

**Exploring the influence of marine science camps on learners'
motivation and dispositions towards scientific inquiry**

A thesis submitted in fulfilment of the requirements for the degree

Of

Master of Education

(Science Education)

At

Rhodes University

By

Nozipiwo Hambaze

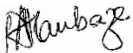
Supervisor: Professor Kenneth Mlungisi Ngcoza

Co-supervisor: Ms Zukiswa Nhase

January 2020

Declaration of Originality

I, Nozipiwo Hambaze, declare that this thesis investigating the influence of marine science camps on learners' motivation and dispositions towards scientific inquiry is my own original work. Ideas of other people cited in this thesis are acknowledged. It is submitted for a Master's degree at Rhodes University and has not been submitted at any other university.



Signature:

Date: 22 July 2020

Abstract

For a number of years, it has been observed that learners' motivation towards science has decreased, especially when they get to higher grades in secondary school. Strengthening learners' motivation has become a very important area for educators to understand and reflect on. Many studies suggest that inquiry-based learning activities can provide a conducive learning environment and build up learners' abilities and motivation to learn science beyond the classroom. It is against this backdrop that this interventionist study sought to investigate the influence of marine science camps on learners' motivation towards scientific inquiry

The study was informed by Vygotsky's social constructivist theory and Wenger's community of practice theory. The participants were 21 grade 10 science learners from seven high schools in the Eastern Cape in South Africa. In order to answer the research questions, data were collected through the use of Student Motivation Towards Science Learning (SMTSL) questionnaires prior and post science camp, learner reflection journals and focus group interviews. Excel was used to analyse quantitative data whereas an inductive-deductive thematic approach was used to analyse the qualitative data.

The findings of the study revealed that through active participation learners' dispositions shifted and became more positive after the scientific inquiry activity experience at the marine science camp. Furthermore, the findings of the study revealed that as a result of the marine science camp experiences learners were highly motivated to develop their own marine related science projects for the science fairs. Science fairs bear the testimony as one learner did not only conduct a marine related project for a science fair but was awarded a gold medal at a regional science fair and a silver medal the national fair. The same learner was awarded an opportunity to present his project in other international fair. Notably also, learners displayed increase science motivation as a result of participating at the marine science camp.

This study thus recommends that in order to enhance scientific inquiry among science learners, efforts in developing *out-of-school* programs not only by the department of education but also other stakeholders such as universities are needed to inspire and motivate more learners in sciences. Additionally, pure science faculties and social sciences should work closely with each other to promote science.

Key words: Life Sciences, marine science camps, scientific inquiry, motivation, informal environments, dispositions, communities of practice, social constructivism

Dedication

This thesis is dedicated to my family, my husband Mncedisi for being so considerate, supportive and understanding. My two sons, Kungawo and Kwakho whom have endured the pressure from a stressful mom during this journey.

Acknowledgements

I would like to thank NRF and SAEON for funding this study. I am grateful for their support in this journey.

Special thanks to Professor Kenneth Ngcoza for his unwavering support, patience and motivation. Thank you Gxarha for pushing me to accomplish this journey.

Likewise, my co-supervisor Ms Zukiswa Nhase for her academic support throughout this process. She immensely supported this research and forgot that she had a PhD to complete.

This study would not have been possible without the support of the Department of Basic Education, that is, the district office and the school principals who opened their doors for me to conduct research. I am also indebted to the teachers who willingly assisted in getting learners ready for the science camp.

My sincere gratitude goes to my research participants, Grade 10 science learners. Their commitment and contributions contributed to the success of this study.

To colleagues and especially the young PhD students who assisted during the camp and who cheered at me when I was swimming against the current during this research. They would say “*sail on mother, you can do this!*”.

To my helper, friend, sister pillar of strength, thank you for being the mother of my kids when I was away from home during the science camps and many other business trips. The word thank you will never be enough, *ndiswele eliwaka imilomo ukukubulela* (I need a hundred mouths to thank you) Nomvuyo Nomatye.

Lastly, to my family for their love, support and understanding and pushing me to get to the finishing line. I thank you!

Table of Contents

Abstract	iii
Dedication	v
Acknowledgements	vi
List of Tables	xi
List of Figures	xii
List of Abbreviations and/or Acronyms	xiv
CHAPTER ONE: SITUATING THE STUDY.....	1
1.1 Introduction.....	1
1.2 Background of the study	2
1.3 Statement of the Problem.....	6
1.4 Significance of the Study	7
1.5 My personal interest in the study	7
1.6 Theoretical Frameworks	8
1.6.1 Community of Practice (CoP).....	8
1.6.2 Social constructivist theory.....	8
1.7 Main Research Question.....	9
1.8 Research Design and Methodology	10
1.9 Brief Definition of Key Concepts Used in the Study	10
1.10 Thesis Outline	12
1.11 Chapter Summary	13
CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK.....	14
2.1 Introduction.....	14
2.2 Theoretical Frameworks	14
2.2.1 Participation in a community of practice.....	14
2.2.1.1 Learning, meaning and identity in a community of practice	16
2.2.2 Social constructivism.....	18
2.2.2.1 Mediation of learning.....	19
2.2.2.2 Zone of proximal development and self-regulation.....	20
2.2.2.3 Language and cultural tools	21
2.3 Conceptual Framework: Motivation and Dispositions	21

2.3.1 Motivation and science learning	21
2.3.1.1 Self–efficacy	22
2.3.1.2 Active learning strategies.....	22
2.3.1.3 Learning environment stimulation.....	22
2.3.2 Dispositions and informal science learning environments	23
2.4 Relationship between Motivation and Learning Environment	25
2.5 Informal Learning Environments.....	26
2.6 Scientific Inquiry and Motivation.....	26
2.7 Science Camps as Informal Learning Environments.....	28
2.8 Chapter Summary	30
CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY	31
3.1 Introduction.....	31
3.2 Research Orientation.....	31
3.3 Mixed Method Case study	32
3.4 Case Selection and Description	33
3.5 Marine Science Camp Site.....	34
3.6 Sampling of Participants.....	36
3.7 Data Generation Techniques.....	38
3.7.1 Questionnaires	38
3.7.2 Learner reflection journals.....	38
3.7.3 Focus group interviews	40
3.7.4 Observation and field notes	41
3.8 Data Analysis	43
3.8.1 Data Management and analysis	46
3.8.2 Data coding	46
3.8.3 Creating analytical memo	47
3.9 Validity and Trustworthiness.....	47
3.10 Ethical Considerations	48
3.11 Chapter Summary	49
CHAPTER FOUR: QUANTITATIVE DATA PRESENTATION, ANALYSIS AND	
DISCUSSION.....	50
4.1 Introduction.....	50

4.2 Learners' Profiles	50
4.3 Nature of schools	52
4.4 Motivation Data Distribution.....	54
4.4.1 Self -Efficacy	54
4.4.2 Alternative learning strategies	56
4.4.3 Science learning value	57
4.4.4 Performance goal	59
4.4.5 Achievement goal	60
4.5 Gender Difference in Motivation on Science in Grade 10 Township Learners	63
4.5.1 Self-efficacy.....	63
4.5.2 Active learning strategies.....	64
4.5.3 Science learning value	65
4.5.4 Performance goal	65
4.5.5 Achievement goal	66
4.5.6 Learning environment stimulation.....	67
4.6 Representation of all Learners' Motivation Constructs	67
4.6.1 Active learning strategies motivations for all learners	71
4.6.2 Learning environmental stimulation of all learners	72
4.7 Chapter Summary	72
CHAPTER FIVE: QUALITATIVE DATA PRESENTATION, ANALYSIS AND DISCUSSION.....	73
5.1 Introduction.....	73
5.2 The Intervention: Marine Science Camp and Rocky Shore Inquiry.....	74
5.3 Analysis of the Focus Group Interviews and Learner Reflection Journals	76
5.3.1 Learners' sources of science inspiration and motivation.....	77
5.3.2 Learners' expectations of the marine science camp	78
5.3.3 Perceptions and attitudes towards science and marine science camp.....	79
5.3.4 Learners' experiences and participation at the marine science camp	80
5.3.5 Mediating and self-regulation at the marine science camp.....	81
5.3.6 Building marine concepts and literacy and knowledge through ZPD	82
5.3.7 Development of motivation, self-efficacy and resilience	84
5.3.8 Understanding of scientific investigation approach.....	85

5.4 Chapter Summary	86
CHAPTER SIX: SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION.....	87
6.1 Introduction.....	87
6.2 Summary of Findings.....	88
6.2.1 Research question one:	88
6.2.2 Research question two:	89
6.2.3 Research question three	89
6.3 Recommendations.....	90
6.4 Areas for Future Research	90
6.5 Limitations to the Study.....	91
6.6 Conclusion	92
References.....	94
Appendices.....	104
Appendix 1: Ethical Clearance	104
Appendix 2: Permission form the Department of Education (District Office).....	105
Appendix 3: Permission letter for school A.....	107
Appendix 4: Permission letter from school	108
Appendix 5: Consent letter to the parents.....	109
Appendix 6: Participant consent letter	110
Appendix 7: Indemnity form	111
Appendix 8: Marine Science Camp Programme	112
Appendix 9: The SMTSL questionnaire	113
Appendix 10: Learner reflection journal prompt questions.....	116
Appendix 11: Focus group interview schedule:.....	117
Appendix 12: Motivation Rubric	118
Appendix 13: Motivational constructs scores data based on rubric	119
Appendix 14: Learner Reflection Journals Transcripts	120
Appendix 15: Focus group interviews transcript.....	141
Appendix 16: Learner presentations	155
Appendix 17: Learner science fair project.....	169

