' original data" (Zina 2004 pp 4-5). This study achieves credibility by using large amount of learners own narratives (data) to provide solutions to the research questions in the discussion chapter. The same data is available elsewhere in the study (see Appendix p). Transferability is the degree to which the findings of this inquiry can be applied or transferred beyond the bounds of the project. This study attains Transferability because its findings and conclusions are similar to those it cited and were done in different settings and with different groups. For example, Diwu (2010 and Siseho 2013). Future researchers doing similar study to this one would cite it in the same way this study. According to Zina (2004), Dependability is the acceptance that studies of social may not be possible, but attests that methods are well systematic, well documented and well designed to account for research subjectivities. This study used validates instruments to collect data, analysed data by quantitative and qualitative approaches, which are recommended by other scholars such a finally, conformability is the fact that data from the participant can be confirmed to be free from the researcher's influence or bias. This concern has been raised by Golafshani (2003). Researchers have to handle data from the participants without making any alterations. According to Guba and Lincoln (1989) Conformability refers to the quality of the results produced by an inquiry in terms of how well they are supported by informants (participants)…it is a degree of neutrality or extent to which findings of a study are shaped by the respondents and not researcher bias, motivation or interest.

To ensure conformability, a researcher normally follows participants' quantitative data with interviews so as to retain its consistence. This is important because it helps the researcher to make fairly accurate interpretation of data and thus, accurate findings of a study also. This study used qualitative data collecting instruments such as interview schedules to follow up data from quantitative data collecting instruments such as Pre-post-test questionnaire for the purpose of conformability.

3.5.6.2 Reliability of the Research Instruments. Reliability refers to the extent to which an instrument obtains similar results consistently over time (Gliem & Gliem 2003). Reliability is determined through a number of scales. One popularly used scale is the Cronbach's Alpha coefficient of internal consistency by Gliem & Gliem (2003). They provide the following formula for calculating the alpha coefficient: rk/ [1+ (k-1) r] where k is the number of items considered and r is the mean of the inter-item correlations. Both the number of items in the scale and the mean inter-item correlation determines the size of alpha. For example; alpha coefficient rules "≥ 0.9 is Excellent, ≥0.8 is good, ≥0.7 is acceptable, ≤0.6 is Questionable, and ≤ 0.5 is poor (p. 87). The current study adopted the Cronbach's alpha coefficient of internal consistency. The reliability coefficient for this study was calculated by using SPSS software and was found to be 0.79. This meant that the research instruments met the requirements of being valid and reliable. That is why they were used in the research process.

3.6 Pilot Study

As it has already been mentioned, the instruments were further piloted for six weeks before they were used for the study. This was to confirm their validity and reliability although the results from the pilot study were not reported in this study, as mentioned earlier.

I did a pilot study at Southern Cross Primary School (not the really name) in a grade 6 class. There were 42 learners (24 girls and 18 boys) .The purpose of the pilot study was to try out the research instruments for data collection before they could be used in the main study. On my reporting day, I trained learners on how to carry on argumentation activity in class. I used argumentation guide (see appendix J and L). I then taught in the pilot school, for five weeks instead of four as originally agreed. I applied the instruments and DAIM intervention discourses as planned in the following ways:

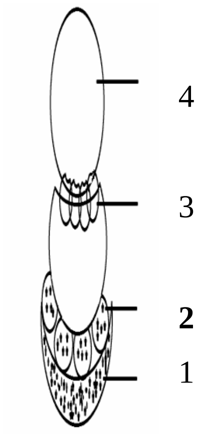
- I gained experience on how to use some instruments such as Tape recorders. At first I thought I would manage it all by myself but I found that I needed the help of 1 or 2 more staff members so as to manage tape recording activity especially during group argumentation activity.
- I realized that some instruments were too big for example; I reduce the number of questions on pre-post-test questionnaire from 25 to 17. I also modified some of the questions on the questionnaire
- I noticed that much propping during interviews consumed much time such that only little is accomplished within a 40 – minute period. So I reduced and modified questions on interview schedules.
- Pilot study reminded me that the daily attendance of the learners fluctuates at all times. For example, 2 to 3 learners were absent from class because of ailments or strikes (e.g. taxi, bus and service delivery demonstrations) that blocked smooth running of transport and other services. All these forced some of the learners to stay at home if their areas are affected.
- The most important experience I gained from the pilot study is that class control is so much at stake, given that argumentation activity in class was a somewhat new experience to the learners and they were so excited to exploit the degree of freedom of speech it gives them. This made me to plan to involve one or two extra staff members in my main study class.

I found the pilot study to be very important because it equipped me with useful information especially on how I could apply the research instruments in the main study. This is consistent to Teijingen and Hundley (2001) who found that piloting can also be pre-testing and pre-trying out a particular research instrument. They observed that pilot studies are likely to be under-discussed, underused and under-reported. Although the results of this pilot were not reported, it went along to helping me to increase the degree of validity and credibility of my instruments for my main study. This is because the aim of the pilot study was to assist the researcher to ascertain if the research instruments would suit the purpose of being used in an investigation or they needed to be improved, modified or changed. Reporting of the pilot results was not part of the aims and objectives of the current study.

3.7 Intervention section

During intervention sessions, the researcher prepared lessons plans that were made in accordance with grade six scheme of work (see Appendix C). He engaged learners in argumentation lessons about the causes of the phases of the moon (see lesson plan guideline on Appendix D). The regular class teacher evaluated the researcher by making comments in accordance with the lesson observation schedule (see Appendix E). The comments were used by the researcher to make the preceding lessons better classroom teaching and learning.

Learner training on argumentation. The learners were divided into four groups in the class, each with a group leader. The groups were named blue (B), green (G), red (R) and yellow (Y). Learners were then given DAIM criteria on how they could argue: i) individually (intra-argumentation); ii) within groups (inter-argumentation); iii) between groups whole class presentations led by the group leaders (trans-argumentation); and iv) whole class mediation and settlement facilitated by the teacher as a co-constructor of knowledge (See Figure 3.1 below)



STEP 4: The whole class reflects and settles on accepted claims, counter-claims and rebuttals and the reasons or grounds supporting them and the newly constructed knowledge becomes the class's collective property.

STEP 3: Groups engage each other (trans-argumentation) at the whole class level, learners accept, disqualify or modify Science and IK claims, counter-claims and rebuttals and their reasons or grounds presented by other groups through discussions and mediations on the understanding of the causes of the phases of the moon

Step 2: In groups, (inter-argumentation) learners present their Science and IK claims, counter-claims and rebuttals to group members where they are critiqued, accepted or denied and then coming out with group claims, counter claims and rebuttals and the reasons or grounds supporting them about the understanding of the causes of the phases of the moon.

Step 1: Individually, (**intra-argumentation**) learners making individual scientific or Indigenous Knowledge (Science and IK) claims. Counter-claims and/or rebuttals and giving reasons or grounds supporting them about their understanding of the causes of the phases of the moon.

Figure 3.1: Learners could argue at different steps of DAIM. Adopted from (Diwu 2010)

During the classroom activities, the learners were exposed to the Dialogical Argumentation Instruction Model (DAIM). This is an instructional model where the participants were to engage each other in argumentation based on their understanding of the causes of the phases of the moon. The learners were trained on how to argue in an orderly way according to TAP and CAT. This was done based on the guide to argumentation class activity (see appendix J, K and L). They would make claims (either from science or indigenous points of view). They would then support their claims with evidence and also give grounds to support them, for example, whether they gathered those proofs from the school environment or from home.

3.7.2 How DAIM was used to integrate IKS in the classroom. Integration of Indigenous Knowledge in science classroom implies giving equal recognition to learners' conceptual understanding from both Indigenous Knowledge and science points of view / worldviews. The Department of Education (2010) provided that one of the main features of CAPS is to recognises Webb (2011) states that Indigenous Knowledge (IK) and recommends its integration into school science. Indigenous Knowledge is unique principles and practices of a particular community that make that community different from others.

Learners are members of communities and they bring their Indigenous Knowledge to class. Wiggins and McTighe (2006) found that learners possess a storehouse of conceptions. Throughout the six weeks of this study, DAIM recognized and integrated the learners' Indigenous Knowledge in science classroom. DAIM provided learners with open opportunity to include their Indigenous Knowledge viewpoints in the claims and reasons their conceptual understanding of the causes of the phases of the moon. Since DAIM is a learner-centred model, it availed opportunities for the learners' viewpoints in the following manner:

- This study employed DAIM teaching and learning strategy (see Appendix C), which accommodated conceptions that learners learned from home (Indigenous Knowledge) in classroom. DAIM provided IKS integrated activities that enabled learners to make claims and supported them with reasons about the causes of the phases of the moon, both from science and IK perspectives (unlimitedly). This was done at individual level, at small group level, at whole class discussion and whole class reflection with the teacher. During this process, learners' experiences were as follows: '*It is* *important and very nice. Because it is to study. We make claims and give reasons. We are happy to hear good information from the others in the groups'*. (learner R22) The class teacher could only participate as a co- constructor of this kind of inclusive knowledge. *'It is good in class. Because if you make a claim, you must give a reason. We are happy to hear many claims and many reasons and we enjoy. Even the teacher was listening to us'* (learner R33). The scheme of work was implemented through the lesson plan (see Appendix D). Learners seem to suggest that they were denied such an opportunity both at home and at school previously. '*I thought it was bad to argue with friends. Because the parents and teachers don't want us to argue* (learner Y1). This implies that DAIM gave learners opportunity to share their home and school lived experiences. This could be a way of resolving their science and IK conflicts.

- This study found that some of learners' Indigenous Knowledge conceptions about the phases of the moon were as important as science. During DAIM intervention for example; learners gained scientific knowledge about what the causes of the phases of the moon were. But most importantly, learners shared experiences on how those phases of the moon affected their families and communities which use them for; lunar calendar, fishing activities, religious activities, farming, cultural dances, storytelling activities, weather and seasons and others (see Appendix I) This could be a learners' resolution to conflicts related to how important it could be to learn both science and IK in class.
- This study found that DAIM included Indigenous Knowledge learners' activities which required learners to outsource information from their homes or communities for example making observations and drawing the phases of the moon at home with the help of family or community members in the evenings (see field observation schedule Appendix K). This implies that science and IK can be learned jointly. This could be a learners' resolution to the conflict on when each of science and IK should be learned.
- This study found that DAIM included Indigenous Knowledge assessments in its classroom assessment activities. For example Pre-post-test (see Appendix G). This resolves learners' conflicts related to the classroom assessment of science and IK.

In conclusion, therefore, DAIM classroom intervention helped grade 6 learners' activities to integrate Indigenous Knowledge into science classroom through, the scheme of work, lesson plan lesson delivery, learner activities and assessment. Clearly, the inclusion/integration of Indigenous Knowledge at every step employed by DAIM, during the intervention, could have helped learners to resolve their IKS conflicts of the causes of the phases of the moon. Thus answering the research question 2.

3.8 Data Analysis

Data was analysed quantitatively and qualitatively.

3.8.1 Quantitative analyses. Quantitative methods were employed in analysing data collected during the pre-test and the post-test scores. The results from the analyses were used to answer the relevant research questions. The comparison between the mean scores of the pre-test with that of the post-test were used as indicators to judge the treatment (DAIM) enhanced and improved learners' understanding of the causes of the phases of the moon.

The approach adopted for the data analysis was, firstly, to present quantitative data and analyses, using descriptive statistics. These included descriptions of observations on how the participants responded to the data gathering instruments. Data was presented in the form of frequencies, means, percentages, standard deviations and other measures of central tendencies, to meet the assumptions of the research questions (Creswell & Clark 2007). They were to be displayed in tables. The purpose was to answer the research questions especially where quantitative data was collected. The statistical analyses were done using statistical tools, inclusive of the paired sample t – test with the aid of the Statistical Product for the Service Solutions (SPSS) (see Field 2005).

3.8.2 Qualitative Analyses. The qualitative data were analysed in order to answer the research questions alongside the quantitative analysis. Secondly, the qualitative results were presented. These were the inferential statistics which included the participants' responses to the tools of data collection, narratives and other forms of explanations, gathered through such tools as interview schedules. For example, Merton (1987) and Morgan (2007) suggested that observations should be done to assess how learners respond when they are exposed to concrete experiences. Learners' responses were then categorised into themes which were carefully studied and from which patterns are identified. The patterns were the participants' views, feelings and other human elements during the study. This performed part of the triangulation of data, which will be discussed later on.

Golafshani (2003) lists the strengths of qualitative research as follows:

- Data is based on participants' own categories of meaning.
- It is useful for studying limited number of cases in depth.
- It is useful in describing a complicated phenomenon.
- It provides individual case information.

The qualitative data included the sketches, the transcripts of dialogue and the responses to the twenty questions as well as interview transcripts.

The data collected during Individual and Focus Group interviews were used on the grade 6 learners to determine the effects of using the dialogical argumentation instruction model on their understanding of the causes of the phases of the moon. The learners spoke about their lived experiences gathered through their everyday observations and narratives they gathered from older family and community members about the causes of the phases of the moon. The interviews were audio-recorded in order to capture the exact words of the participants as they expressed themselves.

3.8.3 Triangulation. The results in this chapter, therefore, are presented both quantitatively and qualitatively and both were jointly used, in support of each other, to provide clearer answers to the research questions. This is called triangulated results.

Triangulation of the results is where both quantitative and qualitative data and analyses are jointly used in a study to answer the same research questions as accurately as possible (MacMillan 2006). Similarly, Creswell (2007) found that: research in which the investigator collects and analyses data, integrates the findings and draws inferences using either qualitative and quantitative approaches or methods in a single study or a program of inquiry.

3.9 Ethical issues

Research, being a social activity, involving humans and institutions should be conducted in accordance with guided ethical considerations to ensure that the research subjects and the institutions they represent are not hurt in any way. Further, Siseho (2013) noted that it is important for researchers to arrange for informed consent with participants and institutions before conducting research.

The current researcher dealt with ethical issues in the following manner:

1. Permission to conduct research was sought from and granted by the University of the Western Cape (UWC). See Appendix P (p.183).

2. Permission to conduct research was sought from and granted by the Western Cape Education (WCE) Department to conduct research in a school in Western Cape Province of South Africa. See Appendix Q (Page 184).

3.10 Chapter Summary

Chapter 3 presented the methodology adopted for the study. The study was conducted in Cape Town. The sample size of the study was 35 grade 6 learners (boys and girls) in a primary school. (Initially, there were 36 participants but one of them voluntarily pulled out during the study). The research design of the study was a case study, of chronological structure, where of one group of participants was observed before the intervention and after the intervention. There was no control group as mentioned earlier on. However, pre-observations were made followed by intervention (treatment) and later, post observations were made. Both quantitative and qualitative approaches were used in data collection and analyses. The following chapter, chapter 4, presents the results from the findings of the study. The study focused on using DAIM on grade 6 learners' understanding of the causes of the causes of the phases of the moon.

CHAPTER 4: RESULTS, FINDINGS AND DISCUSSION.

4.1 Introduction

The study investigated the effects of DAIM on grade 6 learners' understanding of the causes of the phases of the moon. The previous chapter presented the methodology of the study. This chapter presents the results, the findings and discussion of the study. This is done in accordance to the research questions, which investigated the following:

i) The conceptions of the causes of the phases of the moon that the grade 6 learners held before and after they were exposed to DAIM;

ii) The influence of DAIM on grade 6 learners' conceptions of about the causes of the phases of the moon;

iii) The grade 6 learners' perceptions and attitudes about the use of DAIM before and after their classroom teaching and learning of the causes of the phases of the moon, and

iv) The influence of learners' gender, age or geographical location on their conceptual understanding of the causes of the phases of the moon before and after they were exposed to DAIM.

In dealing with the research questions, the following criterion was used;

- The research question was stated
- The relevant results were presented.
- The findings and discussion were done using CAT or TAP as a unit of analyses.
- Conclusion.

4.2 Research Question 1: What conceptions of the causes of the phases of the moon did grade 6 learners hold before and after being exposed to DAIM?

4.2.1 Introduction Data to address this research question were collected by two instruments namely: the pre-post-test (**PPT**) and audio-taped interview schedule **(ATIS)**. Each of the instruments carried two sets of results; the results from data collected before DAIM classroom interventions, then followed by those collected after DAIM.

4.2.2 Results from the Pre-Post Test (PPT). In this instrument the learners' claims about the causes of the phases of the moon made before DAIM, were compared with those they made after DAIM. A comparison was done by the help of a statistical package for service solutions (SPSS) software. The results were then tabulated and presented in Tables 4.1 below.