List of Tables

Table 3.1: Shows brief description of the science camp activities	36
Table 3.2: Shows indicators of science dispositions.....	39
Table 3.3: Shows methods of data collection, data collected and the purpose	42
Table 3.4: Shows sample data on motivation constructs	44
Table 3.5: A sample analytical memo, showing disposition indicators.....	47
Table 4.1: Shows the biographical information of the learners	51
Table 4.2: School profile and learner profile	52
Table 4.2: A sample extract of motivation rubric level	68
Table 4.3: Pre- and post- camp scores per motivational construct	69
Table 5.1: Themes emerging from focus group interviews and learner reflection journals	77

List of Figures

Figure 1.1: Map showing distribution of SAEON Nodes.....	4
Figure 2.1: Shows components of social theory: an initial inventory (Wenger, 1998, p. 5)	17
Figure 3.1: A map showing Skoenmakerskop where rocky shore inquiry occurs.....	35
Figure 3.2: Shows disposition indicators	45
Figure 4.1: I am sure I can do well in a science test	54
Figure 4.2: No matter how much effort I put in, I cannot learn science with understanding	55
Figure 4.3: When learning new science concepts, I find relevant sources that will help me	56
Figure 4.4: When I do not understand a science concept, I discuss with the teacher to clarify my understanding	56
Figure 4.5: Learning science is important because it stimulates my thinking	57
Figure 4.6: The importance of participating in inquiry/investigative activities in science.....	58
Figure 4.7: I participate in science class so that other students think I am smart.....	59
Figure 4.8: I participate in class so that the teacher pays attention to me.....	59
Figure 4.9: I feel most fulfilled when I feel confident about the content knowledge in science.....	60
Figure 4.10: During science, I feel most fulfilled when I am able to solve a difficult problem	61
Figure 4.11: I am willing to participate in this science camp because the teacher uses a variety of teaching methods	62
Figure 4.12: I am willing to participate in this science camp because the students are involved in discussions	62
Figure 4.13: I am sure I can do well in science tests	63
Figure 4.14: Shows responses from the statement “when I do not understand a science concept I discuss it with the teacher to clarify my understanding”	64
Figure 4.15: I think it is important to participate in inquiry or investigative activities in science.....	65
Figure 4.16: I participate in class so that other students think I am smart.....	65
Figure 4.17: I feel most fulfilled when I feel confident about the content knowledge in science.....	66
Figure 4.18: I am willing to participate in this camp because I think it will be fun	67

Figure 4.19: Graphical representation of the pre- and post-camp scores of self-efficacy as motivational construct.....	70
Figure 4.20: Graphical representation of the pre-post camp scores for active learning strategies as motivational construct	71
Figure 4.21: Graphical representation of the pre- and post-camp scores of learning environment as motivational construct	72
Figure 5.1: Learners at the bridge of Agulhas 1 research vessel	74
Figure 5.2: Tools used by learners to collect data on rocky shores	76
Figure 5.3: Learners touching a starfish found during investigation	80

List of Abbreviations and/or Acronyms

CAPS	Curriculum and Assessment Policy Statement
COP	Communities of Practice
DoBE	Department of Basic Education
DST	Department of Science and Technology
ESF	English Second Language
IK	Indigenous Knowledge
LOLT	Language of Teaching and Learning
LTER	Long Term
NSTA	National Science Teachers Association
NRF	National Research Foundation
SACMEQ	Southern and Eastern Consortium for Monitoring Education Quality
SAIAB	South African Institute for Aquatic Biodiversity
SAEON	South African Environmental Observation Network
SCT	Social Constructivism Theory
SI	Scientific Inquiry
SMSTL	Student Motivation towards Science Learning
STEM	Science, Technology, Engineering and Mathematics
TIMMS	Trends in International Mathematics and Science Study
ZPD	Zone of maximal development

CHAPTER ONE: SITUATING THE STUDY

1.1 Introduction

The aim of this case study was twofold. Firstly, it aimed at exposing learners to an outdoor marine science learning environment. Secondly, it aimed at promoting the use of an investigative inquiry learning approach to Grade 10 Life Sciences learners from previously disadvantaged backgrounds. Ultimately, the aim was to investigate the influence of marine science camps on learners' motivation and dispositions towards scientific inquiry.

The South African Curriculum and Assessment Policy Statement (CAPS) which was introduced in 2011 calls for integration of teaching and learning of scientific inquiry (SI) skills (South Africa. Department of Education [DoE], 2011). The aim for this call is to produce learners who are critical thinkers. In as much as the CAPS curriculum has been praised for its systematic approach in organising content, it has been also criticised for the overload of content and assessment, hence leaving little or no time for inquiry based teaching and learning.

Furthermore, CAPS has brought some challenges, for example, it puts emphasis on the development of learners' scientific inquiry skills without adequately capacitating teachers on how to go about doing this. Recent research by scholars such as Kahenge (2013), Lederman and Lederman (2014) and Tshiningayamwe (2016), show that teachers do not have the confidence or adequate knowledge and skills to conduct scientific inquiry learning with their learners. Aulls and Shore (2008) do not contest the fact that there could be other underlying reasons that could be linked to learners' motivation but, they strongly believe that inquiry based teaching and learning fosters critical thinking.

In order to enhance scientific inquiry learning, the South African Environmental Observation Network (SAEON) has invested time and resources in developing a marine science camp inquiry

programme that specifically targets the high school learners from the disadvantaged townships¹. The main reason for the focus on disadvantaged township learners, is to introduce scientific inquiry based learning in the marine space which is underexplored by township learners.

The marine science camps were developed for high school learners to have exposure to hands-on experience and scientific inquiry methods to complement the school curriculum. Notwithstanding, little is known about the impact or influence of these camps on learners' motivation. It is this caveat that triggered my interest to investigate the influence of the marine science camps on learners' motivation and their dispositions towards scientific inquiry. In this chapter, I thus present the background to the study, statement of the problem, significance of the study and my research interest in the study.

1.2 Background of the study

The poor academic achievement in Science by secondary school learners in South Africa has raised many concerns about learners' motivation towards the subject. It is often cited in the Southern and Eastern Africa Consortium for Monitoring Education Quality (SACMEQ), that when South African learners are compared to other countries in Mathematics and Science benchmark tests, they show the poorest performance results in both these subjects (Writer, 2015). This was the case in the 2011 Trends in International Mathematics and Science Study (TIMSS) which showed that South African Grade 7 and 8 learners performed poorly in both Mathematics and Science (Reddy et al., 2015).

The South African learners in these grades were ranked last out of 41 participating countries. Reddy et al. (2015) inform that three-quarters of South African learners achieved below the benchmark score. Likewise, this is further confirmed in TIMSS, that learners from low socio-economic backgrounds perform poorly in these subjects (Bantwini, 2010; Reddy, van der Berg,

¹ Township schools are historically disadvantaged and situated in the outskirts of central town.

Janse van Rensburg, & Taylor, 2012). In my view, it is imperative to understand what motivates or demotivates learners from poor socio-economic backgrounds, specifically in Science learning.

Studies that investigated factors related to motivation for Science learning discovered a link between Science achievement and Science motivation. For instance, family influences were identified as a one of the major factors that has a direct influence on Science motivation and Science achievement, as well as the socio-economic status of the family (National Science Teachers Association, 2009).

In South Africa, several factors have been identified as having an influence on Science motivation and Science achievement (Ramnarain, 2013). These include the lack or inadequate school resources and under preparedness of teachers to teach Science (Seroto, 2012). Additionally, poor command of the Language of Learning and Teaching (LoLT), negative attitudes which are accompanied by lack of insights into the value of Science, low self-efficacy and the poor quality of learning environments to learning Science, were highlighted (Ramnarain, 2013). It is for these reasons that Mavuru and Ramnarain (2017), drawing on Vygotsky's (1978) seminal work, propose that there is a need for the socio-cultural contexts to be considered in Science classrooms in South Africa. In their study, they found that the integration of learners' indigenous knowledge (IK) in the learning environment space promoted learner participation (Sedlacek & Sedova, 2017) and developed critical and analytical skills in learners.

Essentially, learning environments have been central to debates of the Science engagement community in South Africa. As a result, the Department of Science and Technology (South Africa. DST, 2014) developed a science engagement strategy. The strategy clearly brings out how informal Science learning environments can complement the school curriculum to enhance learner motivation to learn Science. In light of this strategy, it could be argued that SAEON was a step ahead, as out-of-school Science camp programmes were already designed but nonetheless have not been researched. These science camps are out-of-school learning environment programmes which are designed to engage learners in scientific inquiry skills as stipulated in CAPS document (South Africa. DBE, 2011).