Table 4.1: Results from PPT on learners' conceptions about the causes of the phases of the moon before and after DAIM classroom interventions

Learners' conceptions about the causes of the phases of the moon	**Before DAIM**	**After DAIM**
No responses	50 %	17%
Clouds cause the phases of the moon	6%	3%
Shadow from the earth, sun, planets and stars are the the causes of the phases of the moon	23%	6%
The causes of the phases of the moon was rain	9%	3%
Seasons cause the phases of the moon	6%	3%
Day and night were the causes of the causes of the phases of the moon	6%	2%
Light from the sun and the revolution of the moon round the earth are the causes of the phases of the moon	0%	63%

From Table 4.1 above the results from PPT seem to reveal that before DAIM, 50% learners were not able to make any conceptual claims about the causes of phases of the moon. However 50% learners made various conceptual claims, which were inconsistent with the principles and laws of science about the causes of the phases of the moon. After DAIM classroom activities, 17% learners did not seem to make any claims about the causes of the phases of the moon while 17% still made claims that were inconsistent with the principles and laws of science. However, 63% made claims that were consistent with the principles and laws of science.

An examination of the learners' responses in the PPT reveals that, before their exposure to DAIM, the learners made no claims or made claims and gave reasons that were inconsistent with the scientific views causes of the phases of the moon. This implies that learners had little or no knowledge about the causes of the phases of the moon. [See table 4.1]. After DAIM, however, (63%) learners were able to make claims and gave supporting reasons that are consistent with scientific views about the causes of the phases of the moon. The following claims made by the learners were representative:

Learner B36: Before DAIM: "*I don't know*" (no claim). No reason.

After DAIM: "*The light of the sun and the revolution of the moon round the sun* (claim). *Because the moon receives the light from the sun and as it revolves the sun, we see the lit part of the moon as phases from the earth"* (reason).

Learner Y15: Before DAIM: "*The shadows are the causes of the phases of the moon*" (claim) No reasons.

After DAIM: "*The sun's light and the revolution of the moon round the sun are the causes of the phases of the moon* (claim). *Because in argumentation class, we saw that the light of the sun lights the moon and we see it from the earth"* (reason).

4.2.3 Results from Audio Taped Interview Schedule (ATIS). Learners were informed about the audio taped interview the previous day and given an option not to attend. ATIS was applied to the learners before and after DAIM classroom interventions. In each case, learners were required to make verbal claims and support them with reasons about the causes of the phases of the moon. Learners' narrations were grouped into coded themes. These were processed through SPSS. The results are presented in able 4.2.

Table 4.2: Results from ATIS on learners' conceptions about the causes of the phases of the moon before and after DAIM classroom interventions

Learners' conceptions about the causes of the phases of the moon	Before DAIM	After DAIM
Those who did not make any claim	57%	14%
Rain is the cause of the phases of the moon	3%	0%
Day and night are the causes of the Phases of the moon	9%	0%
Shadows from the sun, stars, planets and earth cause the phases of the moon	25%	3%
Clouds are the causes of the phases of the moon	3%	0%
Seasons are the causes of the phases of the moon	3%	0%
Light from the sun and the revolution of the moon round the earth are the causes of the phases of the moon	0%	83%

From Table 4.2 above, the result seem to indicate that after DAIM more than half (83%) of the learners held the conception that the "Light from the sun and the revolution of the moon round the earth are the causes of the phases of the moon". This conception is consistent to the principals and laws of science, compared with those they held before DAIM.

4.2.4 Categories of learners' conceptions of the causes of the phases of the moon. The learners' conceptions were grouped into seven categories. These were discussed as follows:

4.2.4.1 Rain. Before DAIM learners claimed that rain is the cause of the phases of the moon. For example ATIS found that learner G23 responded as follows: *'We don't see the moon when it is raining, we see it when there is no rain and it looks different'.* This learner might have observed the moon before the rain and might have seen the moon at the waxing crescent moon (phase). After a few days when he/she saw the moon again, the shape could have been that of first quarter moon depending on how much the lit part of the moon could be observed (sometimes it rains continuously for days).

This learners' conception of the causes of the phases of the moon is not true because it is not consistent with the principles and laws of science.

Rain is part of water cycle, whereby water vapour in the atmosphere condenses because of low temperature at high altitude, forming droplets which fall back to the Earth because it is too heavy to be withheld in the atmosphere. When it rains, people, including learners, take shelter. Thus, there is not much opportunity to make observations about the celestial bodies such as the moon when it is raining. This means that they did not have much explanation on what goes on about the phases of the moon.

The moon orbits the Earth for 28.3 days (Lelliott & Rollnick 2010). During this time the angle at which we (from the Earth) see the lit part of the moon keeps on changing, depending on the Sun-Moon-Earth alignment. This is because the position of the moon had changed as it orbits the Earth and the viewer saw the lit part of the moon from an angle (Moor, 2004), different from the previous one, thus seeing a different moon shape from the one observed before the rain.

In this case, therefore, 'rain' was one of the conceptions held by the grade 6 learners. This finding is consistent with that of Martin et al. (2002) who stated that learners' conceptions are incorrect. However, after DAIM, PPT and ATIS found that learners gave different responses from what they said before DAIM interventions. Learners cited the light from the Sun as the cause of the phases of the moon. For example, learner G23 said, *during the revolution of the moon round the Earth, the light from the Sun shines on it and we can see the lit part of the moon.* This claim is true because it is consistent with the principles and laws of science. The other learner's conception about the causes of the phases of the moon was 'day and night'.

4.2.4.2 Day and Night. Before DAIM interventions, the result from the PPT found that the other conception held by the grade 6 learners regarding the causes of the phases of the moon was 'day and night'. This was given by 6% of the learners. The other result from ATIS (before DAIM) also found that 9%of the learners gave similar responses. For example, learner YI explained that*: 'Sometimes it is big in the evening and sometimes it is small I don't know why'*. Learners G4 and B3 did not give any reason for saying that; *day and night were the causes of the phases of the moon.*

This is an indication that learners sometimes hold conceptions which they are not able to explain. Abell (2001) learners hold conceptions which are inconsistent with scientific law and principles. Similarly, Starakis and Halkia (2010) warn that learners' conceptions could bar them from constructing scientific knowledge. The day and night are actually not the causes of the phases of the moon. The Earth rotates (spins) on its axis. One complete rotation takes 24 hours. During the rotation, one half (part of the Earth facing the Sun) has the day while the other half (facing away from the Sun) has the night. Both the night and day lasts for about 12 hours each.

After DAIM, both PPT and ATIS found that 2% and 0% of the learners still believed that it was 'day and night' that cause the phases of the moon. While learner G4 said; *I don't know*. The rest indicated that the light from the Sun causes the phases of the moon. For example, learner Y1 said; '*The Sun shines on the moon and when we look, we see the lit part'*. This claim is correct. Some other grade 6 learners held the conceptions that shadows from the other celestial bodies like the star, the planets, the Sun and the Earth were the causes for the changing phases of the moon.

4.2.4.3 Shadows from the stars, planets, the Sun and the Earth. The results from PPT and ATIS found that 23% and 25% of the learners respectively, held that the phases of the moon were causes by the shadows from the star, the Sun, the planet and the Earth. This could be a learners' conception. Learners may have arrived at this conclusion by gathering information from the school environment. At school, the grade 6 learners may have learnt about bodies in space like the planets, the stars, the Sun, the Earth, and the effect of light on the formation of shadows. They may have also read some books or done an internet search on this topic. Many times, in trying to make sense of what they see, learners do make their own interpretation of the phenomena. .

Learners' own interpretation of printed information, or through technology or from classroom lessons, would lead to naive science, also called learners' alternative conceptions which are not consistent with scientific laws and principles. Trundle et al. (2002) found that naive science does not easily come out of learners' minds. Also, the results from ATIS found that 8 learners held naive conceptions. The following statements are some of their answers:

- *The shadows of the stars fall on the moon and it looks different every time.* (Learner Y30)
- *The planets cover it and we don't see it sometimes* (Learner Y7)
- *The shadow of the Sun falls on the moon and it changes the shape* (Learner B21)
- *Because when it goes round the Earth, the shadow of the Earth falls on it and it looks different (Learner R9)*

These are all alternative conceptions because the shadows from stars, planets, the Sun and the Earth are not the causes of the phases of the moon. This is similar to what Olson (2007) found, that some classroom readers and other textbooks contain diagrams of the moon drawn 2-dimensionally and this further complicates learners' understanding. This could make them to draw their own conclusions in trying to make sense of their own world. Smolleck and Hershberger (2011) clarified that learners over generalise their conceptions, which creates inadequacies in their science understanding.

After DAIM, majority of those learners changed their mind to a new view that it was the light from the Sun that lit the moon as it revolved round the Earth and that we only see the lit part of it. However, PPT and ATIS showed that 6% and 3% of the learners respectively, such as B26 and R33 maintained that it was the shadows that caused the phases of the moon. The other learners' conception was the clouds.

4.2.4.4 **Clouds.** Before DAIM, the results from PPT revealed that 6% of the learners claimed that the clouds were the causes of the phases of the moon. Also from the result from ATIS, it was found that 3% of the learners for example B26 had the same claim that: *'The clouds cover the moon and makes is it look different'*. This conception could have been picked by the learner, while he or she was making his or her own observations. The learner could have interpreted that if there was a cloud cover in the sky; the moon is partly covered, making it to have different portions. This could be an over generalisation of information by the learner(s) hence, learner's conception. This is similar to the findings by Olson (2007), who listed 'clouds' as one of learners' alternative conceptions. Learners could be assisted to make constant observation of the sky would help learners to see that sometimes there may be no clouds to cover the moon but its phases kept changing. This could prove that the cloud cover does not the cause the phases of the moon.

However, after DAIM, PPT and ATIS found that the same learners changed their minds, and claimed that they see the portion of the lit part of the moon as it moves round the Earth except 3% as indicated by PPT.

4.2.4.5 **Seasons.** The results from the PPT found that one learner claimed that the phases of the moon are caused by the seasons. Also the result from ATIS similarly found 6% of the learners (learner R16) claimed that; *the causes of the phases of the moon were seasons 'because there is no moon in winter. It is only in summer. In January it is small and in*

December it is big'. In winter, the weather is not favourable for learners to do much observation of the sky. They mostly stay indoors at or at school to avoid consequences of cold weather. So, they do not see the moon for quite some time; *no moon in winter*.

During summer, learners spend longer hours outside maybe for two reasons. Most of the days in summer have clear skies and the Sun sets late so they have more time to make observations as mentioned by Lelliott (2007). More time outside in summer gives learners an opportunity to see the phases of the moon for example the full moon (*in December it is big*). It is summer in December in South Africa. Probably learners realise that they did not see the moon for a long time. That could be the reason why they claimed that there is no moon in winter. The learner's conception that the causes of the phases of the moon are the seasons is inconsistent with the scientific law and principles. This inconsistency is similar to that cited by Starakis and Halkia (2010) who found that learners thought that the Sun — moon changes mainly took place around Sunset and Sunrise.

After DAIM, both PPT and ATIS found that in both cases, learners changed their mind by claiming that the phases of the moon are caused by light of the Sun and the movement of the moon round the Earth. Finally, learners thought that the moon was silver.

4.2.5 Conclusion. Findings from various instruments of the study revealed that before DAIM, learners held conceptions about the causes of the phases of the moon. They claimed that the causes of the phases of the moon were; rain, shadows from the stars and planets, clouds, seasons, day and night. Other learners claimed that the moon changed itself into phases within the month and the moon was silver and that is why it was able to shine in different phases. All learners' conceptions were found to be inconsistent with the principles and laws of science because they were not the causes of the phases of the moon. Such conceptions could be the cause of low learner performance in class tests and national examinations. Learners need to be assisted through better teaching and learning strategies so as to make better claims about a phenomenon for example the causes of the phases of the moon.

However, after DAIM classroom discourses, majority of the learners, made new and better well supported claims about the causes of the phases of the moon. They claimed that light from the sun shines on the moon as it orbits the earth and that we see the lit part (phase) of the moon from the earth. This claim is consistent with the principles and laws of science. Better learner conceptualization of a phenomenon could yield better classroom and national tests and examinations performance.

Although learners' conceptions of the causes of the phases of the moon did not conform to the laws and principles of western science, they still remain important to them because the (conceptions) provide solutions for their survival in communities where they live. This will be discussed in the next research question, which follows shortly.

4.3 Research question 2: What is the influence of DAIM on grade 6 learners' conceptions about the causes of the phases of the moon?

4.3.1 Introduction. This question called for the investigator to show the influence of DAIM on the grade 6 learners' conceptions of the causes of the phases of the moon by analysing a) the pre and post-test means; b) The learners' responses using TAP and CAT. To answer this research question, the study used the results from the FIS and ATIS.

4.3.2 Overall mean scores. Table 4.3 below shows the learners' mean scores on concepts of the phases of the moon before DAIM and after DAIM. The results from the pre-post-test scores were processed using SPSS. The paired samples yielded a t-value of 33.45 at p=0.000, which indicates that the differences between the two mean scores is highly statistically significant most probably as a result of the influence of DAIM on the learners' understanding of the causes of the phases of the moon.

Table 4.3 AN0VA Grade six learners' Pre-Posttest mean scores regarding understandings of the causes of the phases of the moon

	Mean	**N**	**SD**	**t**	**P - level**
Pre – test	30.04	31	11.58	33.45	0.000
Post - test	53.56	35	14.41		

Figure 4.1 below is a graphical representation of the learners' pre and post means for their conceptions of the causes of the phases of the moon. It shows that the learners attained improved mean score of 53.46 at the posttest from 30.04 attained at pre-test as indicated by PPT. The increase in scores indicates a better understanding causes of the phases of the moon. This shows that DAIM was an effective teaching and learning strategy which brought the conceptual change observed among the learners.

Figure 4.1 Graphical representation of the learners' pre and post means on conceptions of the causes of the phases of the moon

Similar findings were made by Hewson and Ogunniyi (2008) using a dialogical argumentation instructional model (DAIM). They observed that DAIM helped their subjects in the articulation and appropriation of concepts as well as provide meaningful explanation to certain natural phenomena. Brown and Chin (2000) also found that dialogue helps learners to give elaborate explanations. Von Aufschnaiter et al (2008) concluded that when learners are engaged in argumentation, they are likely to increase their reasoning and understanding of concepts

4.3.3 Grade six learners' conceptions of the causes of the phases of the moon according to TAP. During DAIM classroom discourses, learners had to demonstrate their mastery and the use of TAP argumentation skills by responding to the questions which asked; what are the causes of the phases of the moon? What are the evidences to support your claim? Where did you get your evidence from? E.g. at home, or school. It was important to establish the level of TAP argument the learners had attained because attaining a good level of argumentation skills could enable leaners to make strong and sensible arguments in and out of class in their future lives. This could mould learners into logical thinkers. Jiménez-Aleixandre & Erduran (2008) agree that Argumentation is logical thinking activity. Strong logical thinkers usually excel in academicians and this this means that such people hold high positions in the society for example medical doctors, engineers researchers etc. These are the ones who initiate activities that take human lives to the next better level Learners with lower masterly argumentation skills could, however, need more time to practice over and over again until they master it. Unfortunately, the study time was limited to six weeks. Therefore, only learners' TAP levels achieved with this period of time are reported as shown in Table 4.4 and discussed thereafter. The learners seemed to have attained up to TAP argumentation level three.

Table 4.4: Levels of TAP's arguments in classroom discourse applicable to this study

Level 0	Non–oppositional argument
Level 1	Argument involves a simple claim versus counter claim with no grounds or rebuttals
Level 2	Argument involves claims or counterclaims with grounds but no rebuttals
Level 3	Argument involves claims or counterclaims with grounds but only a single rebuttal challenging the claim.

(Source: Ogunniyi, 2009; modified after Erduran et al. 2004)

4.3.3.1 TAP Level 0 Non–oppositional argument. Findings from ATIS (Appendix P) indicate that before DAIM, learners in this category, showed that they did not make have any argumentation skills such as making claims and giving reasons on their understanding of the causes of the phases of the moon. Each of the learners B14, Y19 and G4, for example said *I don't know*, and gave no reason in response to the question asked to or her. Some learners in this category made unsupported claims which could not amount to an argument, as show in Table 4.5 below.

Table 4.5: Learners' responses at TAP Level 0

Learner	**Before DAIM**		**After DAIM**	
	Claim	Reason	Claim	Reason
B14	I don't know	No reason	*No claim*	*No reason*
B19	I don't know	*No reason*	*No claim*	*Now reason*
R5	*I don't know*	*No reason*	*No claim*	*No reason*
G4	*Day and night*	*I did not hear about it*	*I don't know*	*No reason*

After DAIM, the study found that learners still did not make claims nor did they give reasons. Learners B14, B19 and R5 did not make claims as to what the causes of the moon were. They all said; *I don't* know. They did not give reasons for what they said.

In both sessions (before and after DAIM), these learners said the same thing '*I don't know* and gave no reasons in response to the questions that required their knowledge of the causes of the phases of the moon. The same learners also did not demonstrate the skill of argumentation because they did not make any claims on the subject about the causes of the phases of the moon. The fact that this did not amount to an argument, is the reason for categorizing this non achievement as TAP level 0. The reason for this could be that; in any learning activity, there would be the category of learners that learn at a slower pace, others could be average and gifted. This category of leaners, therefore, could be the slow ones whose argumentation skills and phenomenal knowledge could be at the emerging stage. Naylor et.al (2007) found that learners usually face difficulties on how to argue through entire range of TAP categories during classroom argumentation because of its complexity. This implies that learners in this category needed more time to engage with further DAIM interventions and other forms of support information regarding the causes of the moon. This could enable them to achieve a sufficient level of skill in making claims or counter claims and give supporting reasons or rebuttals about their understanding of the causes of the moon and other subsequent topics in science and other fields of learning.

4.3.3.2 TAP Level 1: The argument involves a simple claim versus counter claim with no grounds or Rebuttals. Before DAIM intervention, all the learners 'I don't know' in response to the questions that called for their understanding of the causes of the phases of the moon. They further gave no reasons except learner R5 who said; 'because I did not read about it. This is shown in the table 4.6 below.

Table 4.6: Learners' responses at TAP Level 1

Learner	Before DAIM		After DAIM	
	Claim	Reason	Claim	Reason
G2	*I don't know,*	*No reason*	*The light from the sun light the moon as it goes round the earth.*	*Because the sun light the moon as it moves round the earth and we see the lit part of the moon in phases. This is what we learned in the argumentation lesson at school.*
B36	I don't know	No reason	*Light from the sun cases the phases of the moon*	*Because the sun lights the moon and we see the lit part of the moon. We learned this information in our science classroom*
Y25	*I don't know*	*No reason*	*The sun's light and the phases of the moon appear when the sun light the moon*	*Because light from the sun fall on the moon and we see lit phase of the moon from the earth. We learn from each other during science argumentation lesson at school,*
R5	*I don't know*	*Because I did not read about it.*	*The light from the sun*	*Because the sun lights the moon and that is when we see the phases of the moon. I study it in class.*

After DAIM the learners made claims and gave reasons to support them for example learner G2 said; *The light from the sun light the moon as it goes round the earth and we see the lit part as a phases.* This was supported with a reason that; *Because the sun light the moon as it moves round the earth and we see the lit part of the moon in phases. This is what we learned in the argumentation lesson at school.* Learners B36, Y25 and R5 made similar claims and supported them with similar reasons.

Although this category of learners did make claims before DAIM, they made valid claims after DAIM, which were supported with logical reasons. These claims and their supporting reason answered the questions where the learners were required to give their understanding of the causes of the phases of the moon. These learners seem to have presented better claims about their understanding of the causes of the phases of the moon than those given by learners at TAP level 0. That is why they are categorized as TAP level 1.This achievement could lead towards attaining argumentation skill with time and constant practice. These learners seem to have benefited from DAIM intervention. This is consistent with studies made by other scholars for example; Osborne et al. (2004) who argue that arguments could be stronger or weaker than others.

4.3.3.3 TAP Level 2: **Argument involves claims or counterclaims with grounds but no rebuttals. L**earners were required to make claims with supporting reasons in response to the questions that called for their understanding of the phases of the moon. Before DAIM, learners at this level made improved claims and gave reasons which were better than those of TAP level 1.as indicated in table 4.7 below.

Table 4.7: Learners' responses at TAP Level 2

Learner	Before DAIM		After DAIM	
	Claim	Reason	Claim	Reason
G23	*Rain is the cause of the phases of the moon*	*Because when it is raining, we don't see the moon. We see it when there is no rain and it looks differen. That is what I see.*	The light from the sun and the movement of the moon round the earth.	*Because the sun lights the moon as it goes round the earth and we see the lit part of the moon and those are the phases of the moon. That is what we learned in science at school.*
Y1	*Day and night are causes of the phases of the moon,*	*Because sometimes it is big in the evening and sometimes it is small and sometimes it is not seen at all.I see it like that every day.*	*Light from the sun*	*Because the light from the sun falls on the moon and we see the lit part of the moon during the time it rotates round the earth. We learned it in our argumentation class.*
R22	*The shadows from the earth, planets and stars are the causes of the phases of the phases of the moon.*	*Because they cover the parts of the moon and cause the phases of the moon.*	*Light from the sun and the rotation of the moon round the earth cause the phases of the moon.*	*Because the part of the moon facing the sun receives the sunshine and we see it from the earth. We study this in science argumentation class.*

After DAIM, learners in this category seem to have made better claims and gave reasons on their understanding of causes of the phases of the moon as shown in table 4.7 above.

Both before and after DAIM, learners made stronger and supported claim and show with evidence that these learners had achieved better skills to argue compared to the learners in TAP levels 1 and 0 categories. TAP level 2 category logically supported claims. The only difference between the claims made and reasons given before and after DAIM is that those made before DAIM did not answer the questions on the learner's understanding of the causes of the phase of the moon. This is because those claims and their supporting reasons are not consistent with laws and principles of science. The conceptions claimed to be the causes of the phases of the moon do not actually cause them. However, the claims made and the supporting reasons given after DAIM, actually answered the questions that required learners to demonstrate their understanding of the causes of the phases of the moon. The learners made claims and gave the supporting reasons that are consistent with the laws and principles of science because they were the causes of the phases of the moon.

The learners' correct conceptions about their understanding of the causes of the phases of the moon claimed after DAIM and good skills to argue logically were the reasons why the argumentation level of these learners is categorized as TAP level 2. With time, practice and other forms of support, such learners hold the potential of progressing to higher TAP levels. Simon and Richardson (2009) recommended that due to fact that argumentation does not come in a natural way; time should be taken to train learners until they master the steps of argumentation.

In this category, learners made claims about the causes of the phases of the phases of the moon and supported them with reasons as shown by the following percentages. As shown elsewhere in the study, before DAIM, (0%) learners made scientifically consistent supported claims about the causes of the phases of the moon. After DAIM 63% learners made scientifically supported claims about the causes of the phases of the moon. This indicates that DAIM could have helped learners to understand the causes of the phases of the moon as one of the ways of resolving conflicts between their science and IK conceptions.

4.3.4 Grade six learners' conceptions of the causes of the phases of the moon according to TAP. While TAP analyses arguments logically, CAT analyses them logically and non-logically (e.g. Kwofie and Ogunniyi 2011). CAT analyses arguments according to the following five cognitive states: dominant, suppressed, assimilated, equipollent and emergent (Amosun, 2012; Diwu, 2010; Diwu and Ogunniyi, 2012; Ogunniyi, 2006, 2007a). One of the strategies of solving conceptual conflict that could arise from both science and IK would be to involve learners in a classroom argumentation activity. Argumentation is a dynamic thinking activity. When learners or people are involved in an activity such as dialogical argumentation on a particular topic such as the causes of the phases of the moon, their minds keep on shifting along the five cognitive states i.e. dominant idea, suppressed idea, assimilated idea, equipollent idea and emergent idea as discussed below;

4.3.4.1 ***Dominant.*** This section presents learners' conceptions of the causes of the phases of the moon. Learners' conceptions are their prior (first hand) knowledge of the causes of the phases of the moon, which they may have acquired either at home (**Dominant IK idea**) or at school (**Dominant scientific idea**) or both.

***Dominant IK idea*.** This is when a learner holds a conception which he or she learned at home from the family community members for example, ATIS reveal that gathered information about the phases of the moon and how the phases control some of the activities in his/her community. Before DAIM, Learner Y15 said; *shadows from stars and the sun were the causes of the phases of the moon. I learned them at home were we cite the moon. We do it in our culture. We must cite another small moon* (waxing crescent phases) *to stop us from fasting. We do it every year.* Learner G29 said*, the cause of the phases of the moon was day and night because my mother told me that in her village, they use the moon for light at night.* Learner B21 said*; seasons were the causes of the phases of the moon because my friend told me how it helps to when they plant the food* (crops) *in their yard*. Learners attach the importance of the phases of the moon to the livelihood activities of their community. In reality, however, the shadows, day and night and seasons are not the causes of the phases of the moon because they are not consistent to the laws and principles of science. Smolleck and Hershberger (2011) further found that these conceptions differ from those of the scientists. Wiggins and McTighe (2006) found that learners come to class with many conceptions about a phenomenon. The phases of the moon themselves, however, control their livelihood activities which help their communities to survive.

After exposure to DAIM, the result from ATIS shows that these learners shifted their minds about the causes of the phases of moon and said that light from the Sun that causes the phases of the moon because the Sun shines on the moon as it revolves round the Earth and when we look [the angle at which we see the moon] we see the lit part. Similar results were found by Cross et al. (2008), that indicates that there was a shift from scientifically inconsistent conception (former statement) to a scientifically consistent concept (latter statement). It could be suggested that, hopefully this shift might have resulted from learners' DAIM classroom engagements and this could help learners to handle their livelihood activities in their communities confidently and with sufficiently integrated IKS knowledge.

Scientific dominant ideas. This is a situation whereby the ideas held by a learner adopts what she/he learned at school and use that information to answer questions posed to him or her. For example in answering the question; what are the causes of the phases of the moon? What are the reasons for your answer? ATIS reveals that the claims made and the supporting reasons reasons given after DAIM were scientific because they were learned at a school environment. Learner B21 said, *'The light from the sun light is the cause of the phases of the moon. This is because the part of the Moon with light is what we see from the Earth and we saw it in Argumentation class.'* [School]. Also after DAIM, learner Y15 answered the question that; *'The sun's light and the movement of the moon round the earth are the causes of the phases of the moon. This is because in the argumentation* [in science classroom at school], *I saw how it happens. The light of the Sun lights the Moon and then we see it from the Earth.* These learners' answers seem to originate from a school environment. When an idea originates from a school environment, it is a scientific dominant idea. Cross et.al (2008) found that argumentation helps learners to conceptualise new ideas and also extend pre-existing concepts.

4.3.4.2 ***Suppressed.*** This where a learner confesses by himself or herself that the idea he/she was holding about a phenomenon such the causes of the phases of the moon is not correct and therefore he / she has to quit it for a better or more correct idea. For example, during argumentation learner G23 was convinced that the idea he or she held about the causes of the phases of the moon was weak and therefore, he/she quits and adopts a new ideas altogether. Therefore, from ATIS, after DAIM, learner G23 answered the question by saying; *I thought the causes of the phases of the moon was rain because. I don't see the Moon when it is raining. We see it when there is no rain and it looks different' but now I realize that it is 'light from the sun that shines on the moon and we see the lit part of the moon from the earth.* Learner R35 also answered the question that; *I thought the moon was silver, that is why it appears to have many phases but now I see that is not the case. I see it is the light from the* *sun that causes the phases of the moon because the Sun shines on the Moon during its Rotation and Revolution round the Earth.* This implies that these learners shifted their minds from the original dominant ideas to new ideas in the same context.

4.3.4.3 ***Assimilated.*** An assimilated idea is where the outcome of argumentation indicated that learner's scientific idea becomes part of IK or the other way round. Results from ATIS found that before DAIM learner R16 answered the question regarding his/her understanding of the causes of the phases of the moon that; 'season are the cause of the phases of the moon because there is no moon in winter, it is there only in summer and it looks small but it is big in December.

After DAIM, the same learner cited the light from the sun as cause of the phase of the moon but failed to give a new supporting reason to the new claim but rather maintained that it is the seasons which were the causes of the phases of the moon. This implies that the new idea [the light from the sun…] was assimilated into the old idea [seasons being the causes of the phases of the moon.] It is not usually easy for old ideas to give way for the new ideas to replace them in the learning process. Yurd and Olgun (2008) argued that it is only when learners' conceptions are removed, that understanding of the phenomenal conceptions improves.

4.3.4.4 ***Equipollent.*** This is when a learner holds two ideas, one from science (school) and another from Indigenous background with the same strength about a phenomenon such the causes of the phases of the moon. Such a learner answered the question about their understanding of the causes of the phases of the moon by keeping answers from both school environment and out of school environment. For example learner R9 answered the question that; *'The earth is the cause of the phases of the moon because the moon goes round it because that is I see always.*[learners' own experience from home] *or the sun shines on the moon as it goes round the earth and we see the phases, as we saw in argumentation classroom'.* [Learnt during DAIM experience at school].

From both school and out of school experiences, the learner keeps the part of the answer where the moon goes round the earth. In CAT, if the knowledge is rooted in two worldviews, then it could be an equipollent idea because it has almost equal intellectual force from both science and IK (Ogunniyi and Hewson, 2008).

4.3.4.5 ***Emergent.*** An emergent idea is one that a learner hears for the first time from his/her peer, books, teacher, internet, family/community member or any other source. In other words, it is a situation where the learner may not have had the prior knowledge of the concept or idea, either from scientific or IK world view.

Before DAIM, the results from ATIS showed that 8 learners seem to have heard about the concept of the phases of the moon for the first time. For example, learners G2, G11, G17, G29, Y25, B32, B36 and R5 all said *I don't know what causes the phases of the moon.* They did not give their reasons for saying what they said. The indication here implies that that these learners seem to have no prior knowledge about the causes of the phases of the moon.

After DAIM, the results from ATIS reveal that the 8 learners who seem to have not known the causes of the phases of the moon, now seem to have started saying something about it. They said the following;

- *The cause of the phases of the moon was the Sun's light and the movement because we did learn and I saw it in the argumentation class.* (Learner G2)
- *The Sun light lights the moon because we study like that in science argumentation* (Learner G11)
- *The light from the Sun causes the phases of the moon because we saw it in the pictures in science in our group* (Learner G17)
- *The light of the Sun is the causes of the phases of the moon because we did see the pictures in the argumentation class* (Learner G29)
- *The light of the Sun is the causes of the moon because the phases appear when the light of the Sun falls on the moon as it goes round the Earth it appears small or big.* (Learner Y25)
- *The Sun, the Earth and the movement of the moon are the causes of the phases of the moon because the Sun shines on the moon as it goes round the Earth and we see different shapes* (Learner B32).
- *The movement of the moon round the Earth and the Sun are the causes of the phases of the moon because during the movement of the moon round the Earth, the moon receives the light from the Sun and we are able to see the small parts and big parts* [phases] *of the moon.* (Learner B36)

- *It is the light of the Sun and the revolution of the moon round the Earth that causes the phases of the moon because we saw it in science argumentation but I forgot.* (Learner R5)

After DAIM, the majority, if not all, of 8 learners seemed to at least have started to explain the causes of the phases of the moon for the first time. This implies that these learners may have encountered the information about the phases of the moon during the classroom DAIM discourses and then they seem to have had a new [emerging] idea. An emergent idea is one that the learner has no prior knowledge of (Ogunniyi & Hewson, 2008). Most of what they said after DAIM seems to have carried scientifically consistent facts about the causes of the phases of the moon. Many of the statements were short which would indicate that their thinking would have been on its way [emerging] to the mastery of the whole idea about the causes of the phases of the moon. This could be achieved with time.

From their presentations, FGIS found that the majority of learners seemed to give comparative views about argumentation based on their pre- and post-DAIM experiences. These comparisons pointed to whether or not argumentation helped them to give better IK or scientific explanations of the causes of the phases of the moon. While presenting their views, learners seem to argue that before they were engaged in argumentation, it [argumentation] did not help them in any way to give valid IK and scientific explanations of the causes of the phases of the moon. Learners seem to have supported their claim with the reason that seems to suggest that they had not heard about argumentation especially in the classroom situation. For example learner B36 seemed to confess by saying that, *they didn't teach me about argumentation*. Learner Y25 also said that *I did not hear about argumentation in class.*

Few of learners who had probably heard about argumentation seem to have carried a negative impression of it. They may have thought that argumentation was not meant for classroom teaching and learning but a mere provocation which could end up in physical fighting between individuals. For that reason, they seem to have been instructed to avoid argumentation amongst themselves both at school and at home. For example learner Y1 said *I thought it was bad to argue with friends because the teachers and parents did not want us to argue.* Learner Y25 also said *I thought it was rude to argue.* Seemingly, learners' negative notions towards argumentation presented to them by their role models (parents and teachers) may have led them to say that it did not help them learn.

Since the grade 6 learners seem not to have been involved in DAIM before, it may then be assumed that other instructional strategies might have been employed for teaching and learning science. It could be assumed further that traditional classroom instructional strategies like lecture method or chalk-and-talk or dictating notes to learners may have been common practice in teaching and learning science. If this was found to be true, then it could have been one of the reasons why learners held scientifically inconsistent conceptions about the changing phases of the moon.