SAEON is a research facility of the National Research Foundation (NRF) which is funded by the Department of Science and Technology (DST). Its mandate is to establish and maintain environmental observation sites (nodes) and data management for research purposes, while providing Science engagement platforms for long term studies. SAEON nodes are distributed in six biomes across South Africa with a national coordinating office in Pretoria. Out of the six nodes, noteworthy is that three nodes have indigenous names which are derived from their biomes as listed below.

- Coastal Inshore in the Eastern Cape Province, also known as *Elwandle* (Coastal) Node.
- Lowveld Savannah, in Limpopo Province, also known as *Ndlovu* (Elephant) Node.
- Marine Offshore in the Western Cape Province, also known as *Egagasini* (Waves) Node.
- Grasslands, Forests and Wetlands Node in KwaZulu-Natal; and
- Fynbos Node in Western Cape and Arid lands in Northern Cape.



Figure 1.1: Map showing distribution of SAEON Nodes

Algoa Bay is labelled in the map to show exactly where the long term coastal observation research is conducted. Algoa Bay Sentinel Site for Long-Term Ecological Research is the first of its kind

in Africa. It consists of a continuous monitoring platform made up of *in situ* sensors measuring a range of variables including, amongst others, ocean temperature, salinity, currents and waves.

This network currently consists of over 190 sensors continuously recording data. In addition to the oceanographic instruments, SAEON also conducts monthly sampling of the pelagic ecosystem at eight stations in Algoa Bay, collecting data on the physical, chemical and lower trophic biological (phytoplankton, zooplankton and ichthyoplankton) environment. The data and the research platforms (vessels, laboratories and scientific equipment) are available to the broader scientific community and public at large.

Another aspect of the Elwandle Coastal node is Science engagement which focuses its support on the seven previously disadvantaged schools in the Eastern Cape for both learners and educators. The Science engagement programme is coordinated by a Science engagement officer who works closely with node scientists and other stakeholders, such as education district officers to design curriculum-based activities. This partnership epitomises what Lave and Wenger (1991) and Wenger (1998) refer to as a community of practice, central to which is learning. The node scientists introduce to both educators and specifically Grade 9 to 11 learners, hands-on practical activities (Asheela, 2017; Ndevahoma, 2019) such as school weather and climate monitoring and scientific methods which are usually taught at Science camps on weekends or during school holidays.

Teachers select learners to come to the rocky shore Science camps, however, SAEON's criteria is to have learners who take Mathematics, Physical Sciences and/or Life Sciences including Geography as subjects. The Elwandle Coastal Node marine Science camps usually run for about three to four days. The camps are usually held in Port Elizabeth at a venue that is near the proximity of the sea.

The marine Science camps are held to expose learners to scientists and to engage them in an intensive structured small-scale research to stimulate their scientific inquiry process skills. Walker and Shore (2015) describe inquiry as an ability to critically engage and use the language, tools and skills of inquiry during the inquiry activity and encourage collaborative work (Goos, 2000).

During these science camps, usually learners are not familiar with each other as they come from diverse schools. In consequence, I have observed that they tend to be uncomfortable. As an attempt to break the ice, on arrival at the camp learners are divided into groups whereby each group is composed of learners from different schools. The idea behind this group formation is to allow them to form new relationships, so that they can socially engage with one another including the SAEON staff, as proposed by Vygotsky (1978) in his social constructivist theory.

1.3 Statement of the Problem

In light of the lack of motivation in Science stated above, it is crucial to identify and address factors that may impact learning of Science amongst secondary school learners, specifically in informal learning environments that can introduce scientific inquiry. According to Lederman, Lederman and Gaigher (2014), scientific inquiry (SI) is important for learners as the foundation for the development of future generation of scientists and scientific literate citizens.

Furthermore, Gaigher et al. (2014) also state that South African learners across socio-economic sectors have little to no exposure in doing inquiry-based activities in schools. It is against this backdrop that in this study I sought to understand learners' motivation and dispositions towards scientific inquiry.

In many studies, motivation has emerged as a leading factor that influences learners' achievement in science learning (Velayutham, Aldridge, & Frazer, 2011; Ramnarain, 2013; Schulze & van Heerden, 2015). Such research has paid much attention to learner motivation in the classroom environments, and yet little is known about the influence of informal Science experiences on learners' motivation. In their study on identifying influences of the learning environment, Schulze and van Heerden (2015) found out that teachers play a huge role in motivating learners to learn Science by creating conducive learning environments. They recommend future research that should seek to understand what motivates learners in these learning environments. This study sought to close this gap by exploring the influence of science camps on learners' motivation and dispositions towards scientific inquiry.

1.4 Significance of the Study

The concept of a marine and science camp is foreign to township previously disadvantaged schools. This suggests that this case study is important, as there is not much research conducted on the influence of marine science camps on learners' motivation specifically in South African context. The study might also provide reflexivity to SAEON's marine science camp facilitators to establish and reflect on what motivates or demotivates learners during scientific inquiry activities.

The study might also provide some insights on the use of teaching practices or approaches that influence learners' dispositions about science learning, with specific reference to scientific inquiry learning in a socio-cultural setting as highlighted by Mavuru and Ramanarain (2017). These insights might assist in developing and incorporating science camp programmes that will create the learning environment desired by learners to increase their motivation levels. Furthermore, the study might add to the existing body of literature and knowledge on marine science camps.

1.5 My personal interest in the study

As a Science Engagement Officer at SAEON, and someone who comes from a similar disadvantage background as the learners participating in the science camp, when I was at high school we used to get extra-curricular support from out-of-school institutions such as Rhodes University, which is situated not far from most township schools in Grahamstown. Most of the schools could not afford to fund excursions due to socio-economic factors.

Participating in these excursions would motivate most of us, as we aspired to be and identified as science learners. Along with having been a learner of science at school and now a qualified teacher, I also brought with my past experiences of working as an outreach officer at the South African Institute for Aquatic Biodiversity (SAIAB). Furthermore, I come to the study as someone who has been involved for a number of years in informal learning environments and also as the SAEON coordinator of the marine science camps, but have never understood if these camps have any influence on learners. In light of this, I deemed it necessary to investigate the influence of the marine science camps on learners' motivation and their dispositions towards scientific inquiry.

1.6 Theoretical Frameworks

Due to the nature of this study, I deemed it suitable to use two frameworks which specifically target learner motivation and dispositions in informal environments such as science camps. These frameworks are Communities of Practice (CoP) (Lave & Wenger, 1991; Wenger, 1998) and Vygotsky's (1978) social constructivist theory, specifically the notion of the zone of proximal development (ZPD). I chose these frameworks for the reason that community of practice complements ideas from Vygotsky's notion of the ZPD, as they both deal with social interactions and environmental influences. I now briefly discuss these theories below.

1.6.1 Community of Practice (CoP)

Wenger (1998) describes a community of practice (CoP) as a group of people who share a concern, a set of problems, or a passion about a topic. Wenger (1998) further highlights that a CoP has three main elements: the *domain of knowledge* which defines the issue(s); the *community of people* who care about the domain of knowledge and a *shared practice* being developed to make the domain of knowledge effective.

People learn as they become members of what Lave and Wenger (1991) refer to as a community of practice. They describe learning as an important part of social practice and as legitimate peripheral participation in the community of practice. 'Legitimate' in Lave and Wenger's terms refers to being a potential member of the CoP.

Thus, through interacting and participating in the CoP, the learners involved in this study were afforded an opportunity to share information, knowledge, and experiences and understood who they are and in which CoP they belonged (Lave & Wenger, 1991). To Roberts (2006), within CoP, power shapes social interactions and might influence the perceptions of those involved.

1.6.2 Social constructivist theory

Vygotsky's (1978) social constructivist theory emphasises that social interactions play a fundamental role in the development of cognition. Within Vygotsky's learning theory, in this study

I focused on the concepts of the zone of proximal development (ZPD), mediation of learning, and self-regulation.

The ZPD has been described as the distance between the actual development level determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers with the use of mediational tools (Vygotsky, 1978).

Vygotsky's (1978) theory suggests that mediation tools shape the way social beings interact in a social activity. He further states that in order for learning to happen there should be cultural tools, such as language, signs, symbols and artefacts to mediate learning (Vygotsky, 1978). In this study, I view rocky shores as a learning environment.

Vygotsky (1978) believes that language develops from social interactions for the purposes of communication. He views language as a tool to communicate with the outside world. Furthermore, he argues that once children acquire speech, the internalisation of a language is important as it drives cognitive development. In the context of this study, it means once learners acquire ocean literacy which is ocean concepts, they might be able to make connections related to the new marine science environment.

1.7 Main Research Question

What are the influences of marine science camps on learners' motivation and dispositions towards scientific inquiry?

Research sub-questions:

1. What are Grade 10 learners' science motivation and disposition levels prior to the marine science camp experiences?
2. How do Grade 10 learners' motivation and dispositions evolve during the marine science camp scientific inquiry experience?
3. How do Grade 10 learners' participation in scientific inquiry learning affect their dispositions?