Probably, the traditional models might not have presented learners with an opportunity to examine and to re-examine their IK and science conceptions, through sharing of ideas and learning from each other so as to arrive at a scientifically valid explanation of the causes of the phases of the moon. The evidence of such scientifically inconsistent claims about the causes of the phases of the moon could arise from learners' personal interpretation of the phenomenon. More DAIM classroom activities could help learners with scientific inconsistencies to shift their thinking so that new and scientifically correct conceptions may begin to emerge in their learning process. FGIS revealed examples of learner's alternative conceptions about the causes of the phases of the moon as follows;

- *I thought that the causes to the phases of the moon was the shadows from the stars.* (Learner Y30)
- *I thought that the moon was silver because it shines*.(Learner R35)
- *I thought that the causes of the phases of the moon was the clouds.* (Learner B26)
- *I thought it was the shadows from the planets that caused the phases of the moon. (*Learner Y7)
- *I thought the moon phases were caused by the shadow of the Sun falling on the moon.* (Learner B21)

In other words, all they seem to say are not true about the causes of the phases of the moon. Similar findings have been reported by Galili et al. (2003). As learning goes on, learners master emergent ideas which become dominant ideas. This change make learners better and confident in handling science activities.

Secondly, the grade 6 learners expressed themselves on whether or not argumentation helped them to give scientifically consistent explanation after they were engaged in it in class. The results from FGIS indicated that learners seem to have compared what they thought argumentation was and whether or not it had helped them to give a better explanation of the causes of the phases of the moon and what they actually found it to be and whether or not it helped them to understand and give better explanation of the causes of the phases of the moon, during and after DAIM classroom discourses. For example:

- *Now argumentation helps me to learn and understand the phases of the moon.* (Learner B10)
- *Now argumentation helps me to learn many different things* [information] *from different children* [sharing ideas]. Learner B26)

The results from FGIS found that the majority (9 out of 10) seem to have accepted that their original thought about the causes of the phases of the moon was different from what learners later found out.

However, one learner seems to have maintained his/her original thought about argumentation. Learner B10 seemed to have appreciated that later argumentation helped him/her but maintained that the moon changed itself during the month. This implies that DAIM seemed not to have helped him/her to give a better explanation about the causes of the phases of the moon because it was not true that the moon changed itself during the month. Another assumption is where the majority of learners seem to have changed their negative attitude towards DAIM. They later accepted that they found [argumentation] to be useful because it helped them to share ideas and learn about the causes of the phases of the moon among themselves.

4.3.5 Summary. Before DAIM, CAT analyses, seem to indicate that learners may have had conflicting science and IK ideas about the causes of the phases of the moon. DAIM classroom activities may have had some positive effect on learners because the majority of them seem to have improved their understanding of the causes of the moon by shifting their claims from scientifically inconsistent claims to scientifically consistent ones. Data presentation and discussion that covered the following : Learners' ways of knowing, Learners' IK and claims about the causes of the phases of the moon before and after DAIM both from IK and school science points of view and how DAIM was used to integrate IKS in the classroom namely:

- What learners from home, (learners' IK), would be used to learn science from known to unknown. For example, learners already know that phases of the moon do exist although they associate those other natural phenomenon such as rain, clouds and others already mentioned in the study.
- Learners' conceptions of the causes of the phases of the moon are important to them because they help them to control their livelihood activities such as food and water collection. While science clarifies the causes of the phases of the moon, learners' IK would clarify other natural happenings related to a particular phase of the moon and the human activity to be done in their community. For example; a Waning Gibbous phase of the moon could indicate the coming of rain and would warn the community to hasten the preparation their garden in preparation for planting their food crops. Food is important because learners will never learn while their stomachs are empty.
- Integration of IK and science would enable learners to be multi- perspective in the sense that they would use both IK and science to solve conflicting issues both in the school environment like passing tests and examinations as well as handling community affairs effectively such as animal breeding, crop production, fishing, honey gathering, environmental preservation and many more.

4.4 Research question 3: What were the grade 6 learners' attitudes and perceptions on the use of DAIM before and after their classroom teaching and learning of the causes of the phases of the moon?

4.4.1 Introduction. The research instruments that were used for data collection to address this question were ATIS and PPT. These were administered to the learners before and after DAIM and FGIS, which was administered only after DAIM.

4.4.2. Comparing Learners' attitudes and perceptions towards the use of DAIM. Results from ATIS indicate the learner made a variety of claims on how they perceived DAIM before and after it was used for classroom teaching and learning. The claims are presented, followed by discussions of the findings. Learners' claims and their supporting reasons were made in accordance with TAP for example;

Table 4.8: Learners' attitudes and perceptions before and after the use of DAIM

Learner	Before DAIM	After DAIM
G2	*I did not know it (claim). We did not argue before (reason).*	*It is important. Because we learn from each other*
G4	*I knew it was to fight (claim). Because we were not allowed to argue and fighting (reason).*	*I now know it is to learn. Because we used it in the science class and we enjoyed to learn.*
G23	*It is bad. You cannot argue with big people. Because it is not allowed.*	*It is great. Because we talk our ideas and also listen to group and we learn a lot of information*
G29	*I didn't hear it before. Because at home and at school we are told not to argue.*	*It is very nice. Because if you have a claim you must have a reason.*
Y1	*I thought it was bad to argue with friends. Because the parents and teachers don't want us to argue.*	*I now know it is to learn. Because it is to learn and make a claim and give a reason*
Y7	*I did not know about it. Because the teacher did not tell us to argue*	*I know about it and it is nice for me. Because I learn something new*
Y15	*I did not quite understand it. Because I did not hear about it*	*It is interesting and enjoyable. Because you hear the news from your friends and you learn from their claims and reasons.*
Y19	*I didn't know about it. Because we did not argue before.*	*It is very helpful. It helped me to learn the Phases of the Moon with my friends*
Y25	*I knew it was bad to argue. I thought it was rude to argue with*	*I can see it is nice. Because I learn a lot about the Moon*

	people.	
Y30	*It was bad. Because I did not know how to make claim and give reasons*	*It is a good one. Because I learn how to make claims and give reasons.*
Y18	*I never knew it was so good and easy. Because I didn't see it anywhere.*	*It is not difficult anymore. Because we used the science and we enjoyed learning a lot of new stuff about the Moon.*
B3	*I did not like it. I knew it was complicated.*	*It is nice and not complicated. Because we used in class to learn about the moon and it was nice.*
B10	*I thought it was just to argue. Because I don't like to be rude*	*It was good to argue to make a claim and give or ground. Because we learned the ideas from the other people*
B21	*No claim. No reason*	*a reason ; It is important. Because you must give for what you always say.*
B26	*I didn't know much about argumentation. Because I did not hear about it before.*	*I now know it and it is important. Because we know many things through argumentation.*
B32	*It was not nice at all. Because, before, there a lot of wrong answers from the learners.*	*It helps us to learn better. Because we argue together and get more information.*
B36	*I didn't know argumentation. Because we did not argue before in class and we are told to be quiet*	*I now know it and it is important. Because we know many things through argumentation.*
R35	*It was not familiar. Because it is new to me.*	*It is important and it helps us. Because you must have grounds when you make a claim and this helps us to learn many things.*
R16	*I did not know it. No reason*	*It is to study. It helps us to study and to know many things about the Moon and we enjoyed it.*
R22	*I knew it as a bad thing for children. We were always told not to do argumentation with big people and even friends because we can end up fighting.*	*It is important and very nice. Because it is to study. We make claims and give reasons. We are happy to hear good information from the others in the group.*
R28	*I fear it. Because if people start an argument, they fight and get arrested.*	*It is a very good thing to do in class. Because you make a claim and give the reasons. It is interesting.*
R33	*I did not know it very well. Because everyone told me that it was bad to make an argument with someone else*	*It good in class. Because if you make a claim, you must give a reason. We are happy to hear many claims and many reasons and we enjoy. Even the teacher was listening to us.*

4.4.3 Learners' perceptions on how DAIM had an effect on their conceptions of the causes of the phases of the moon. From the instruments mentioned above, the study found that learners perceived the effect of DAIM on their conceptions of the causes of the phases of the moon in various ways as discussed below.

4.4.3.1 *To understand the causes of the phases of the moon.* The results from ATIS found that before the DAIM intervention, the grade six learners said that they did not understand and were unable to explain the causes of the phases of the moon. After the DAIM intervention, learners said that argumentation helped them to understand and explain the causes of the phases of the moon. For example:

- *Before we argued in class, argumentation did not help me because I did not know it was a good idea to argue. But after we argued in class, I learned that it* [argumentation] *helped us very much because we were able to learn about the phases of the moon. At first I thought the phases of the moon were caused by the rain. But after argumentation, I found that it was because of the light from the Sun, the revolution of the moon round the Earth that we see the lit part of the moon from the Earth* (learner G 23)

- *Before the argumentation class, argumentation did not help me because I did not hear about it. Later, after we argued in the classroom, it helped me a lot because I now know the phases of the moon. I thought it was the shadows from the planets that caused the phases of the moon. But in the argumentation class, I learnt that the causes of the phases of the moon is the light from the Sun and the way the moon goes round the Earth and the way we see the part of the moon where the light shines* (learner Y7).

- *Before argumentation, I thought the phases of the moon were caused by clouds covering the moon. But in argumentation we studied that the light from the Sun and the revolution of the moon round the Earth caused the phases of the moon, when we see it. So argumentation helped me* (learner B26).

4.4.3.2 ***To share ideas about the causes of the phases of the moon.*** The results from FGIS found that before DAIM intervention, some of the grade 6 learners said that they did not argue with each other [so as to share ideas]. Some of them said that they did not know argumentation; others said that they were not allowed to argue and others thought argumentation was a rude practice. After DAIM intervention, some of learners accepted that argumentation helped them to share ideas. For example, some of them said:

- *Before we argued in class, argumentation did not help me at all. I did not know it. But I now learn it in class and it helps to learn many different things from different children* (Learner B26).

- *Argumentation did not help me before we learned it in class and I was not sure about it. But after we argued in class I now know that argumentation is so nice because you hear what other people say* Learner Y30).

- *Before argumentation, I thought it was bad to argue with people because we were not allowed to argue with anybody. But after we argued in a science classroom, I found that argumentation was great because it helps us to talk about our ideas and listen to the group and we learn a lot of information together* (Learner G23).
- *Before we argued in class, I thought it was just to argue in a rude way because we did not know how to make claims and give reasons. But after science argumentation, I now understand that it is to learn from each other because we make claims and give reasons but we learn from one another.* (Learner R5).

Before DAIM, learners seem to indicate that their perception of DAIM was negative and not even acceptable in a learning environment whether at home or at school. They had the perception that argumentation activities were equivalent to rudeness towards each other and could result into ugly incidents like fighting. Parent and teachers did not allow learners to engage themselves I augmentation. But after DAIM intervention, learner had the perception that DAIM was useful to them because it was a good teaching and learning activity. It helped them learn how to make good claims and give reasons in support of that they said and also it led to better understanding of what they learned in groups in class. When learners have positive perceptions of a teaching and learning strategy, they learn better. One learner, Learner Y25, appreciated the fact that argumentation enhanced the good practice of learning from each other.

A similar observation has been made by Munford & Zembal-Saul (2002) and Grady et al. (2010) also found that argumentation broadens learners' minds especially when they share ideas with their peers.

4.4.3.3 ***To enjoy learning about the causes of the phases of the moon.*** The results from FGIS indicated that the grade 6 learners said they did not enjoy argumentation because they thought it was a bad idea to argue. Others said that they did not enjoy it. After DAIM intervention, some of them said that argumentation helped them to enjoy learning. They said:

- *Before I learned it in class, I did not know about it. After we learned about argumentation in class, it helped us to study many things and we enjoyed learning about the phases of the moon.* (learner 16)

- *Before I learned about argumentation in class, I was afraid of it because if people start an argument, they fight and get arrested. But later after we argued in class, I learned it was a good thing to do in class because it is interesting [enjoyable] to learn things like the phase of the moon* (learner R 28).

- *Before the classroom argumentation, it [argumentation] did not help me because everyone told me that it was bad to have an argument with someone else. But after the argumentation in the classroom, I learned that it is good to argue in classroom because we are happy to hear claims and reasons about the phase of the moon and we enjoyed it.* (Learner R33).
- *Before classroom argumentation, it did not help me because I did not know anything about argumentation. But after the classroom argumentation, it helped me to learn and it was interesting and enjoyable to learn the moon phases* (learner Y 15).

Kriek and Grayson (2009) found that learners learn better if they enjoy classroom activities. When learners enjoy a lesson, other learning dynamisms manifest, for example, being able to explain an idea fluently. This would signify the degree at which their understanding would have taken place.

4.4.3.4 ***To learn how to argue reasonably in class.*** The results from the FGIS indicated that before the classroom DAIM intervention, some of the grade 6 learners said that they did not gain from argumentation because they did not know it and they were discouraged from arguing by their teachers and parents. After the DAIM intervention, some of them said it helped them to learn how to argue reasonably. Some of them said:

- *Before we argued it class, argumentation did not help me because I did not know about it. But after classroom argumentation, it helped me to learn how to argue. I thought it was bad to argue with friends. Parents and teachers don't want us to argue. But after our class argumentation, I now know it is nice to learn how to argue, how to make a claim and to give reasons* (learner YI).

- *At first I didn't know about argumentation because teacher did not teach us how to argue. But after the classroom argumentation, I now I know it and it is nice because I learn how to argue and it is something good* (learner Y 7).

- *Before classroom argumentation, I did not know how to argue because I did know argumentation. But after the class argumentation, I now know that argumentation is nice because I learn to give a reason when I say something* (learner B 21).

- *Before we argued in class, argumentation was not familiar to me. But after the class argumentation, now I know that it is to learn. We learn that you must make a claim and give reasons. It is very important* (learner R 35).

- *Argumentation did not help me before it was brought to us in class. I was not sure about it. But after learning it in class, now I learn how to argue by making claims and giving reasons about the phases of the moon* (learner Y30).

4.4.3.5 ***To express ourselves while our teacher listened to us.*** The results form FGIS found that before DAIM intervention, some of the grade 6 learners said that they were not allowed to argue [meaning that they did not get the opportunity to express themselves freely]. After DAIM intervention, they said that they discussed [expressed themselves] their ideas with each other and in groups. For example some learners said:

- *Before the argumentation in class, I knew it was bad to argue because we were not just allowed to argue with people. But after the class argumentation, we talked* [voiced or expressed] *about our ideas and also listen to groups and we learn a lot of information* (learner G23).

- *Before the classroom argumentation, I did not know argumentation very well. But after the classroom argumentation I saw that argumentation is good because when we were arguing, even the teacher was listening to us* (learner R33).

4.4.3.6 ***To learn new ideas.*** The results from the FGIS found that before DAIM intervention, some of the grade 6 learners said that argumentation did not help them to learn new ideas because they did not know it. After DAIM intervention, some of learners said that argumentation helped them to learn new ideas like listening to each other, the phase of the moon, how to make claims and to give reasons. Some of them said:

- *Before we learned it in class, argumentation did not help me to learn new ideas because I did not hear about it. But after we learned it in class, now I know it is interesting to argue together and listen to each other and we hear a lot of new stuff* (ideas) (learner B26).

- *It did not help me before because I did not hear anything about argumentation .After we argued in the science class, I now know what makes the shapes of the moon. I thought the moon was silver because it shines when you see it. But now in argumentation we learn that it is the light from the Sun and the movement of the moon. When you see it you only see part of it where the light falls* (learner R35).

- *Before we learned argumentation in class, I did not hear about what causes the phases of the moon. But after classroom argumentation, I learn something new that, it is the light from the Sun that falls on the moon and we see the lit part as the moon moves round the Earth* (learner Y30).

- *Before we argued in class, I thought it was just to argue. But from the classroom argumentation, now I learn about argumentation, how to make a claim and give reasons in what I say. It is nice* (learner B10).

4.4.4 Summary. Before DAIM was implemented in class, some of the grade 6 learners did not seem to have knowledge of it. So, their attitudes and perceptions did not come out clearly. Other learners seemed to indicate argumentation was not a good idea because it could cause various conflicts among the involved parties. Moreover, at school and at home, learners were not encouraged to involve themselves in argumentation activities. Such learners seemed to have negative attitudes and perceptions on how DAIM affected their conceptions of the causes of the phases of the moon.

However, after DAIM, learners seemed to have positive attitudes and good perceptions towards argumentation because they made more valid and well supported claims about the causes of the phases of the moon. This seemed to indicate that their positive attitudes and perceptions of DAIM helped them to have better understanding of the conceptions of the causes of the phases of the moon.

4.5 Research question 4: How were grade 6 learners' pre- and post- conceptions of the causes of the phases of the moon related to their gender, age and geographical location?

4.5.1 Introduction. The instruments that were used for data collection to address this research question were: pre-post-test (PPT), audio taped interview schedule (ATIS) and focus group interview schedule (FGIS). The results from the PPT were used to test the hypotheses to ascertain whether or not the gender, age and geographical location influenced the learners' understanding of the causes of the phases of the moon before and after participating in the DAIM classroom discourses. The data obtained provided the answers for research question 4. Before the hypotheses were tested, however, the related demographic information for the grade 6 learners were established and listed as shown in table 4.9 below.

Table 4.9: Grade 6 learner's demographic information

Demographic factors	**%**
Age	
Under 12 years old	n 12 (33%)
12 years old	n 16 (47%)
Over 12 years old	n 7 (20%)
Gender	
Male	n 17 (49%)
Female	n 18 (51%)
Geographical location	
Central Business District	n 7 (20%)
Township	n 23 (67%)
Suburb	n 5 (14%)

Key: n = number.

The demographic information is explained as follows:

Age distribution: 12 (33%) learners were below 12 years old, 16 (47%) learners were 12 years old, 7 (20%) were over 12 years old. In terms of age distribution it can be said that the most of the learners (80%) were below 12 years and only a few (7%) were above 12 years i.e. the sample was relatively homogenous.

Gender distribution; 19 (51%) of learners were girls while 17 (49%) were boys. However, one girl voluntarily pulled out of the study. Also, in terms of gender, the number of girls and boys who participated in the study was fairly close.

Distribution according to geographic location: 7 (19%) lived in Cape Town central business district (CBD), 23 (67%) resided in townships while 5 (14%) lived in suburbs**.** In other words, the majority the learners lived in the townships compared to the relatively low number who lived in the CBD and the suburbs,

Gender distribution among grade 6 learners is represented by pie chart in Figure 4.2 below.

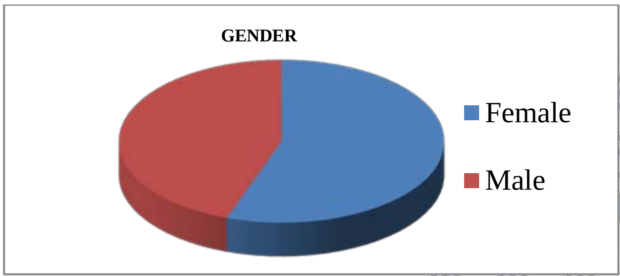


Figure 4.2: Grade 6 learners' distribution based on gender
Female 58.8%

Male 47.2%

4.5.2 The influence of Gender on learners' conceptual understanding of the causes of the phases of the moon. Comparisons of learners' pre post-test mean scores attained before and after DAIM classroom activities based on gender were made as shown in table 4:10 below.

Comparisons of learners' pre-post-test mean scores attained before and after DAIM classroom activities based on gender are as shown in table 4.10 below. As stated earlier the number of the boys and the girls who participated in the study was quite close.

Table 4.10: ANOVA Table: Grade six learners' pre-post-test mean-scores according to gender

	Gender	No	Mean	SD	t	P - level
Pre - test	Boys Girls	14 17	27.00 30.94	12.021 10.680	3.05	0.359
Post - test	Boys Girls	16 18	59.29 52.35	17.081 13.592	5.06	0.366

The main aim of this hypothesis was to ascertain whether or not statistically significant differences among grade 6 learners' mean scores existed before and after DAIM based on gender. First, a comparison was made to ascertain the gender differences in the pre-test mean scores. The independent samples t-test was carried out and it revealed that, t = - 0.934, p = 0.359 > 0.05. This indicates that, there are no statistically significant differences between the mean scores of the boys and those of the girls in the pre-test. The conclusion based on this finding is that, both boys' and girls' understanding of the concepts of the causes of the phases of the moon were similar before being exposed to DAIM. Sampson and Douglas (2013) found that both boys and girls contributed ideas during argumentation in more or less the same way. This disapproves the popular notion in the extant literature that boys generally perform better than girls in science.

Then, a comparison was also made to ascertain the gender differences in the post-test mean scores. The independent samples t-test was carried out and it revealed that, t = 1.259 and p = 0.218 > 0.05. This suggests that there are no statistically significant differences between mean scores of the boys and those of the girls at the post-test relative to their conceptions of the causes of the phases of the moon. In other words, their understandings at the pre- and post-test were similar. Grade 6 learners' age distribution is represented in Figure 4.3 below:

4.5.3 The influence of Age on learners' conceptual understanding of the causes of the phases of the moon Grade 6 learners' age distribution is represented in the pie chart on Figure 4.3 below:

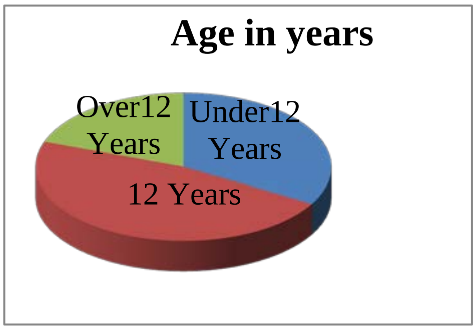


Figure 4.3: Grade six learners' distribution based on age groups.
Under 12 years old = 33%

12 years old = 47%

Over 12 years old = 20%

Table 4.11 ANOVA table: Grade six learners' Pre-test scores on account of age.

Groups	Sum of Squares	Df	Mean Square	F	P - level
Between Groups	177.826	2	88.319	0.684	0.513
Within Groups	3378.312	26	129.935		
Total	3556.138	28			

The results on the ANOVA table above indicates that F = 0.684, at p= 0.513 > 0.05. This implies that there are no statistically significant differences among grade six learners' understandings of the causes of the phases of the moon on account of age.

Second, another comparison was made to ascertain whether or not statistically significant differences existed in the post-test mean scores on the bases of age groups. Again, a one-way ANOVA was used to test this. The results are as shown in Table 4.12 below.

Table 4.12 ANOVA table: Grade six learners' understandings about the causes of the phase of the moon in terms of age

Groups	Sum of squares	Df	Mean squares	F	P - level
Between groups	141.07	2	70.538	0.283	0.76
Within groups	6976.66	28	249.17		
Total	7117.71	30			

The results displayed in 4.11 above indicate that, F = 0.283 at p = P obtained = 0.756> 0.05. This post-test result suggests that there are no statistically significant differences in the grade six learners' understanding of the phases of the moon in terms age categories.

4.5.4 The influence of Geographical location on learners' conceptual understanding of the causes of the phases of the moon. The main aim of this hypothesis was to ascertain whether or not statistically significant differences among grade six learners' mean scores existed before and after the dialogical argumentation instruction based on places of residences. The places of residences were categorized into three, which are, city, township or suburb.

Figure 4.4: below represents grade 6 learners' distribution according to their geographical location**.**

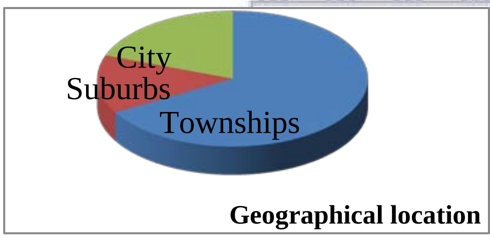


Figure 4.4: Learners' distribution on the basis of geographical location

Townships 66%

Suburbs 13%

City 19%

First, a comparison was made to ascertain whether or not statistically significant differences existed in the pre-test mean scores on the bases of places of residences. A one-way ANOVA was used to test this, and the results are presented in table 4.13 below.

Table 4.13: ANOVA table indicating grade six learners' pre-test scores based on their geographical location

Groups	Sum of Squares	Df	Mean Square	F	Sig.
Between groups	239.61	2	119.83	0,339	0.40
Within groups	3316.49	26	127.56		
Total	35556.14	28			

The results of the ANOVA table 4.13 above indicates that, F = 0.939 at p = 0.40>0.05. This result implies that there are no statistically significant differences in the pre-test mean scores of grade six learners' understanding of the causes of the phases of the moon on the basis of their geographical location. In other words before DAIM, did not have much understanding about the causes of the phases of the moon regardless of their geographical location. For example before DAIM, ATIS found that some learners, (31 %) were not able to make a claim (48%) did not give reasons, to answer the interview question which asked 'what are the causes of the phases of the moon? and give a reason for your answer' learner Y18 said *I don't know* and gave no reason.

Second, another comparison was made to ascertain whether or not statistically significant differences existed in the post-test mean scores of the learners on the basis of their geographical location. A one-way ANOVA was again used to test this, and the results are presented in Table 4.14 below.

Table 4.14: ANOVA table: on learners' post-test scores based on their geographical location

Groups	Sum of Squares	Df	Mean Squares	F	P - level
Between groups	255.24	2	127.62	0.521	0.60
Within groups	6562.50	28	245.0		
Total	7117.70	30			

The results in Table 4.14 above indicates that F = 0.52 at p = 0.60> 0.05 imply that there are no statistically significant differences in post-test mean scores of grade six learners' understanding of the causes of the phases of the moon on the basis of places of their geographical location This implies that after DAIM, grade 6 showed good signs of improved understanding of the causes if the phases of the moon regardless their geographical location. A summary of the results follows shortly.

4.5.5 Summary of Results. The differences between learners' pre and post - test mean scores are statistically insignificant in that they are higher than p = 0.05.

The overall understanding of the causes of the phases of the moon, was most probably due to influence of DAIM. Differences on the account age, gender and geographical location. were statistically insignificant. This is because the learners' mean scores in the pre-test were generally low and their claims and supporting reasons were of lower quality. Also, in some instances, the learners neither made claims nor gave reasons as far as their understanding of the causes of the phases of the moon is concerned. This happened consistently regardless of their age, gender and geographical location.

Unlike learners' means in the pre-test, their posttest means scores were much higher and they also made scientifically better claims and supported them with appropriate reasons concerning the understanding of the causes of the phases of the moon. This also seemed to happen consistently regardless of the factors already mentioned. One question that any researcher would ask him/herself is; what could have led to the learners' improved mean scores at the posttest compared to their low mean scores at the pre-test?

In trying to answer this question, a number of factors were considered normally, learners' age, gender and geographical location which remained unchanged. These variables seemed not to have been responsible for either the learners' low mean scores at the pre-test nor improved their posttest mean scores. The other factor that considered was DAIM. DAIM was implemented immediately after the pre-test and was carried out throughout the study as an intervention on which classroom activities concerning learners' understanding of the causes of the phases of the moon were based. In other words, DAIM was not part of the pre-test condition but it was part of the posttest condition. So DAIM might have been the major factor responsible for the significant difference between the learners' pre-test and posttest mean scores depicted in table 4.10. At the post-test they were able make better claims with valid reasons about their understanding of the causes of the phases of the moon that was previously the case.

In other words, DAIM may have enabled the learners to make the cognitive shifts and conversely suppressed their prior conceptions of the causes of the phases of the moon. This cognitive shift in terms of Contiguity argumentation theory (CAT) is known as emergent stage, i.e., the acquisition of a new idea about the causes of the phases of the moon. This improvement may have been as a result of learners engaging each other in argumentation during DAIM classroom activities. It is apposite to mention that DAIM provided them the necessary intellectual space to work individually, small group and large group levels. All these activities helped the learners to refine their ideas and to gradually shift from their cultural understanding to more scientific valid understanding of the causes of the phases of the moon. This finding corroborates an earlier study by Diwu (2010) who found that learners made cognitive shifts from their cultural to a more scientifically valid understanding of fermentation as a result of being exposed to DAIM

This study is also consistent with studies done by other scholars for example; Cross et.al (2008) attested to the positive effect of argumentation on conceptual understanding of phenomena. They further asserted that arguments lead to more secure understanding of pre-existing concepts and allow learners to hear new ideas that extend their existing knowledge and new ideas from peers spill over from peer to peer. Kuhn (1993) agrees that argumentation is a thinking activity that shows how learners are different and have different perceptions of a particular issue. Likewise, Von Aufschnaiter et al (2008) explained that when learners engage in argumentation they learn on how to construct new ideas on a particular subject matter.

Bennet et al. (2005) found that learners engaged in small group discussions showed improved understanding of evidences regardless of gender. Douglas and Sampson (2013) found that both boys and girls contributed ideas during argumentation in more or less the same way. In any science classroom, it is given that participants will come from different residences and from different ages. For example, the results from ATIS indicated that the participants in the current study, who were boys and girls of ages between 11 and 14 and resided in different geographical locations, were able to argue freely and fairly equally and without fear. They seemed to have had similar conceptions about the causes of the phases of the moon before and after DAIM. For example, learners Y30 and learner B21 are female and male respectively. The two had similar conceptions about the causes of the phases of the moon. Before DAIM, learner Y30 said; "*The causes of the phases of the moon was the shadows* *from the stars because the shadows from the stars fall on the moon and it looks different every time."* Learner B21 said; *"The shadow from Sun was the causes of the phases of the moon because the shadow of the Sun falls on the moon and makes it to look different."* So the two learners made similar claims about the causes of the phases of the moon.

After DAIM, learner B21 said; *"Light from the sun light on the moon and we see the lit part from the earth."* And learner Y30 said*; "The causes of the phases of the moon was the light from the Sun and the way we see the lit part of the moon from the earth."* Before DAIM, both learners had similar conceptions about the causes of the phases of the moon. They supported their conceptions with similar scientifically inconsistent reasons because their claims were not the scientifically valid causes of the phases of the moon. After DAIM, the two learners seemed to have shifted their thinking from scientifically inconsistent thinking about the causes of the phases of the moon to a more scientifically consistent claims.

Earlier studies have found DAIM or similar argumentation instruction model to be effective teaching and learning strategies in a science classroom e.g. (Erduran & Jimenez-Alexandre 2008, Maloney & Simon, 2006, Brown & Chin, 2000, Nhalevilo & Ogunniyi, 2012, Hewson and Ogunniyi, 2008, Von Aufschnaiter, 2008). Siseho (2013) found DAIM to be effective on Pre-service teachers' ability to implement a science-IK curriculum. All these studies are in support the findings of the current study, that DAIM, is an effective teaching and learning strategy for conceptual development.

Likewise, studies using DAIM or similar instructional strategies have shown consistently the effectiveness of argumentation instruction model for: 1). enhancing learners' conceptual understanding of diverse phenomena, 2). meliorating the conflicts between their science and IK in their classroom endeavours, 3). making it possible to integrate their scientific and IK understanding in the classroom and, 4). creating integrated activities to take place in class, creating a teaching and learning environment where learner enjoy sharing their ideas and proudly constructing their own knowledge, etc.

DAIM also, could help eliminate gender related learning obstacles in class because it provides learners with the opportunities to listen to each other and to learn from each other freely without fear or intimidation. DAIM could also improve learner centeredness as well as reduce learner dependence on the teacher, thus, making teaching and learning meaningful. It could promote higher learner achievement as well as contribute to the development independent learners and consequently dependable citizens.

4.6 Chapter summary

This chapter (chapter 4) presents the results and the discussion of the findings of the study. The study investigated the use of dialogical argumentation instructional model (DAIM) on grade 6 learners' understanding of the causes of the phases of the moon. The chapter presents and discusses data that were collected for the study. The results and the findings of the study provided some answers to the research questions, which was a fulfilment of the aims and objectives of the study. The next chapter deals with the conclusions, recommendations and implications of the study.

CHAPTER 5: CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS

5.1 Introduction

This chapter presents a summary of the findings followed by the discussions and finally the recommendations of the case study. This case study investigated the effects of Dialogical Argmentation Instructional Model (DAIM) on grade 6 learners' understanding of the causes of the phases of the moon. The study had 4 research questions. The reporting of the findings was done chronologically, which means that for every research question, there are two sets of findings: The findings that were gathered before DAIM classroom intervention are presented first, followed by the findings that were gathered after DAIM classroom intervention. The summary of the research findings follows shortly.

5.2 Conceptions of the causes of the phases of the moon held by grade 6 learners before and after being exposed to DAIM.

Before the DAIM classroom intervention, this study found that the grade 6 learners held conceptions about the causes of the causes of the phases of the moon. They said that the causes of the causes of the phases of the moon are: the rain, the clouds, the shadows, the seasons and others, and all these were not consistent with laws and principles of science. Learners might have picked these conceptions by interpreting the phenomenon based on their scientific and IK experiences. The traditional classroom teaching and learning strategies may have not have helped them to attain a better understanding of the phenomena so as to give a correct explanation for the causes of the causes of the phases of the moon.

Smolleck and Hershberger (2011) stated that learners' ideas differ from the scientist's science. Similar concerns have been raised by the DoE, (2011) found out that learners are usually faced with problems of explaining the phases of the moon. Trundle et al, (2002) warned that learners need to be assisted to conceptualize so as to give correct explanation of the phenomena. This could help them to perform well by scoring higher marks in their class and that could be one of the ways by which low mean scores could be avoided.

After the classroom DAIM intervention, this study found that the grade 6 learners were able to explain the causes of the causes of the phases of the moon. They made their claims and gave supporting reasons that were consistent with scientific laws and principles, citing the light form the Sun, the revolution of the moon round the Earth and the angle at which we view the lit part of the moon as the causes of the causes of the phases of the moon and thus their conceptions after DAIM. It could be argued that DAIM would have assisted this improved level of conceptualization. The employment of classroom strategies that enhance improved conceptualization among learners, such as, argumentation, has been strongly recommended by the following researchers: Kriek and Grayson (2009), Bybee (2009), Ogunniyi (2004a), Galili, Weizman & Cohen (2003), Newton, Driver and Osborne (1999) and others.