1.8 Research Design and Methodology

The study employed an interpretive paradigm and a mixed method case study approach. That is, in order to answer the research questions, both quantitative (surveys) and qualitative (focus group interviews, learner reflection journals) were used as data generation techniques.

1.9 Brief Definition of Key Concepts Used in the Study

Informal science learning

This is characterised by learning science outside the school context, including but not limited to museums, zoo, science camps, after school programmes, science clubs and science fairs. These informal learning environments provide opportunities for social interactions and meaning making of the content (Riedinger, 2015). Informal science learning is often regarded as an experience that may influence the development of science motivation and interest to learn science further (Lil & Schunn, 2016).

Science camps

Science camps have specific features that distinguish them from other informal science education (Riedinger, 2011). Foster and Shiel-Rolle (2011) state that science camps are a platform from which to provide an outside classroom atmosphere for learning to take place in an informal way and where learners are introduced to hands-on experiences. They argue that at a science camp, a facilitator is able to introduce science concepts right in the field where learners are hands-on to receive first-hand information.

Bischoff, Castendyk, Gallagher, Schaumloffel and Labroo (2008) believe that science camps aim to provide conducive learning environments whereby learners brainstorm ideas, and find solutions to scientific problems in their small groups. Bischoff et al. (2008) further maintain that team work and active participation (Sedlacek & Sedova, 2017) in a science camp set-up, may yield the formation of new relationships within the group. They further argue that when high school learners are exposed to or participate in the science camps, they may be motivated to consider pursuing science careers at tertiary level (Sedlacek & Sedova, 2017).

Participation and self-regulation

Wenger (1998) describes participation as a process of taking part with others in a social activity. Furthermore, he states that participation shapes the participant and the community in which they participate in an ongoing interaction (Wenger, 1998). Self-regulation is described as the capacity to attain and change one's level energy to match the demands of the task during their participation in a social interaction (Harrison & Muthivhi, 2013). In other words, in attaining self-regulation in learning, means learners should be involved in learning whereby they can participate by applying their existing knowledge to new learning areas and incorporating it into new skills.

Barlia (1999) further argues that if learners perceive the value of science learning tasks, they will actively participate in these tasks to construct a meaningful understanding of a new science concept based on their existing knowledge – in this way, their motivation to learn science might increase. Many studies found that inquiry based learning fosters motivation and enhances critical thinking amongst learners (Walker & Shore, 2015). Some studies suggest that learning science in conducive learning environments can influence learners to develop positive dispositions towards science, especially after an inquiry experience.

Motivation

Research shows that inquiry based learning can benefit learners and motivate them towards science learning. Motivation is a very important educational variable as it promotes both new learning and skills (Barlia, 1999). Motivation to learn science promotes learner construction of their conceptual understanding of science (ibid.).

Disposition

Friedman (2008) believes that dispositions are shaped by personal, physical, and socio-cultural context in which learners live and may only be evident after the exposure to many experiences. Undoubtedly, the two terms dispositions and attitudes are often used interchangeably in most studies (Agunbiade, 2015). In my study, I have opted to use *dispositions*. Osborne, Simons and Collins (2003) argue that attitudes towards science are associated with feelings about scientific

objects and allow prognosis of scientific attitudes. Concurring, Crick and Goldspink (2014) state that disposition refers to a person's certain response behaviours in new learning spaces.

Damon (2005) and Crick (2009, 2012) perceive dispositions as individualised mental and moral qualities that make us who we are and frame our future learning paths. Raths (2001) views dispositions as skills and practices that are directed towards learning a particular subject. In the context of this study, the subject was learning through scientific inquiry.

Scientific Inquiry

Aulls and Shore (2008) believe that inquiry involves asking questions based on interest and curiosity. They explain that through an inquiry-based approach a conducive learning environment is created which then contributes to learners' motivation. As a result, learners can become inquiry literate when they receive an explicit instruction from more knowledgeable other such as teachers, parents and their peers, in addition to the experience (ibid.)

The general understanding of scientific inquiry is that it follows a simplified set of steps of a tested hypothesis in order to come to a conclusion.

1.10 Thesis Outline

Chapter One: This chapter gave the outline of the research, the background of the research, rationale, and the significance or potential value of the study. The concepts were briefly discussed as well as the theoretical framework. Finally, the research focus as well as research questions and study overview were also explained in this chapter.

Chapter Two: This chapter is a literature review which provides a broad theoretical and historical context for the study. It explores the introduction of scientific inquiry learning in the South African national curriculum. It also takes a look at informal science learning environments including science camps in South Africa.

Chapter Three: This chapter provides a description and discussion of the overall design of the study, its methodological approaches and methods of data generation and analysis. In this chapter, I also discuss ethical issues, validity and trustworthiness of the study.

Chapter Four: This chapter maps out and presents the data generated from questionnaires, focus group interviews, observations and learner reflection journals.

Chapter Five: This chapter provides an interpretation based on Wenger and Vygotsky in analysing the findings presented in Chapter Four. This chapter presents a concluding summary for the study. It also presents recommendations arising from the study and recommendations for further research.

1.11 Chapter Summary

In this chapter, I outlined the background of SAEON and the use of science camps as learning environments to study learners' motivation and dispositions. I gave a brief definition of concepts used in this study, presented the problem statement and significance of the study in literature. I also described the relevance of my interest in seeking to understand learners' motivation in the marine science camps. In the next chapter I discuss literature relevant to the study.

CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

In the previous chapter, I presented the background of my study whose main goal study was to investigate the influence of marine science camp on learners' motivation and dispositions towards scientific inquiry. In this chapter, I discuss literature relevant to my study. Firstly, the study draws on two theories, namely, Wenger's (1998) communities of practice and Vygotsky's (1978) socio-constructivist theory to interpret learners' motivation and dispositions.

Secondly, it explores literature on learner motivation towards science learning and also the dispositions learners have during the science learning process both in the classroom setting and in the informal science learning environment.

Thirdly, the literature investigates learners' social interactions and how they engage and make meaning of the scientific inquiry processes in informal learning environments, a marine science camp in the context of this study, in particular.

2.2 Theoretical Frameworks

Wenger's (1998) communities of practice theory and Vygotsky's (1978) social constructivist theory were used as useful theoretical lenses for investigating how marine science camps influence (or not) learners' motivation and dispositions towards scientific inquiry in this study. I now discuss each of these below.

2.2.1 Participation in a community of practice

Fields (2009) and Roschelle (2000) state that when learners participate in extended open inquiry learning experiences, they imagine the role of the scientist and become practicing members of the

scientific community. Wenger (1998) clearly states that when people engage with one another in a social context as a group of people who share a concern, a set of problems, or a passion about a topic, a community of practice is formed. Drawing from Wenger's definition of community of practice (CoP), learners participating at the camp facilitated by a scientist and Marine Science PhD students can be considered as a social group that is engaged in social interactions with one another, are interdependent and share a goal of participating in science.

In *Legitimate Peripheral Participation (LLP)*, Lave and Wenger (1991) propose that learners should be engaged and participate as legitimate peripheral participants in communities of practice for learning to occur. By legitimate peripheral participants, Lave and Wenger (1991) considered participation as a way of learning. Lave and Wenger (1991) view peripheral participation as an empowering position, where a newcomer gets initial access and moves from the boundary towards gaining access to sources of understanding through growing participation in a CoP.

They further argue that the learner enters the community of practice as a newcomer on the periphery of the practice (Lave & Wenger, 1991). As they are absorbed into the culture of the practice, they move toward participation in the central activities that define the community of practice. That is, their participation proceeds from new-comer to becoming an old-timer as they acquire the skills, knowledge, and language for participation in these communities (Lave & Wenger, 1991).

Through participation in the community of practice, they are thus transformed and are able to make sense of the practice itself. Identity development occurs as they come to see themselves as members and participants within communities of practice (Lave & Wenger, 1991)

My assumption is, that periphery indicates the possibility of members contributing at different levels of expertise, depending on knowledge and skills that are set by a community of practice and who deepen their knowledge and expertise in this area by interacting with the aim of learning. In the case of this study, it would be scientific inquiry.

2.2.1.1 Learning, meaning and identity in a community of practice

Wenger (1998) posits that in a community of practice, people are social beings and knowing is about participation in a social world. He asserts that human beings define themselves through active engagement and by how they are viewed by others within the community of practice. According to Wenger (1998), in a community of practice, meaning is negotiated through a process of *participation* and *reification*. He insists that communities of practice are important places of *negotiation, learning, meaning, and identity*. In this study, I did not see learning, negotiating and meaning as different aspects but as interconnected processes. Learning in the science camp through social interactions provided a platform to learn in this new context, through negotiations with members of the group, making meaning of science content.

Varelas, Martin and Kane (2012) view identity as lenses through which people make sense of something in a social context and position themselves through interactions in a given context. They believe that identities are lenses to understand how individuals see themselves and how members of a group perceive the individual. I view science camp participants as learners that did not initially identify themselves as young scientists, but through the marine science camp interactions they were taken from the periphery to the centre. In other words, learners were firstly not familiar with marine science concepts, but during the course of their camp they picked up and executed them in a very good way. From this perspective, I view them as learners of science within the CoP.