5.3 The influence of DAIM on grade 6 learners' conceptions about the causes of the phases of the moon

Before DAIM classroom intervention, this study found that the grade 6 learners attained a mean score of 30.04 in the moon achievement pre-test. Low learner performance could have been as a result of their incorrect interpretation of the phenomena based on their own experience. It could also be true that traditional instructional methods may not have helped them to overcome their conceptual challenges. Similar explanations have been given by Martin et.al (2002). In accordance with the DoE, (2011), traditional teaching and learning strategies do not assist the learner to overcome the naive science and IK conceptions which they come to class with.

After DAIM classroom interventions, this study found that the grade 6 learners scored a mean of 53.46 in the post-test. This shows that learners' performance improved from the mean 30.04 during the pre-test. The improved performance could be as a result of DAIM intervention because it was the only teaching and learning strategy that was employed in class for the entire study period. Yurd and Olgun (2008) observed that the understanding of learners improved when they were assisted to overcome their naive science and IK conceptions and adopt those that are consistent with the laws and principles of science. Dogru et al. (2008) supported that assisting learners to arrive at correct phenomenal conceptualization is the primary concern of school science. It could also be true that when learners attain improved understanding of phenomenal conceptions, then they could also attain improved classroom performance.

5.4 Grade 6 learners' perceptions and attitudes on the use of DAIM before and after their classroom teaching and learning of the causes of the phases of the moon

Before DAIM classroom intervention, this study found that the grade 6 learners had a negative perception of DAIM. They said that argumentation did not help them: to share ideas among themselves, to experience much joy during classroom activities, to express themselves freely while the teacher listened to them, to practice how to argue and moreover they did not like argumentation. They were further advised by their teachers and parents to avoid any kind of argumentation. They were warned that argumentation could lead to physical fighting. In such a situation, learners remain entangled in IK and science ideological conflicts. This was also in accordance with Coble and Koballa (1996).

After DAIM classroom intervention, this study found that argumentation seemed to have helped the grade 6 learners in a number of ways. They said that argumentation helped them as follows: to understand the concepts of the causes of the causes of the phases of the moon, to enjoy learning together and sharing ideas, to express themselves freely while the teacher listened to them, to achieve good argumentation practice by making reasonable scientific and IK claims about the causes of the causes of the phases of the moon. In accordance with Grady et al. (2010) when learners are involved in a real- world argumentation, they are likely to contribute to the understanding of the phenomena.

This means that learners could comfortably interpret the phenomena from either IK worldview or scientific worldview without one worldview conflicting the other but rather complementary to one another. This could be the reason why argumentation has been recommended as a strategy that could resolve conflicts in IK and science integrated classrooms. Lelliott (2011) found that argumentation increased interest in learners to learn more. Abell (2001) indicated that learners share ideas during argumentation activities. According to Maloney and Simon (2006), learners collaborate during classroom argumentation discourses. Chin and Brown (2000) agreed that argumentation helped learners to give more elaborate conceptual explanation.

5.5 Grade 6 learners' pre- and post-conceptions of the causes of the phases of the moon influenced by their gender, age and geographical location

Before DAIM classroom discourses, this study found that when the T–test for the pre-test scores was calculated through SPSS software, mean scores between boys and girls were: t = -0.934, p = 0.539 > 0.05. This indicated that there were no statistically significant differences between boys' and girls' mean scores in the pre-test as far as gender was concerned. After DAIM classroom activities, this study found that the T–test was as follows: t = 1.29, p = 0.218 > 0.05. This shows that there are no statistically significant differences between boys' and girls' mean scores in the post-test regarding gender.

Before DAIM classroom activities, this study found that through ANOVA, the boys' and the girls' mean scores in the pre–test regarding categories were: F = 0.684, p = 0.513 > 0.05. This indicated that there are no statistically significant differences between the boys' and the girls' mean scores in the pre-test regarding age categories. After DAIM classroom activities, this study found that when ANOVA function was performed on the post-test regarding age categories: F = 0.283, p = 0.756 >0.05. This shows that there were no statistically significant differences between the boys' and the girls' mean scores in the post-test regarding age categories.

Before DAIM classroom activities, this study found that the result of the boys' and girls' mean scores in the pre-test conducted through ANOVA regarding learners' place of residence were: F = 0.939, p = 0.404 >0.05. This indicated that there were no statistically significant differences between the boys' and the girls' mean scores in the pre-test regarding the place of residence. After DAIM classroom activities, this study found that the boys' and the girls' post-test mean scores through ANOVA regarding their place of residence were: F = 0.521, p = 0.600 > 0.05. This indicates that there are no statistically significant differences between the boys' and the girls' mean scores in the post-test regarding their place of residence.

The null hypotheses confirm that there are no statistically significant differences between the grade 6 boys' and the girls' mean scores before and after they were exposed to DAIM regarding gender, age categories and place of residence. It seems that DAIM may have created equal opportunities among the grade 6 learners to contribute to knowledge production. The grade 6 learners might have found it interesting and helpful to learn from one another rather than waiting to learn from the teacher. Similar explanations have been recorded by Douglas (2013) and Bennet et al. (2005). This may be a big advantage for DAIM over the traditional methods of science classroom teaching and learning.

5.6 Recommendations

The recommendations of this study could be utilized in 4 areas: to develop the curriculum, to form part of classroom instructional strategies, to enhance further research and to be available as a contributed existing knowledge.

5.6.1 Curriculum development. This study, therefore, recommends that the findings of this study be utilized to develop the existing curriculum at school level by the subject panels which are managed by the heads of departments and at district, provincial and national levels by the curriculum planners. This is to help in the modification of the curriculum so as to fit in the local environment where the school, the district, the province and the nation is situated. This is to cater for the consumers of the curriculum at their various locations with different opportunities of producing useful citizens. The findings emanating from the study of the causes of the phases of the moon, for example, could provide astronomic content in science. This could help in producing astronomy experts who could interpret the behaviour of the moon and other celestial bodies so as to provide reliable information about the weather and climate change and how these affect humankind. This is in line with the aims and objectives of the curriculum (DoE, 2011). Similar views have been shared by Siseho (2013), Ogunniyi (1999) and Jensen (1997).

5.6.2 Instructional purpose. It is hoped that the findings of this study could be found useful as guidelines and could be part of the topics in the pre-service and in-service training of teachers, to equip them in instructional skills for curriculum delivery in their teaching career. Ogunniyi, (2011) contends that it is only when teachers are well trained [and well guided] that they can enhance and improve learners' understanding. The findings of this study further indicated that DAIM, the newly investigated teaching and learning strategy, could be used as one of the methods to implement the integrated IK and science syllabus in the science classroom.

The DoE, (2001) recommends IK and science integrated programmes. Asmal (2000) found that the curriculum developers have not given much attention to teaching and learning methodology development. Mushayikwa and Ogunniyi (2011) hold the view that the fear of the lack of methodology in handling the dualistic worldviews [IKS and science], makes teachers reluctant in adopting the integrated curriculum. It is in this regard that this study recommends DAIM as an instruction for the delivery of integrated IK and science in classrooms. This could be part of the solution to the already mentioned fear. This study found that DAIM helped the grade 6 learners to resolve their IK and science conceptual conflicts of the causes of the phases of the moon.

5.6.3 Further research. Since this case study is of chronological structure, it is recommended that DAIM be researched further through other forms of case study design such as narrative report, comparative structure, theory-generating structure and sequenced structures. This could avail enriched resource information that could benefit curriculum and instruction planners, classroom teachers and any other parties that could try out DAIM in the teaching and learning situations.

5.7 Implications of the findings.

In the wise words of Prof. Ogunniyi: ‘As a researcher, ask yourself if you have made a contribution to the existing knowledge’ personal communication 2014 at UWC. To rise to this challenge, this study, therefore, found some emergent ideas:

Firstly, this study found that there is no literature that gave an illustrative classroom model for contiguity argumentation theory (CAT), similar to that of TAP, where learners argue individually, in small groups discussion, whole class presentations by the group leaders and whole class reflection mediation and settlement with the teacher as a co-constructor of knowledge. Such an illustration would show how human minds shift to and from one cognitive idea to another, when CAT as a unit of analysis is used to analyse classroom argumentation activities. CAT has five cognitive ideas as follows: Dominant idea, Suppressed idea, Assimilated idea, Equipollent and Emergent idea. The CAT illustrative model could guide teachers, tutors, education supervisors and others on how to handle CAT cognitive shifts in a more unified way and this could give them confidence and encouragement to use CAT in class more often. This study, therefore recommends that researchers come up with solutions to close that gap.

Secondly, the study found that learners engaged in DAIM activities may become people with higher thinking skills and more inquisitive minds. They could slowly evolve into a class of people that would not easily accept claims which are not supported with founded ground (TAP) or fast thinkers, who gauge their ideas against their colleague's (CAT) and quickly voice their conclusions. They may be more critical both at school and at home, and even at work. This study, therefore, recommends that teachers, parents, communities and prospective employers, be given awareness programmes so as to assist this unique learners as people to take over their world.

Thirdly, learners engaged in argumentation activities, may acquire a better attitude towards teamwork. This is because during classroom argumentation engagements, learners carefully listened to each other. Each learner was a new speaker, with different voice, tone and ideas and this made teaching and learning interestingly new, breaking the monotony of the teacher's voice. This is one of the differences between DAIM and the traditional teaching and learning strategies such as chalk and talk. DAIM freed learner's voices from classroom slavery of voice suppression by the teacher and the school rule that require learners to sit quietly in class at all times. This calls for more teacher preparedness such as re-training programmes learners' diverse ideas. This study recommends team teaching in all spheres of teaching and learning which could be one of the ways of handling teaching and learning in diversity.

The study further found that learner participated in the teaching and learning with great joy and enthusiasm during the DAIM classroom activities. However, the was faced with some challenges, for example; it was difficult to control the level shouting by the learners when accepting or denying another learner's idea, making the class out of control. The model was time consuming because some took much time making their claims and giving supporting reasons and answer arising questions from the their fellow listeners who, interrogated them. Therefore, a 40 minute lesson was not enough time for a DAIM lesson. The teacher had to limit learners' speaking time so as to allow the next learner to make their claims. Limiting a learner's participatory time was not fair although that was the only fair way to reach everybody.

The interestingly, study found that DAIM activities encouraged the learners to do more research from the internet, libraries, families and communities so that they could equip themselves fully with new claim and supporting evidences, ready for the next class. So learners who, unfortunately did not have uncles, grandparents or older family members, befriended and accompanied those who were blessed with resource persons and internet facilities so as to get first-hand information, in readiness for the next classroom argumentation lesson. This improved the spirit of Ubuntu among the learners and their communities and this could in turn raise the standard of education.

These are some of the new insights from the findings of the study, which are a contribution to the existing knowledge.

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APPENDICES

APPENDIX A: Training manual for the assessor

In readiness for the researcher to be assessed, the researcher has to ensure that the assessor is: well trained to meet the expectations of the intended assessment.

The following training manual was used to train the assessor.

1. The assessor should enter into the assessment classroom before the researcher enters in order to make a fair judgment from the very start. He / She sit at a designated place at the back of the room.

2. The assessor should use special forms to assess as follows:

a) If the researcher greeted and welcomed the subjects.

b) If the researcher called out the roll call and then introduced the topic by clearly spelling out the objectives of the study of the day.

c) If the researcher moved the lesson from known to unknown.

d) If the researcher used appropriate resources and methods.

e) If the researcher's language and vocabulary was to the level of the subjects.

f) If the activities were involving i:e individually, in groups and whole class discussion.

h) If the researcher had whole class to reflect on and confirm what was learned.

g) If there were indications of the subjects showed indication of having one change in as far as the essence of learning Science/IKS is concerned, i.e. developing the Attitudes, Skills and Knowledge is concerned.

3. The assessor will give an holistic view as to whether the intended Objectives were achieved by the end of the lesson.

APPENDIX B: Assessment form (Internal assessor)

Did the facilitator clearly state the objectives of the lesson?

____

____

____

_______________Did the facilitator have enough resources?

____

____

____

________________Did the facilitator have good mastery of content?

____

____

____

____

Did learners enjoy the lesson?

____

____

____

________________Did learners learn from each other?

____

____

____

____

General comments.

Signature_____________________ Date of Assessment___________________

APPENDIX C: Scheme of work for grade 6 science

UNIT 7	LOP A_5		ASSESSMENT TYPE	ASSESS ACTIVITY	ASSESSMENT TOOL
Earth's Travelling Companion LB PP 66-67	L01 L01 L02 L01	AS_2 AS_3 AS_1 AS_3	Individual observation, group observation, Whole Class observation and Test.	Writing, drawing, construction, singing, reciting, painting and presentations	Assessment questionnaire, observation schedule, and Test.

APPENDIX D: Lesson Plan

Lesson plan **Date:**

Class

TOPIC:

OBJECTIVES: By the end of the lesson, the learner should be able to:

Attitudes

Skill

Knowledge

RESOURCES:

ROLL:

TIME:

LESSON DEVELOPMENT

STEP I: INTRODUCTION

STEP II: COLLARATING THE LESSON TO PREVIOUS ONE(S)

STEP III: LEARNER'S ACTIVITY

Individual activity

Group activity

Whole class activity. Groups reporting their findings.

STEP IV: CONCLUSION

The facilitator summarises the lesson learners reflect on their finding.

STEP V: SUMMARY WRITING

The facilitator and learners build the summary notes, which will be recorded by learners.

COMMENTS

APPENDIX E: Lesson observation schedule

This schedule will be used by the research in class at the time of activity.

Type of activity: ____

Learning outcome: ____

Do learners understand the task? YES ☐ NO ☐

Are learners actively involved in the task? YES ☐ NO ☐

Do learners co-operate and help each other? YES ☐ NO ☐

Do learners follow the instruction concerning the activity? YES ☐ NO ☐

Do learners have the required materials/information? YES ☐ NO ☐

Are the objectives of the task clear? YES ☐ NO

Do learners enjoy the activity and if not, what seem to be the problem? ____
____
____
____

How will learners be assisted if the above problem needs to be evaded?

____
____
____
____
____

General comments.

APPENDIX F: Concepts of the causes of the phases of the moon

Most people who have looked up in the sky and seen the moon notice that it does not always have the same shape. Scientists say that the moon has different phases. Many adults however cannot explain why the moon has different phases. The following are some ideas which have been suggested to explain why the moon has different phases.

Read the explanations carefully and discuss them in your group.

Choose the best explanation and give your reasons why you decided this was the best.

Then try to give reasons why you think the other explanations are not so good or are wrong.

A The moon spins around so that the half of the moon that gives out light is not always facing us

B The moon shrinks and then gets bigger during each month

C The rest of the moon is blocked out by clouds

D We cannot always see all the part of the moon which is lit up by the Sun

E The moon moves in and out of the Earth's shadow and so light from the Sun cannot always reach the moon.

APPENDIX G: Pre-post achievement test for grade 6 learners on the phases of the moon (PPTQ)

All the information collected will be used for the purpose of the research only and it will be treated with strict confidentiality.

No____

GENDER____

DATE ____

Place of stay_____________________________________

INSTRUCTIONS:

Answer all the questions

Read carefully and understand the question before you answer. Circle the letter with correct answer.