The CoP in this study consisted of a scientist, SAEON PhD/MSc students who were interns at the time of this study, Grade 10 science learners, two science teachers, and me as a researcher as well as a participant observer.

Wenger (1998) identified three dimensions of the relation by which practice is the source of coherence of a community. Firstly, members interact with one another, establishing norms and relationships through *mutual engagement*. Secondly, members are bound together by an understanding of a sense of *joint enterprise*. Finally, members produce over time a *shared repertoire* of communal tools such as language, routines, artefacts and stories. For Wenger (1998),

learning is a process which regards the individuals as active participants in the social practices. In other words, learning is not static but instead it is dynamic and evolves.

Wenger's theory (1998) looks at the intersection of the learning components: that is *community, practice, meaning* and *identity*. These components are all connected and interchangeable with regards to learning. This gives credence to the use of this theory as an analytical framework in this study. Here, Wenger puts forwards that learning is a process which places individuals as active participants in a socio-cultural context (Mavuru & Ramnarain, 2017). Learning can be central or peripheral as shown in Wenger's diagram in Figure 2.1 below.



Figure 2.1: Shows components of social theory: an initial inventory (Wenger, 1998, p. 5)

I now briefly discuss these components. Wenger's first component is Meaning (learning as experience) in which he sees meaning as an ability to talk about an experience that takes place through participation. The second component is Practice (learning as doing), which involves participation within the community through sharing of resources. The third component is Community (learning as belonging), which deals with the creation of knowledge in a learning community in this study, learning community refers to all involved in the science camp. Fourth

components is *Identity* (learning as becoming) which Wenger explains it as taking about learning changes who we are (Wenger, 1998)

Wenger (1998) states that communities of practice entail learning as a social phenomenon that is placed in the context of lived experience and participation in the real-world context. Wenger and Wenger-Trayner (2015) argue that the community of practice theory can produce tangible outcomes. They further state that by using a community of practice theory, a researcher can construct a good study case using qualitative data to find out dispositions created by a community and trace how members are crossing the boundaries and improving performance as a result of the community of practice (Wenger & Wenger-Trayner, 2015).

CoP as a *situated learning* framework focuses on knowing and learning as participation in a specific community of practice, and also highlights the importance of situating a learner in a specific context such as physical and social environments (Lave & Wenger, 1991). These scholars further state that learning contexts are formed by the learners and other participants including available ideas, tools, and physical resources as proposed by Vygotsky (1978) in his social constructivist theory.

It is recognised, however, that a community of practice is not without its weaknesses. Roberts (2006), for instance, argues that Wenger (1998) does not deal with issues such as power dynamics, trust, pre-disposition, size, spatial reach and nature of the CoP. While for Wenger (1998), meaning can be negotiated within the CoP, Roberts (2006) argues that power dynamics may be evident in degrees of participation; expert knowledge may be a dominant source of power (Yanow, 2004). In this study, power dynamics as highlighted in the epigraph, were evident during discussions, where in some cases I observed that some group members who were confident about species identification in that activity were taking a lead in the group.

2.2.2 Social constructivism

Vygotsky's (1978) social constructivist theory (SCT) emphasises that social interactions play a fundamental role in the development of cognition. Concurring, McRobbie and Tobin (1997) posit that social constructivism recognises the importance of *social* and *personal* aspects of learning.

Within the social constructivist theory, I focused on the concepts of mediation of learning, the zone of proximal development (ZPD) and self-regulation in this study.

2.2.2.1 Mediation of learning

Vygotsky (1978) viewed language and cultural tools as mediating factors in development. He considered language as an important social tool for social interactions. Learners use language to communicate with their teachers, adults and peers as well as mediate their own mental abilities through self-talk, such as acquiring and remembering information and organising their thoughts.

Language in science teaching could refer to the medium used by the teacher for communicating or explaining science concepts. The language of the learners could either be their mother tongue (isiXhosa in the context of my study) or the everyday language they use to communicate, as well as language of terminology. The role of language in acquiring new concepts is uncontested, especially in the marine field which is foreign to many learners who participated at the camp and in this study. Science in general, is always viewed as a practical subject but it requires language whether it is written or spoken.

The use of the English language as Language of Learning and Teaching (LoLT) at the marine science camps, which in our case was for all participants for whom English is a second language, served as an opportunity for learners to improve their English vocabulary and learn specific scientific terms. The CAPS curriculum document stipulates explicitly that teachers of Life Sciences should be aware that they are also engaged in teaching language across the curriculum (South Africa. DoBE, 2011). Science educators were present and played a supervisory role for learners and assisted those learners with low command of English due to the fact that LoLT was not their mother-tongue.

When learners are unable to communicate in a scientific language it becomes a challenge for the researchers involving those learners in marine scientific activities, particularly when introducing scientific vocabulary (Mellors, McKenzie & Coles, 2008). Making an effort to improve English fluency allows the participants to master the necessary scientific vocabulary and increases confidence and self-esteem, which leads to a desire to understand the marine environment, not just

from a cultural viewpoint but also from a scientific point of view (Mellors et al., 2008). Hence, language was used as a mediational and cultural tool. Admittedly, Mavuru and Ramnarain (2019), concurring with Msimanga and Lelliot (2014), accentuate that home language can be used as a resource in science classrooms.

Essentially, the use of language for science is an essential and critical aspect of scientific development such as discussing ideas, debating, and collaborating to refine or extend ideas (Riedinger, 2015). In this study, I had hoped that learning to talk science would be useful in reinforcing marine science concepts, a necessary part of gaining access into the community of science and a way to motivate learners to talk as emphasised by Lemke (1990).

2.2.2.2 Zone of proximal development and self-regulation

The zone of proximal development (ZPD) has been described as “the distance between the actual development level determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (Vygotsky, 1978, p. 86). Stott (2016) argues that there is no ZPD before learning activity takes place, hence she calls it the zone of proximal learning (ZPL). She further accentuates that the ZPD is created through and during social interactions. In order for the ZPD to be reached, valuable contributions should come from all participants involved in the CoP (ibid.). In other words, the ZPD and self-regulation are accomplished through social interactions.

Harrison and Muthivhi (2013) posit that self-regulation is facilitated by mediation during social interactions. They assert that the teacher contributes to the mental functions of the learner by being a mediator who provides scaffolding until the learner achieves self-regulation.

Stott (2016) argues that mediation is important in learning in order for learners to reach their ZPD, which could potentially lead to self-regulation as proposed by Harrison and Muthivhi (2013). In her study, she highlighted an interesting point which, in my view, has been ignored, that is, that the ZPD is not only reached from one way – that is from the teacher to the learner – but it could be from learner to teacher or learner to learner. In my study, I noticed this when one of the learners

who was a twin threw a coin in the water before she surveyed rocky shore. She shared a cultural belief that throwing a coin is asking for protection to not be taken by a rip current.

Sadler (2014) cautions that not all contexts facilitate knowing and learning, arguing that contexts may afford and/or constrain what learners and other participants can do and come to know. Hence, he suggests that learners should understand the cultural rules of participation and procedures of the community in order to be motivated and fully participate (Sadler, 2014).

2.2.2.3 Language and cultural tools

Vygotsky (1978) considers language and cultural tools as mediating factors and important for social interactions. Children use language to communicate with their peers as well as mediating their own mental abilities through self-talk (Riedinger, 2011). Using rocky shores as an area to conduct scientific inquiry meant that learners who have their cultural beliefs about the sea had to practice cultural rules. For example, a learner who was a twin believed that before she could get closer to the sea she had to throw a coin in first, before she could interact with other learners.

2.3 Conceptual Framework: Motivation and Dispositions

Grant and Osanloo (2014) explain that a conceptual framework provides a researcher with a logical structure of interconnected concepts in the study, in order to provide a picture of how ideas are related within the framework. I now discuss my conceptual framework for this study.

2.3.1 Motivation and science learning

The increasing interest in the study of learners in learning science has sparked the development of several instruments for measuring their motivation. For example, Cavas (2011) believes that learners who have high motivation to learn science are more successful in science learning and their attitudes toward science are more positive. Glynn, Brickman, Armstrong and Taasobshirazi (2011) developed the Science Motivation Questionnaire (SMQ), while in this study I used the Students Motivation Towards Science Learning Questionnaire developed by Tuan, Chin and Shieh (2005). For the purpose of this study, however, I focused only on three motivational constructs, namely, self-efficacy, active learning strategies, and learning environment stimulation.

2.3.1.1 Self-efficacy

Bandura (1997) defines self-efficacy as a judgment about one's ability to organise and perform the courses of action necessary to attain a specific goal. Essentially, self-efficacy judgments are related to specific tasks. Self-efficacy is a significant predictor of both the level of motivation for a task and ultimately task performance (Bandura & Locke, 2003); on average, individuals with high Science Technology Engineering and Mathematics (STEM) self-efficacy, perform better and persist longer in STEM disciplines relative to those lower in STEM self-efficacy (Bandura & Locke, 2003). Velayutham et al. (2011) assert that learners who have developed self-efficacy in science learning will probably regulate their effort in science learning.