1. What is the colour of the sky?

a) Yellow b) Green c)Blue d) Black

How did you learn it?____

____

2. Where is the sky?

a) Down in the soil

b) Up above our heads

c) In the water

d) It cannot be seen. Why do you say so?
____

3. When you look up at the sky in the early hours of evening, what do you see? You can circle more than one answer.

a. The moon b. Stars c. Clouds d. Planets

Where did you get that information?______________________________________

4. What is the shape of the moon?

a) Round

b) Square

c) It appears in many shapes

d)Rectangular

Why do you say so?____

____

5. Which direction does the moon travel?

From West to East

From North to South

From East to South

From down up

How do you know?____

____

6. What causes the moon to have a different shape every time?

Clouds

Light from the Sun

It enters into a bag

Shadows from planets

Shadow from the Sun

How did you learn that?____

____

7. We cannot see the new moon from the Earth because

The moon is completely covered by the shadow from the Sun

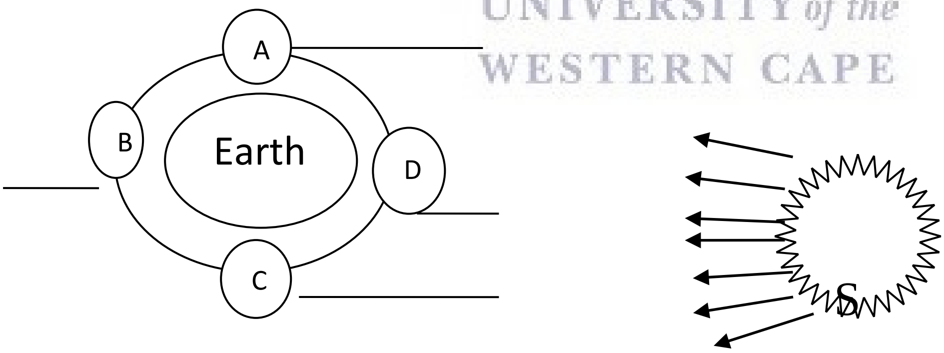
The is completely covered by the shadow from the Earth

The moon hides behind the Sun

the moon is between the Earth and the Sun

What are the reasons for your answer? ____

8. What are the names of the shapes of the moon indicated by the letters A, B, C and D in the figure below ?



Give reasons for you answer:

A____

—

B____

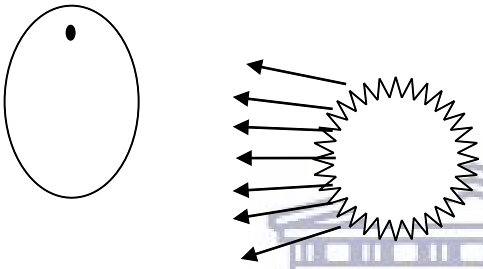
—

C____

—

D____

–

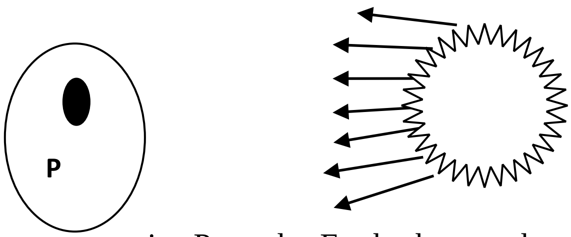


9 .If you are at point X on the Earth above, which shape of the moon will you see in the evening

(i) (ii) (iii) (iv)

What is the reason for your answer___________________________________

____



10. If you are at point P on the Earth above, what shape of the moon will you see in the evening?

(a) (b) (c) (d)

Give reasons for your answer____

11. How does the moon help the Muslim people?

(a) To mark the start and end of Ramadan

(b) They worship the moon

(c) They don’t use the moon

(d) I don’t know

12. We will never see the moon during daytime. True or False

Because____

____

13. The moon has its own light. True or False

Because____

14. The moon appears in the east at the same time every day. True or False

How did you learn that____

____

15. The first quarter moon and the third quarter moon are all half-moon. True or False

This is because____

16. About how many days does the moon take to travel round the Earth

a) 1 and 30 b) 15 to 20 c) 28 to 30 d) 365

How did you learn that.____

____

17. What is the difference between the New moon and the full moon?

a) We see the full moon in the East and the new moon in the West

b) We see the new moon while we don't see the full moon.

C) We don't see the new moon while we see the full moon in the East at early evening hours.

d) The new moon is also called the full moon.

Because____

APPENDIX H: Argumentation activity (Individually)

Draw the following phases of the moon: In each case, give a reason for your answer.

PHASE OF THE MOON SHAPE OF THE PHASE

1. Waxing crescent moon

The reason for my answer is…

2. First quarter moon

The reason for my answer is…

3. Waxing gibbous moon

I say so because…

4. Full moon

My reason for this is…

5. Waving gibbous moon

I think so because…

6. Third quarter moon

My reason for this is…

7. Waving crescent moon

This is so because..

8. New moon

My reason for this is…

APPENDIX I & J: Guide to class activity

In class the learner is guided on how to get involved in an argument

ACTIVITY: ____

BASED ON INDIVIDUALUNDERSTANDING, GROUP DISCUSSION AND WHOLE CLASS PRESENTATION.

STEP 1: In each activity, Give/Say what you know about the idea to be discussed

STEP 2: What information do you have about the idea that enables you to think that way?

STEP 3: How do you know that the information you have about the idea is true and

correct?

STEP 4: Do you get the information from School, Teacher, TV, Newspaper, Book etc.?

Say where you got the information.

STEP 5: You need to know that others can refuse what you say and also show how you are wrong and he/she is right – Counter Argument

ANOTHER WAY TO ARGUE

THE WAY TO DO IT

IDEA 1: If someone says something an idea that is true and unquestionable you don't have to spend time to argue against. You need to accept it and move forward. Give your support.

IDEA 2: Some may say something/an idea when he/she did not have reason why he/she think that way. He/she cannot support the idea. Then another person shows him/her that things don't work that way. The originator of the idea ends up putting it aside and supports the second person

IDEA 3: If someone comes with something a new idea/information which no one knows about, he can explain it and give information about it while no one dispute it.

IDEA 4: Sometimes one keeps the old and the new ideas each with enough support information. You need to accept them as they are

IDEA 5: One doesn't want to give up the old idea even in it is wrong. ASSIMILLATED

Field observation schedule

Observation of the moon

While you perform this activity, ensure that you are safe and secure.

You should be accompanied by your parent or guardian every time you want to perform this activity at home in the late afternoon/evening.

Spend sometimes outside in the early hours of the evening, to watch the moon and fill in this tables below.

No______________________________________

Gender____________________________________

Age______________________________________

The area I stay is____________________________

JULY 2011

Date	time	The shape of the moon I saw	Where I saw it
Example	19:00	☾	West
09/03/2011			
Use this space .			

APPENDIX K: Argumentation (CAT)

What happens if one learner brings a good idea more than the other learners? (Dominant)

____

____Example____________

____

____

____

What happens when a learner comes up with an idea similar to what the class has already discussed? (Assimilated; Suppressed)

____

____Example____________

____

____

_____

What happens when two learners bring up similar ideas to class? (Equivalent)

____

____Example____________

____

____

_____

What happens if the ides is new to the class from a learner? (Emerging)

____

____Example____________

____

APPENDIX L: Group interview schedule (a)

In each case, give a reason for your answer.

Did you enjoy the argumentation?

Did you learn something new?

Would you like to argue more in science and other subjects in future?

Who talks more in the argumentation? (The teacher or the learner?)

How much do you think you learned through argumentation?

a) 10%

b) 40%

c) 60%

d) 80%

APPENDIX M: Group interview schedule (b)

All the information collected will be used for the purpose of the research only. The information obtained will be treated with strict confidentiality. Therefore answer all questions honestly and confidently without fear.

No. ____________________________________

GENDER________________________________

AGE____________________________________

Place of stay_____________________________

Answer all the questions by indicating the correct answer clearly.

1. Did you learn new ideas on Science/IKS during and after the argumentation in class?

Explain your answer____

____

2. How did argumentation help you to understand the changing phases of the Moon

SPECIFICALLY? How____

____

3. How do you start , carry on and end argumentation on Science/IKS in class?__________

____.

4. Who talked more during the Science/IK class argumentation, the Teacher or learners?

Explain your answer____

____

5. How much did you understand Science/IK after argumentation?____________________

a) very much b) Very little c) Nothing at all d) No comment

APPENDIX N: Post argumentation interview schedule

WHOLE CLASS

ATTITUDE TOWARDS SCIENCE/IKS

Answer the following questions:

Did you enjoy learning science/IKS by argumentation?

Yes / No

Did you learn new ideas about the moon from other learners?

Yes / No

How did argumentation help you to understand the phases of the moon?

Write what you enjoyed or liked most during the study.

5. Write what you did not like during the study

APPENDIX O. Group interview results (What learners said in each group)

YOUR UNDERSTANDING BEFORE THE STUDY		YOUR UNDERSTANDING AFTER THE STUDY	
QUESTION 1.	DOES THE MOON HAVE ITS OWN LIGHT? WHY DO YOU SAY SO?		
GROUP	GREEN		
CLAIMS (before the study)	REASONS (before the study)	CLAIMS (After the study)	REASONS (after the study)
G2 Yes	Because it can shine	No	The Sun shines on it and it shines on us.
G4 Yes	Because we can see it	No	I now know that the Sun shines on it.
G11 Yes	Because anyone can see it at night.	No	It gets from the Sun.
G17 No	It is just like that. No reason.	No	It gets it from the Sun.
G23 Yes	Because it is bright.	No	It gets from the Sun.
G29 Yes	Because my mother said it does have and in her village there was	No	Because we argued in class that it gets the light from the Sun and

	no electricity and they used the light of the Moon		it reflects it to the Earth.
GROUP	YELLOW		
CLAIMS	REASONS		
Y1 Yes	Because we sometimes see it.	No	Because we learned in argumentation that it gets it from the Sun.
Y7 Yes	Because it gets from the Sun	No	The Sun lights on it.
Y15 Yes	Because many people see it	No	It gets the light from the Sun.
Y19 Yes	It has its own light only at night. We see it every night	No	Because the light from the Sun. reflects on the Moon to the Earth
Y25 Yes	Because I thought the Moon was Silver	Not at all	The Sun lights on it.
Y30 It has	Because we can see the light.	It doesn't	It is the Sun that lights on it.
Y18 It has its light	Because it shine at night	Not	It is the Suns light that is on it
GROUP	BLUE		
CLAIMS	REASONS		

B3 It has light	Because when the Sun goes and it is night the Moon gives us light,	I doesn't have light	It is the Sun that lights it up
B10 Yes it has.	Because it its own life.	No it doesn't.	Because the light from the Sun fall on it.
B14 It doesn't have	It gets its light from the Stars and the Planets I thought.	No it doesn't have	Because we learned in argumentation that it gets its light from the Sun.
B21 No	But I do not have a reason	No	It does get its light from the Sun.
B26 Yes it has	Because it is a satellite and so it lights through the Earth	It has no light	Because I naive learned about it in Science argumentation that the Sun lights on it then we see it.
B32 It has its own light	I don't have a reason	It doesn't have its light	We learn that it gets it from the Sun.
B36 Yes it does have	Because many people say so	No it doesn't	Because that is what we learned in argumentation that it gets it from the Sun.
B25 I don't	No reason	No it has no light	The light in it comes from the Sun.

know			
GROUP	RED		
CLAIMS	REASONS		
R5 Yes it is having.	Because that is what I know	No it doesn't have	Because we learned in class that it is the Sun's light that is on the Moon.
R9 I say yes	But I didn't have the reason	No	It gets from the Sun.
R16 Yes	I don't have a reason	Yes	Because…(No reason given)
R22 It has its light	I don't know why	No	Because we were taught that the Sun shines on it.
R28 Yes it has	Because it gets it from the stars	Yes it has Its light	Because that it is what we know.
R33 Yes	No reason given	No light	No reason given
R35 It doesn't have	Because they told us so in the Museum with my parents before we argue	It does not have its light.	Because we learned the same thing in Science argumentation that it reflects from the Sun.
QUESTION	DOES THE MOON MOVE?		

2.	WHAT IS THE REASON FOR YOUR ANSWER?		
GROUP	GREEN		
CLAIMS	REASONS		
G2 No claim	No reason	It moves	From West to East though the Earth
G4 Yes it moves	It is turning and moving	Yes it moves	Because we see different shades As it rotates and revolves
G11 No claim	No reason	Yes	Because in argumentation we Talked about rotation and revolution
G17 No claim	No reason	Yes it moves	Because it is in a different Position every day
G23 No claim	No reason	No answer	No reason
G29 No claim	I don't know	Yes it moves	Because it goes round the Earth in revolution in one month
GROUP	YELLOW		

CLAIMS	REASONS		
Y1 Yes it moves	It moves round	Yes it moves	It has revolution and rotation round the Earth.
Y11 No claim	No reason	Yes it does move	That is why we have one month.
Y17 No claim	No reason	It moves	Round the Earth because we have 30 days in a month
Y23 No claim	No reason	It changes the position	We don't see it on the same place always.
Y29 I don't know	I did not see it move	Yes it moves	It moves round the Earth every month of the calendar.
GROUP	BLUE		
CLAIMS	REASONS		
B3 I didn't know	I did not learn it anywhere	It moves around the Earth	It is called revolution It changes the position every time for one month
B10 I don't	Because I did not hear	It rotates and	Sometimes it comes earl and

have the answer	about it	revolves round the Earth	other time it is late. Every month it goes round the Earth once
B14 No answer	No reason	No answer	No reason
B21 I didn't know	We did not study about it	Yes it moves	It moves round the Earth in one revolution in one month
B26 I didn't Know.	They didn't teach me	Yes it moves	That is why we have one month Because it rotates and revolves round the Earth.
B32 Yes it moves	It moves like the Sun	Yes does	It moves round the Earth it
B36 No answer	No reason	Yes it moves	I hear about it in class
GROUP	RED		
CLAIMS	REASONS		
R5 Yes I think it	I do don't know the reason	Yes it moves	We learned about those movements that it revolves around the Earth

turns round			
R9 No claim	No reason	It moves	Every time we see it in a different place East West.
R16 No claim	No reason	Yes it moves	Because we argued in class that it goes round the Earth once in month.
R22 I don't know	I don't know	Yes it moves	It moves round the Earth and that is why we see many phases.
R28 Yes it moves	I think it was pushed by the Sun and wind	Yes it does move	It is moving round the Earth. We study about the Revolution of the Moon round the Earth.
R33 No claim	I didn't hear about the movement of Moon	Yes we learn about it	Because it moves from the West to the East in one month round the world.
QUESTION 3.	WHAT CAUSES THE PHASES OF THE MOON? WHY DO YOU SAY SO?		
GROUP	GREEN		
CLAIMS	REASONS		

G2 No claim	I don't know	The Sun's light and the movement of the Moon.	Because we did learn so I argumentation
G4 Day and night	Because I did not hear about it	I don't know	No reason
G11 I didn't Know the phases	No reason	The Sun lights on it.	Because we studied like that in science Argumentation
G17 The shadow of the Earth	No reason	The light from the Sun	Because we saw it in the pictures in Science in our group
G23 The Rain	We don't see the Moon when it is raining. We see it when there is no rain and it looks different	The Sun's light	When there is revolution, the Sun shines on it and we the small part.
G29 I don't know	No reason	The light of the Sun	Because we did see the pictures in Argumentation class.

GROUP	YELLOW		
CLAIMS	REASONS		
Y1 Day and night	Sometimes it is big the evening And sometimes it is small. I don't know why.	The light of the Sun	The Sun shines on the Moon and when we look we see the lit part.
Y30 The shadow of the Stars	The shadow of the Stars falls on it and it looks different every time	The light of the Sun and the way you see it.	Because the Sun lights it when it rotates we see the part with light from the Earth.
Y18 The Sun and the Earth	I don't know	No claim	No reason
Y7 The shadow of the Planets	The Planets cover it and we don't see it sometimes	The light of the Sun	The lit part of the Moon can be seen from the Earth depending the time of the Month
Y15 The shadows	No reason	The Sun and the moving round of	Because in the argumentation I saw how it happens. The light of the Sun lights the Moon and then we see it from the Earth.

		the Moon.	
Y19 I didn't know	No reason	No claim	No reason
Y25 I didn't know	No reason	The light of the Sun	The Phases appear when the light of the Sun falls on the Moon. As it goes round the Earth it appears small or big
GROUP	BLUE		
CLAIMS	REASONS		
B3 Days and nights	No reason.	Days and nights	No reason
B10 It changes during the month	Because it is different every time I see it	It changes during the course of the month	Because its shape changes every time I see it
B14 I don't know	No reason	No claim	No reason
B21 The	The shadow of Sun fall on the	The light	The part of the Moon with light

shadow of the Sun	Moon and it changes the shape	of the Sun lights the Moon.	is what we see from the Earth and we saw it in Argumentation class.
B26 The clouds help it to change the shapes.	Clouds cover the Moon and the make it to look different.	The shadows	No reason.
B32 I didn't know	No reason.	The Sun, The Earth and the rotation of the Moon	The Sun shines on the Moon as it goes round the Earth and we see different shapes
B36 I didn't know	No reason.	The rotation of the Moon round the Earth and the Sun	During the rotation the Moon receives the light from the Sun and we are able to see the small parts and big parts.
GROUP	RED		
CLAIMS	REASONS		
R5 I don't know	Because I did not read about it	The light of the Sun and the Rotation	We saw it in argumentation but I forgot

		of the Moon	
R9 The Earth causes the phases of the Moon	Because when it goes round the Earth, the shadow of Earth falls on the Moon.	The Sun lights the Moon and that is what we see	Because that is what we learned in science this term
R16 Seasons	Because there are no moons in winter, only in Summer. In January it is small and in December it is big.	The light of the Sun	No reason
R22 They are caused by the Earth	The shadow of the Earth covers the Moon because one part is white and another part is black	The light of the sun and the movement of the moon.	Because the part of the Moon that facing the Sun receives the light and we see it from here.
R28 The Moon changed itself in different phases	Because it is different every time, it changes itself.	The shadow of the Sun causes the phases of the Moon.	Because they are always together.

R33 The shadow of the Sun	No reason	I don't know	No reason
R35 I thought the Moon was Silver.	Because Silver shines when you look at it.	The light of the Sun	Because the Sun shines on the Moon during its Rotation and Revolution round the Earth.
QUESTION 4	WHAT ARE THE PHASES OF THE MOON CALLED? HOW DO YOU KNOW THEM?		
GROUP	GREEN		
Claims before the study	Reasons before the study	Claims after the study	Reasons after the study.
G2 I don't know	Because I did not hear about it.	New Moon, Half Moon, Full Moon. Forgotten.	Because we studied them during argumentation Science lesson.

G4 I don't know	I did not study it yet.	Full Moon, New Moon, Waxing Crescent Moon, 1st quarter Moon, 3rd quarter Moon, Waxing Gibbous Moon Waning Gibbous Moon	We studied them in Science argumentation activity.
G11 I don't know	No reason	New Moon, Full Moon, Half Moon, Quarter Moon.	I heard them in the argumentation class.
G17 I don't know them	I didn't hear it.	Waxing Gibbous Moon, Waning Gibbous Moon, 1st quarter Moon, 3rdquarter Moon, Full Moon, New Moon, Waxing Crescent Moon, Waning Crescent Moon.	Because we did learn them in Science when we Argued and listened to each other.
G23 Sun	No reason	Earth	No reason
G29 I didn't know	No reason	New Moon, 1st quarter Moon, Waxing Crescent Moon, Waxing Gibbous Moon, Full Moon, 3rd quarter Moon, Waning Crescent Moon,	Because we learned them in argumentation science class.

		Waning Gibbous Moon.	
GROUP	YELLOW		
Y1 I don't know	No reason	Full Moon, New Moon, Waxing Crescent Moon, 1^{st} quarter Moon, 3^{rd} quarter Moon, Waxing Gibbous Moon, I have forgotten Others	Because we learn them in Science this term.
Y7 I don't know	They didn't teach us.	New Moon, Full Moon, Waning Crescent Moon, Waxing crescent Moon, Waxing Gibbous Moon, Waning Gibbous Moon	We study them in Science
Y15 I don't know	No reason	Half Moon, 3^{rd} quarter Moon, Full Moon, Waxing Crescent Moon, New Moon, Waning Crescent Moon.	When we argued, we learned them.
Y19 I don't know	No one told me about them	Full Moon, Half Moon, New Moon, 1^{st} quarter Moon, 3^{rd} quarter Moon, Waxing Gibbous Moon, Waning Gibbous Moon,	We study all of them when we argue in Science.

		Waning Crescent Moon, Waxing Crescent Moon.	
Y25 I don't know them	I didn't learn them	Waxing Crescent Moon, 1st quarter Moon, Waning Crescent Moon, New Moon, 3rd quarter Moon. Full Moon.	We study them from pictures and argumentation in Science.
Y30 Full Moon, Half Moon.	I studied them and I looked at the Moon.	Waxing Gibbous Moon, Half Moon, Full Moon, Waning Gibbous Moon, Waxing Crescent Moon, Waning Crescent Moon.	We learn them in Science class.
Y18 Full Moon and New Moon.	My brother told me.	Crescent Moon, Banana Moon, Full Moon. New Moon.	My friends told me.
GROUP	BLUE		
B3 Half Moon, 1st quarter, Whole Full Moon.	I heard from my friends.	Waxing Crescent Moon, Waning Crescent Moon, New Moon, 3rd quarter Moon.	We learn them in Science group
B10 Full	I saw them in a book in the	New Moon, Full Moon,	We did learn all

Moon, New Moon	Library.	1st quarter Moon, Waxing Crescent Moon, Waning Crescent Moon, Waxing Gibbous Moon, Waning Gibbous Moon, 3rd quarter Moon.	of the in Phases of the Moon argumentation lessons.
B14 Half Moon.	I saw it in the sky	Crescent Moon, Full Moon.	My science group told me.
B21 I didn't study them	No reason	Full Moon, 1st quarter Moon, Waxing Crescent Moon, 3rd quarter Moon, New Moon, Waxing Gibbous Moon.	I know them from the Science class we had recently.
B26 Full Moon, Half Moon.	I learn them at Home	Half Moon, Waxing Crescent Moon, 1stquarter Moon, Waning Crescent Moon, Full Moon, New Moon, 3rd quarter Moon.	We learn them in the Science argumentation class.
B32 I didn't learn them	No reason	1st quarter Moon, Full Moon, New Moon, Waxing Crescent Moon.	I heard them during the Science lesson.
B36 I don't	I did not hear about them	Full Moon, New Moon, Waxing Crescent	I hear them from the Teacher and friends in

know.		Moon, 1st Quarter Moon. I forgot others.	Science class.
GROUP	RED		
R5 I don't know	We were not taught	Full Moon, Waxing Crescent Moon,1Stquarter Moon, 3rd quarter Moon, Waning Gibbous Moon, Waning Crescent Moon.	Because we study everything in Science argumentation lessons.
R9 I didn't learn .	Because I have never learned them anywhere.	Full Moon. Crescent Moon, Half Moon, New Moon, Waxing Crescent Moon, last quarter Moon, 1st quarter Moon.	No reason
R16 I don't know	No reason	I don't know.	No reason.
R22 I don't know.	No reason	Full Moon. New Moon, Half Moon, Quarter Moon, Waxing Moon.	Because we discussed some of them with the teacher in our

			class.
R28 I don't know them	They did not teach us	New Moon, Gibbous Crescent Moon, Waxing Crescent Moon, 1st quarter Moon, Full Moon, 3rd quarter Moon. I don't remember others.	
R33 I don't know	I don't know them.	New Moon, 1st quarter Moon, Waxing Moon, Waning Moon, Full Moon, 3rd quarter Moon, waxing Gibbous Moon Waning Gibbous Moon.	I listen to them when we argue with the teacher and my friends in the science lessons.
QUESTION 5	HOW DO PEOPLE IN YOUR AREA MAKE USE OF THE MOON? WHY DO YOU SAY SO?		
Claims before the study	Reasons before the study	Claims after the study	Reasons after the study
GROUP	GREEN		
G2 I don't know	I have never seen them	I don't know	I didn't see them.
G4 I don't know	I did not see it happening	I don't know	I did not see it happening.

G11 No claim	No reason	No claim	No reason
G17 No claim	No reason	No claim	No reason.
G23 For light	For the light in the rural area.	For light	It lights the night because I saw that there is no electricity in the rural homes.
G29 To see outside at night	If you outside till late, the moonlight can help you to see each other.	It gives the light at night	Because we use its light to see when we have late functions or playing.
GROUP	YELLOW		
Y1 No claim	No reason	No claim	No reason
Y7 The Muslim people cite it so that they can mark Ramadan.	Because I have seen them when they don't eat.	The Moon helps the people to fish	My friend's uncle told us how they fish at night.
Y15 We cite Moon	Because we do that in	We must cite another small Moon to stop us	We do that every

to start fasting	our culture.	from fasting	year.
Y19 No claim	No reason	No claim	No reason
Y25 For Ramadan and fasting.	Because I have seen it happening.	To recite and start Ramadan	I do see the people of Ramadan doing that.
Y30 They don't use it	I didn't see how they use it.	They didn't use the Moon	Because I don't see them using it.
Y18 To recite the Moon during IDI.	My friend told me so.	I don't know what they do.	My friends told me that they recite
GROUP	BLUE		
B3 The Muslims use it.	Because they cite it for prayer.	It is the Muslims who use the Moon for prayer	Because they use it to mark the start and the end of Ramadan
B10 So we know when fasting ends	Because if they don't cite the Moon, the fasting will continue for another day or two.	The Muslim people use it a lot.	Because the Moon helps them to start and end fasting period.
B14 I don't know	I did not see it.	I didn't see anything	I did not see

			anybody using the Moon.
B21 I don't know	Because I did not see how they use it	To know the month they plant food in the yard	I was told by my friends.
B26 To enjoy	Because when there is the Moonlight outside, it looks beautiful	People use it a lot	Because People go fishing at night People sit outside to listen to stories about Moonlighting.
B32 It will show you the time.	Because if there is Moonlight, you will know that it is late	To make people careful	Because if it is and you see the Moon, you should be careful not to be robbed. Other people must close the doors.
B36 To light in the night	If there is no light, you can see your way home if the Moon is bright	People use the Moon to write stories and Poems	Because I have read stories and Poems about the Moon.
GROUP	RED		
R5 I don't know.	No reason.	No claim	No reason

R9 No claim.	No reason	No claim	No reason
R16 No claim.	No reason	No claim	No reason
R22 I did not hear someone using the Moon.	Because I did not see	I don't know.	I didn't see them using the Moon.
R28 We did not use the Moon for anything	I have never seen anybody using the moon for	They use it for light and for telling time.	Because if you see the Moon, then you will know it is late.
R33 It is beautiful to look at	Because people watch The Moon in the evening	Sometimes if we like, we can sit outside until the Moon come and we see it	Because it is nice to see the Moon.
R35 They use it for lighting if the street light is not there and for Muslim fasting	Because I have seen it myself	The ancient people use it for hunting	Because the animal are walking at night and they can kill them and eat them.
QUESTION 6	HOW IS ARGUMENTATION IMPORTANT? GIVE		

	REASONS FOR YOU ANSWER.		
GROUP	GREEN		
Claims before the study	Reasons before the study	Claims after the study	Reasons after the study.
G2 I did not know it	We did not argue before	It is important	Because we learn from each other.
G4 I knew it was to fight	Because we were not allowed to argue and fighting.	I now know it is to learn	Because we used it in the science class and we enjoyed to learn.
G11 -----------	-----------	----------	--------
G17 -----------	-----------	----------	--------
G23 It is bad	You cannot argue with big because it is allowed.	It is great	Because we talk our ideas and also listen to group and we learn a lot of information
G29 I didn't hear it before.	Because at home and at school we are told not to argue.	It is very nice	Because if you have a claim you must have a

			reason.
GROUP	YELLOW		
Y1 I thought it was bad to argue with friends.	Because the parents and teachers don't want us to argue.	I now know it is to learn.	Because it is to learn and make a claim and give a reason.
Y7 I did not know about it.	Because the teacher did not tell us to argue	I know about it and it is nice for me.	Because I learn something new
Y15 It did not quite understand it	Because I did not hear about it.	It is interesting and enjoyable	Because you hear the news from your friends and you learn from their claims and reasons
Y19 I didn't know about it.	Because we did not argue before	It is very helpful	It helped me to learn the Phases of the Moon with my friends.
Y25 I knew it was bad to argue	I was it was rude to argue with people	I can see it is nice	Because I learn a lot about the Moon.
Y30 It was bad	Because I did not know how to make claim and	It is a good one	Because I learn how to make

	give reasons		claims and give reasons.
Y18 I never knew it was so good and easy.	Because I didn't see tit anywhere	It is not difficult anymore	Because we used the science and we enjoyed learning a lot of new stuff about the Moon.
GROUP	BLUE		
B3 I did not like it.	I knew it was complicated	It is nice and not complicated	Because we used in class to learn Moon and it was nice.
B10 I thought it was just to argue.	Because I don't like to be rude.	It was good to argue to make a claim and give or ground.	Because we learned the ideas from the other people.
B14 ---------	----------	-----------	---------
B21 No claim	No reason	It is important	Because you must give a reason for what you always say.
B26 I didn't know	Because I did not hear	I now know it and it is	Because we

much about argumentation	about it before	important.	know many things through argumentation.
B32 It was nice at all	Because , before, there a lot of wrong answers from learners	It helps us to learn better	Because we got most of the answers right.
B36 I didn't know argumentation	Because we did not argue before in class and we are told to be quiet.	It is important	Because we argue together and get more information
GROUP	RED		
R5 I thought it was just to argue in a rude way	Because we did not know how to make the claims and give reasons	I now understand it and it is to learn from others	Because we make the claims and give reasons but we learn more from one another.
R35 It was not familiar.	Because it is new to me	It is important and it helps us.	Because you must have grounds when you make a claim and this helps us to learn many things.
R9 ----------	-----------	-----------	----------

R16 I did not know it	No reason	It is to study	It helps us to study and to know many thing about the Moon and we enjoyed it.
R22 I knew it as a bad thing for children.	We were always told not to do argumentation with big people and even friends because we can end up fighting.	It is important and very nice	Because it is to study. We make claims and give reasons. We are happy to hear good information from the others in the group.
R28 I fear it	Because if people start an argument, they fight and get arrested.	It is a very good thing to do in class.	Because you make a claim and give the reasons. It is interesting.
R33 I did not know it very well.	Because everyone told me that it was bad to make an argument with someone else.	It good in class	Because if you make a claim, you must give a reason. We are happy to hear many claims and many reasons and we enjoy. Even the teacher was listening to

			us.
QUESTION 7	HOW DID RGUMENTATION HELP YOU TO UNDERSTAND THE PHASES OF THE MOON? WHAT IS THE REASON FOR YOUR ANSWER?		
Claims before the study	Reasons before the Study.	Claims after the study	Reasons after the study.
GROUP	GREEN		
G2 It did not help me before.	Because I did not hear about it.	It helped to learn	Because I learned much about the phases of the Moon.
G4 I did not learn anything from it.	Because I did not know it.	I learn something new	I did not know the phases of the Moon but now I know them
G11 ---------	----------	----------	---------

G17 It did not help me at all.	Because we did not know it.	I learn much.	How to make a claim and give reasons and also I learned the phases of the Moon.
G23 I did not know it was a good idea.	Because I did not know it.	It help us much	Because we were able to learn much about the phases of the Moon.
G29 It did not help me	It did not hear about it.	It helped us much	Because we learned a lot of stuff from each other about the phases of the Moon.
GROUP	YELLOW		
Y1 It did not help me.	I did not know about it.	It helped me to know more..	Because I learned many phases of the Moon.
Y7 It did not help me.	Because I did not hear about it.	It helped me a lot	Because I now the phases of the Moon and

			I know how to make a claim and give reasons
Y15 It did not help me	I did not know anything about it.	It helped me to learn.	Because it was interesting and enjoyable to learn the Moon phases.
Y19 It did not help me.	Because I did not understand it	It helped me to learn	Because I was able to learn more from the other people when I listened to them.
Y25 It did not help me.	Because I did not hear about it in class.	It helped me to hear more information.	Because I learned much from others about the Moon.
Y30 It did not help me.	Because I was not sure about it.	It helped me to sure.	Because I now know what ask and how to argue and give reasons I also learned much about the Moon.
Y18 It did not help	Because I did not know	I know that in everything	Because we learn

me	about it.	you say you must have a reason	from each other.
GROUP	BLUE		
B3 It did not help me	Because we did not know it	It helped us to learn	We learned the phases of the Moon very well.
B10 I did not have something to say.	Because I did not know argumentation.	I learned and understood more	*Because the Moon and argumentation have a link.*
B14 --------	---------	----------	---------
B21 It did not help us.	I don't know	It is good.	Because it help us to understand
B26 It did not help me.	I did not know about it	It did help me to learn many things.	Because I did learn many different things from different children like the Moon phases

			and their names.
B32 It didn't help me	Because we did not know many things.	We learned things we didn't know.	We didn't know how to argue and also we didn't know the Moon phases but now we know them.
B36 It didn't help me.	Because they didn't teach me about the Moon.	It helped me to hear new things.	Because it helped me hear the phases of the Moon for the first time.
GROUP	RED		
R5 No claim	No reason	No claim	No reason
R9 No claim	No claim	No claim	No reason
R16 It didn't help me.	Because I did not know many things.	I helped to understand	Because we talk everything in our group
R22 It didn't help me	Because I didn't know it	It helped many children to learn and have skills and some new stuff	Because we learned the Moon phases together and it was nice

			stuff.
R28 It did not help me.	We did not use it	It helped to new science information about the Moon	I did not know that the Moon rotates and the phases of the Moon.
R33 No it didn't.	No reason given	I learned some new things	We learned many things about the Moon
R35 It did not help me.	Because I did not hear anything about it.	It helped me to learn nice things and understand so much	I now understand the Moon stuff. I also know what makes the Moon to have many phases.

APPENDIX P & Q.: LETTERS OF PERMISSION TO ESEARCH

UNIVERSITY OF THE WESTERN CAPE
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UNIVERSITY *of the* WESTERN CAPE

24/03/2011

The Director
Department of Education
Western Province
Cape Town

Dear Sir /Madam.

Re: Permission to conduct research at a primary school in Cape Town

Mr. Magaseti Andrew Onyambu (Student Number 3100685), is a registered Masters student in the School Science and Mathematics Education of the University of the Western Cape. His research topic deals with determining grade six learners' understanding of the phases of the moon.

The proposal has been approved by the Senate of the University of the Western Cape. Kindly assist him in every way possible to meet this academic requirement by granting him permission to collect the required data from any willing primary school in Cape Town.

The data collected will be for the purpose of research only and all the ethical considerations related to confidentiality will be strictly adhered to.

Thank you in advance for your cooperation. It is my hope that the study will enhance the learners' understanding of a topic which forms part of their current science curriculum.

Yours sincerely,

Professor M . B . Ogunniyi.

Director of School of Science & Mathematics Education

BLANK.