2.3.1.2 Active learning strategies

Tuan et al. (2005) state that learners take an active role in interacting with the environment. That is, they use active learning strategies to retrieve existing knowledge to interpret new experiences in order to construct new understanding. Additionally, they try to find resources to help them understand concepts. These active learning strategies are also matched with MSLQ (Pintrich Marx & Boyle, 1993) learning strategies; that is, learners' learning strategies depend on the nature of motivation and learning goals.

2.3.1.3 Learning environment stimulation

Motivation has been identified as one of the most critical factors affecting science learning. The term motivation has been unpacked in different ways in science education. For example, Koballa and Glynn (2007, p. 85) define motivation as the "internal state that arouses, directs and sustains students behavior" whilst Brophy (1983, p. 200) describes it as the "enduring dispositions of learners to find learning process relevant and worthwhile in order for them to take pride in the outcomes of experience involving knowledge acquisition or skills development". Koballa and Glynn (2007) and Brophy (1983) believe that motivated learners achieve academically by engaging in class participation, question asking, seeking advice, studying and participating in study groups.

According to Palmer (2005), the aim of motivation is to give directions in understanding individuals' behaviour performing different activities. In the context of this study, this refers to the science camp participants and their participation in scientific inquiry activities. Palmer (2005) further posits that motivation can be applied to any process that activates and maintains learning behaviour. Motivation to learn science promotes learners' construction of their conceptual understanding of science (ibid.). Motivation is a very important educational variable as it promotes both new learning and new skills (Barlia, 1999). Barlia further argues that if learners perceive the value of science learning tasks, they will actively participate in these tasks to construct a meaningful understanding of a new science concept based on their existing knowledge and hence their motivation to learn science will increase.

Lee and Brophy (1996) explain that learners' motivation in learning of science results in the active participation in science-related tasks in order to achieve a better understanding of science. Concurring, Martin (2002) argues that there are outside school environmental factors that affect learners' motivation towards science which could be attributed to home life, parental influence, and peer pressure.

2.3.2 Dispositions and informal science learning environments

Bourdieu's (1993) seminal work provides a platform for ideas about dispositions. He poses that behaviour is not a stand-alone entity but it comes out of a person's *values*, *attitudes* and *beliefs* about life and learning and the communities in which they find themselves. He further argues that dispositions are instilled through childhood, socio-cultural, and historical experiences and are shaped by schooling practices.

In a study of the impact of informal learning, Friedman (2008) for instance, found that dispositions depend on the personal, physical, socio-cultural context and may only be evident after the experience. Undoubtedly, the two terms dispositions and attitudes are often used interchangeably in most studies (Agunbiade, 2016).

In my study, however, I have opted to use dispositions throughout my thesis, mostly for the reason stated by Crick and Goldspink (2014), who state that disposition refers to a person's certain

response behaviours in new learning spaces. In the case of this study, science camp was a new learning space for the learners. Osborne et al. (2003) expound that attitudes are feelings, beliefs and values about something. Agreeing, Crick and Goldspink (2014) argue that in the disposition process the shifting to and fro of opinion changes, until a given moment when they become attitudes.

For example, Walshaw (2012) ascertains that teaching and learning in the form of projects or experiments helps to foster connections between the real-world experiences and motivates learners to learn. In my study, this was observed when learners were exposed to the rocky shore context which was new to them and did not withdraw from participating, instead they were willing to participate in the experimental inquiry activity. Inquiry is often seen as an active learning strategy for learners to construct new knowledge based on their previous understanding.

The involvement of learners in the science camp inquiry activity made it easier for them to reflect on their dispositions about scientific inquiry. To this end, Damon (2005) and Crick (2009, 2012) perceive dispositions as individualised mental and moral qualities that make us who we are and frame our future learning paths. Raths (2001) views dispositions as skills and practices that are directed towards learning a particular subject.

In the informal learning science learning experience,

learners will develop dispositions to reason scientifically only if they have a chance to develop understanding, develop interest, have social interactions that help them to sustain their interests and see the value in what they are learning to do, and make connections between what they are learning and their own lives. (Clegg & Kolodner, 2014, p. 38)

Clegg and Kolodner (2014) proposed a framework and named four building blocks that promote development of learners' dispositions. These building blocks are:

- procedural and conceptual understanding supports learners' efforts to develop the competence needed to engage in scientific inquiry;
- interest helps learners develop a curiosity about the world – a desire to learn more;

- social interactions promote learners' engagement in communities of individuals who share similar interests, as well as communities to which they can make contributions; and
- personal connections help learners develop personal values for scientific inquiry and reasoning and a commitment to engage in scientific inquiry.

2.4 Relationship between Motivation and Learning Environment

Science learning is not only confined to classroom environments. Instead, learning can take place in a variety of contexts including informal learning environments. Riedinger (2011) posits that informal science learning complements and supports the classroom learning environment by fostering interest and motivating. It also helps learners feel that they have shared control over their learning (Riedinger 2011). In an informal environment learner feel free to express their views and interact with each other to improve their science learning (Taylor, Fraser, & Fisher, 1997).

Fraser (2012) placed emphasis on the importance of learner perceptions of the classroom environment. Pintrich, Smith, Garcia and McKeachie (1993) explain that learning environment structures are task structures, authority structures, evaluation structures, classroom management, teacher modeling and teacher scaffolding. These structures quite similarly correspond to learning environment dimensions.

In my view, if the aim of science education is to go beyond rote learning and memorisation and enable meaningful understanding, learner motivation should also be factored into learning environments.

It is stated that there is a relationship between learners' perceptions of classroom environments and their *cognitive* and *affective* outcomes (McRobbie & Fraser, 1993). If the learning environment is conducive for learning through teaching approaches, it motivates learners to freely voice their own thoughts and share their opinions (Aldridge & Fraser, 2008; Fraser, 2012). Also, if the learning environment allows a democratic space, learners become more motivated by internal goals and processes of learning (Vedder & Weiss, 2011). These arguments suggest that the nature of informal learning environments play a pivotal role in motivating learners during the learning process.

2.5 Informal Learning Environments

Science education is conducted predominantly in three types of learning environments: classroom, laboratory, and informal learning environment. Riedinger (2015) argues that learning science is not confined to the classroom. Instead, learners learn in a variety of contexts and from a number of sources, including learning in informal learning environments. Such informal learning environments include science centres, museums, after-school programmes, science fairs and science camps. Through participation in these communities of practice, learners engage in mutual practice, imagine and consider other identities, and align their efforts to those of the community. In my view and according to observations during the marine science camp, learning environments influence motivation and interest.

2.6 Scientific Inquiry and Motivation

Scientific inquiries are activities through which learners develop knowledge and understanding of scientific ideas and the methods that scientists use to study the natural world (National Research Council (NRC), 1996). As alluded to earlier, the latest South African CAPS curriculum in science education emphasises the importance of learners developing current understandings of the nature of science and scientific inquiry (South Africa. DoBE, 2011). The rationale behind this aim is the development of scientific literacy for all learners.

Nhase (2019) argues that inquiry-based approach plays a crucial role in developing young learners' basic scientific process skills and scientific literacy from an early age. Scientific literacy is associated with the ability to make informed decisions in relation to science and technology-based issues. In my view scientific literacy is linked to better understandings of scientific concepts, the processes of scientific inquiry, and the nature of science. Unfortunately, Tshiningayamwe (2016) has shown that learners do not develop such understandings through their participation in school science, due to the fact that some science teachers are incapacitated to conduct scientific inquiry activities. The only exposure to scientific inquiry learners get, is when outside school organisations provide help during science expo projects (Kahenge, 2013; Agunbiade, 2016).

Lederman, Lederman, Bartos, Bartels, Meyer and Schwartz (2014) reveal that to better understand learners' views about scientific inquiry, learners should be involved in some form of scientific inquiry experiences so that they can better reflect on the inquiry experience. Therefore, drawing on Lederman et al.'s (2014) seminal work, this study used a study of rocky shore community as a scientific inquiry experience. This claim is supported by proponents such as Fields (2007), who likewise contends that science camps play a crucial role by addressing affective aspects of learning such as attitudes, interest, attempt to increase motivation and confidence among science camp participants. In support, Sibiyi (2015) considers science camps as a valuable tool that could be used to positively stimulate participants' scientific inquiry skills, knowledge and develop love for science.

Research around science camps by Riedinger (2015), confirms that marine science camps can provide participants with access to resources for scientific inquiry which are not always available in the formal school setting. Research equipment, basic skills of doing inquiry, and professional scientists are examples of resources provided by science camps that may influence participants' motivations and attitudes towards science (Markowitz, 2004). During the science camp – the practical activity at the rocky shores – learners were given an opportunity to use tools such as a refractometer to measure the salinity; they found this very interesting as some learners were not aware there is an instrument to measure salt content.

In his study conducted in Phalaborwa, South Africa, Sibiyi (2015) revealed that science camps seem to be an answer to ignite learners' interest in Science, Technology, Engineering and Mathematics (STEM) careers. He engaged learners in practices of scientific inquiry, which included asking scientific questions, informing those questions through scientific methods means, analysing, and communicating their study findings.

His findings revealed that the majority of the science camp participants were motivated and developed a positive attitude towards science as a result of participating in a scientific inquiry. As a result, some learners later chose careers in science related fields. Scholars who are proponents of scientific inquiry such as Bischoff et al. (2008), Fields (2009), Lederman et al. (2014) and Ngozo, Sewry, Chikunda and Kahenge (2016) to name a few, suggest that participation in out-

of-school science learning experiences have a positive influence on participants' attitudes towards science in both the short and long term.

While learning and teaching of scientific inquiry is clearly stipulated in the CAPS curriculum document, Lederman et al. (2014) observe that research on the development of knowledge about inquiry has not been given much attention. They suggest that understanding about scientific inquiry should be understood by scientifically literate communities, specifically in science camps. This study used a marine science camp to understand learners' motivation and dispositions towards scientific inquiry. This study aimed to add to existing knowledge about the influence of marine science camps on learners' motivation.

2.7 Science Camps as Informal Learning Environments

Science camps are alternative strategies for informal science education as they have specific features that distinguishes them from other informal science learning environments (Foster & Shiel-Rolle, 2011; Riedinger, 2011).

In light of this, Foster and Shiel-Rolle (2011) state that science camps are a platform to provide an outside classroom atmosphere for learning to take place in an informal way, and where learners are introduced to hands-on experiences. They further acknowledge that in order for learners to understand the world around them, education should not only happen in a confined classroom environment or from a textbook (Foster & Shiel-Rolle, 2011).

Instead, learners need to be exposed to the world of reality beyond the classroom. Likewise, the Department of Basic Education (South Africa. DoBE, 2011) also suggests that the environment where learners get skills should support creativity and stimulate minds.

Bischoff et al. (2008) also believe that science camps aim to provide conducive learning environments whereby learners brainstorm ideas, and find solutions to scientific problems in their small groups. Bischoff et al. (2008) maintain that team work and active participation (Sedlacek & Sedova, 2017) in a camp may yield the formation of new relationships within the group. They

further argue that when high school learners are exposed or participate in the science camps, they may consider pursuing science careers at tertiary level.

This was also mentioned by Ngcoza et al. (2016) in their study conducted in South Africa, that learners who participated at the Science Expos found the experience of participating exciting. As a result of their participation in the expo, they pursued science related careers. It is therefore reasonable to think these results extend to the case of marine science.

Foster and Shiel-Rolle (2011) have similar views to those of Bischoff et al. (2008) and affirm that science camps provide a different learning approach for informal science education. They argue that at a science camp, a facilitator is able to introduce science concepts right in the field, where learners can have hands-on experience and first-hand information.

Based on investigation at the South African Environmental Observation Network (SAEON), we believe that for young people who have comparably low accessibility to the practicalities of marine and coastal environments, a short-term marine science camp led by practicing scientists is one of the best opportunities to develop marine awareness of and ocean literacy among disadvantaged learners. In my opinion, ocean literate learners are the leaders of tomorrow, as they need to be aware and understand marine science language so that they are part of marine ongoing conversations.

Foster and Shiel-Rolle (2011) believe that efforts to build positive attitudes to science learning should include the use of informal learning settings such as after-school programmes and science camps to complement classroom settings.

Scholars such as Foster and Shiel-Rolle (2011) and Riedinger (2015) suggest the importance of informal environments and the need to understand how learners learn in these contexts. Field (2009) posits that science camps improve learners' understanding of scientific inquiry. However, there are no studies that examine the influence of these science camps on learners' motivation and dispositions towards scientific inquiry, hence this study.

2.8 Chapter Summary

This chapter provided an overview of the theoretical frameworks informing my study. Vygotsky's (1978) Social Constructivism Theory and Wenger's (1998) Community of Practice have been described as lenses through which to understand learners' motivation and dispositions before and after participation at the marine science camp. Science camps as informal science learning environments and scientific inquiry platforms for social interactions were discussed. I also discussed the impact of these science learning environments on learner motivation and their dispositions thereof. Most importantly, the literature reviewed confirmed the choice of theoretical frameworks to guide this research. In the next chapter, I discuss the research design and methodology informing this study.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

In the previous chapter, I discussed literature relevant for my study whose main goal was to investigate the influence of marine science camps on learners' motivations and dispositions towards the scientific inquiry. In this chapter, I thus present the research paradigm, overall description of the methodology, research method, sampling of participants, data generation techniques and data analysis. In addition, I address the issues of trustworthiness, reliability and validity, as well as the ethical considerations.

In order to gain insights in this study, I used an exploratory paradigm, and qualitative and quantitative case study approaches. In this chapter, I will justify the choice of case study and the route I took to gather data and to analyse it.

3.2 Research Orientation

In order to understand the influence of science camps on learners' motivation and dispositions, I decided to employ a mixed method case study approach underpinned by an interpretive paradigm (Cohen, Manion, & Morrison, 2011; Bertram & Christiansen, 2015). Cohen et al. (2011) state that an interpretive paradigm aims at understanding the subjective world of human experiences and it is concerned with the individual's actions or interpretation during a certain process.

Despite many definitions of a mixed method approach in literature, I have adopted the definition presented by Kelle (2006), which states that mixed methods mean the combination of different qualitative and quantitative methods of data collection and data analysis in one research study. He argues that the combination of qualitative and quantitative can help to discover and to handle threats against validity arising from the use of qualitative or quantitative research methods (Kelle, 2006). He also accentuates that the mixed method can be used to gain a fuller picture and deeper

understanding of the investigated phenomenon, by relating findings to each other which result from the use of qualitative and quantitative research methods (Kelle, 2006). Mixed method can also assist in the validity issues and can enhance triangulation of data.

Similarly, Aikenhead (1997) states that the interpretive paradigm is based on the understanding of experiences of individuals. This is based on the belief that reality is socially constructed. The interpretive paradigm helped me draw inferences from the information and look for patterns in my data. Within the interpretive paradigm, an exploratory case study approach was employed.

3.3 Mixed Method Case study

A case method is an approach that provides unique examples of real people in real situations and enables readers to understand ideas more clearly (Cohen et al., 2011). Case studies can blend both qualitative and quantitative data and can explain, describe, illustrate and enlighten (Yin, 2009). This study lent itself to a mixed method approach to generate my data. That is, I used both quantitative and qualitative approaches to gain insight into the research goal, which is how the rocky shore science camp influences learners' motivation and dispositions towards scientific inquiry.

A case study is described as an in-depth description of a process, experience, or structure at a single institution. In order to answer a combination of 'what' and 'why' questions, case studies generally involve a mix of quantitative (i.e. surveys, usage statistics, etc.) and qualitative (i.e. interviews, focus groups, extant document analysis, etc.) data generation techniques. In most cases, the researcher analyses quantitative data first and then uses qualitative strategies to look deeper into the meaning of the trends identified in the numerical data.

Despite many definitions of a mixed method approach in literature, I have adopted the definition presented by Kelle (2006), which states that mixed methods mean the combination of different qualitative and quantitative methods of data collection and data analysis in one research study. He argues that the combination of qualitative and quantitative can help to discover and to handle threats for validity arising from the use of qualitative or quantitative research methods (Kelle, 2006). He also accentuates that the mixed method can be used to gain a fuller picture and deeper understanding of the investigated phenomenon by relating findings to each other which result from

the use of qualitative and quantitative research methods (Kelle, 2006). Mixed methods can also assist in validity issues and can enhance triangulation of data.

Cohen et al. (2011) argue that case studies can be easily understood by the wide range of audience such as academics and non-academics. It is recognised, however, that a case study is not without flaws, as the results may not be generalised. I specifically chose a case study and mixed method approach, for the reason that they allow the researcher to obtain thick and rich description in order to examine the issue in great depth as suggested by Cohen et al. (2011). My case in this study was therefore understanding the influence of marine science camps on learners' motivation and dispositions towards scientific inquiry.

3.4 Case Selection and Description

Yin (1994) states that case studies involve an in-depth investigation of a single or multiple events and asking questions that will enrich a researcher's understanding as to why and how the real-life event happened the way it did. This study focused on the influence of science camps on township secondary school learners' motivation and dispositions towards a scientific inquiry experience. Riedinger (2011) focused her study on the development of learners' identity at a science camp, whilst Lederman, Antik-Meyer, Bartos and Lederman (2014) used science camps to develop learners' understanding of scientific inquiry.

Few studies have examined the effectiveness of science camps in motivating learners from the disadvantaged communities (Fields, 2009). Since I could not find a study that explored science camps as learning environments and their influence on learners' motivation and how learners view participation in the science camps in South Africa, in particular, I thought a study of this nature could give a better understanding of what motivates learners from township under-resourced schools to learn in the marine science camp environment.

Foster and Shiel-Rolle (2011), as well as Schulze and van Heerden (2015) identified this gap and suggested future research in this area. The aim of this study was to gain in-depth understanding of the influence of science camps on learners' motivation and dispositions (see Section 2.3). I had

hoped that the insights gained in this study would provide a better understanding of these learning environments.

In order to gain these insights, I selected a case which is a marine science camp programme. As explained earlier, science camps are described as informal learning environments involving intensive hands-on and structured small-scale scientific research, aimed at high school learners (Fields, 2009; Riedinger, 2011; Agunbiade, 2016). The purpose of the marine science camps was to stimulate learners' scientific knowledge, understand learners' cultural beliefs in relation to the ocean, ocean literacy and inquiry skills, by providing access to tools and expertise learners would not be exposed to in the classroom context.

Notably, marine science camps are designed in accordance with the Curriculum and Assessment Policy State (CAPS) document with the aim to produce learners that are able to collect, analyse, organise and critically evaluate information (South Africa. DoE, 2011).

In justifying the use of a marine science camp programme as a case, I believe that science camps offer well-designed experiments that are intended to create conditions that optimise opportunities to observe, document and measure change within learning environments (Kelly & Lesh, 2000). According to Bodner and Orgill (2007), science camps offer an opportunity to provide tools (artefacts, tools and language) to facilitate the construction of ideas.

This suggests that marine science camps as learning environments could provide rich opportunities for investigating how individuals and groups learn in those environments, specifically in a South African science education context. It is also of utmost importance to understand how science camp learning environment experiences affect motivation and disposition of learners to learn science.

3.5 Marine Science Camp Site

The marine science camps are held at Pine Lodge Resort, closer to where SAEON Elwandle Node conducts scientific research in Algoa Bay, Port Elizabeth in South Africa. Fields (2009) states that science camp programmes are offered in the exotic location such a wilderness and coastal marine environments. The Pine Lodge resort in Cape Recife has chalets where learners stay and are

provided with meals during the three day science camp. The resort is in the proximity of the rocky shores, making it easy to access Schoenmakerskop rocky shores to conduct mini-research. The resort also provides activities during break-away sessions. Below is the map showing Schoenmakerskop where the camp is held.

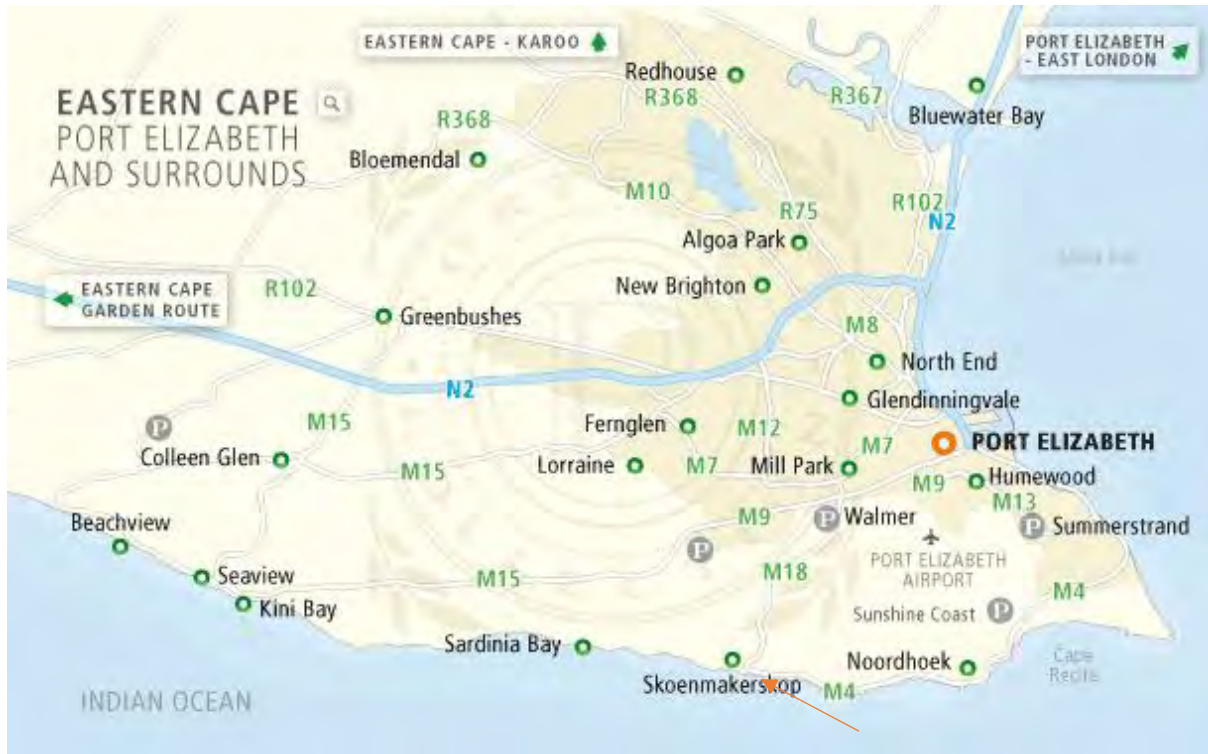


Figure 3.1: A map showing Schoenmakerskop where rocky shore inquiry occurs

The science camp programme includes a research vessel tour at the harbour, talks by scientists and hands-on practical activities based on the rocky shore inquiry.

Below I give a brief description of activities during the three day science camp, for the full marine science camp programme (Appendix 8).

Table 3.1: Shows brief description of the science camp activities

Science Camp Activity	Description
Research Vessels Tour	The camp participants arrived at the harbour and were taken to a research vessel (Agulhas 1) tour by the staff. They were taken to the bridge where most of the navigation happens.
Scientist's Talk	The scientist who was facilitating the rocky shore inquiry gave a brief talk about rocky shore ecology. She also gave guidance as to how the participants were going to collect data.
Rocky Shore Data Collection	The scientist led participants to collect data relating to temperate, salinity, and identifying and counting species occurring in different zones of the transect line.
Data Analysis	Groups analysed and interpreted their data. All groups prepared their power point presentation.
Presentation	Participants presented their mini-research scientific inquiry to all at the science camp.

3.6 Sampling of Participants

Mertens (2005) describes sampling as the method used to select a given number of people from a population. In terms of sample size, Cohen et al. (2011) state that a correct sample size depends on the purpose of the study. They advise that 30 participants should be the minimum number if one plans to use statistical analysis.

For this study, I purposefully sampled 21 participants (seven boys and 14 girls). The number was limited to only 21 learners since science camps are expensive to run and this number is manageable in terms of logistical arrangements and makes facilitation easier, as well as obtaining data from the smaller group as proposed by Cohen, Manion and Morrison (2018).

The learners involved in this study were selected from township disadvantaged secondary schools, namely, four schools in Grahamstown, one school in Paterson, one school in Port Elizabeth and the last school from Uitenhage. These schools are all in the Eastern Cape Province and were chosen by the district Department of Education to be part of the SAEON science engagement programme,

hence the department gave permission to conduct this research (Appendix 2). The letter inviting learners to participate at the camp and in this research were sent out to school principals (Appendix 3 & 4). The selection criteria for the learners to come to the science camp, were that learners should be in Grade 10 and should be doing at least two of these subjects: Life Sciences, Physical Sciences, Geography and Mathematics.

Parents were also asked to sign consent forms if they wished their children to be part of the marine science camp, as well as the research (Appendix 5) Learners themselves were given consent forms to allow them to show their interest in the marine science camp (Appendix 6).

The class teachers selected learners based on their performance, in at least one of the above subjects, to attend the science camp. Since all learners were going to travel from different towns, parents were requested to sign the indemnity form (Appendix 7) if they wished their children to travel. Learner profiles are presented in the next chapter.

All learners were isiXhosa speakers and English was their second language. Although the Language of Learning and Teaching (LoLT) in many schools in South Africa is English, consistent with Vygotsky's (1978) social constructivist perspective, at the camp, learners were allowed to discuss in their mother tongue and then translate to English when reporting. I observed that when learners were talking to each other they would speak in isiXhosa, which is the language that was spoken by all learners at the camp. One learner said "*Ndiyayazi yintoni kanene ngeNgesi?*" (I think I know what it is in English?).

Accompanying the learners were three teachers and a school principal. On arrival at the Pine Lodge Resort, learners were divided into groups of about four with one group having five learners to form investigative groups. They were mixed gender groups and learners were from different schools to encourage friendships.

3.7 Data Generation Techniques

Data gathering techniques refer to the research tools and instruments that were employed to collect the necessary data for this study. Questionnaires, learner reflection journals and focus group interviews were the data collection tools in this study.

3.7.1 Questionnaires

Questionnaires were the first data gathering tool I used in this study. The research participants were given questionnaires to complete before they attended the science camp. Before the camp I visited all the participants in their schools, so that I could meet participants face-to-face and administer the questionnaires in the presence of a teacher. After the marine science camp programme (Appendix 8) had come to an end, the participants were then given the same questionnaire to complete. The main aim was to measure and understand learners' motivation towards science before and after the science camp.

I adopted the questionnaire from Tuan et al. (2005) and it was on Students' Motivation Towards Science Learning (SMTSL) (Appendix 9). I used this tool, which comprised of a Likert scale questionnaire ranging from strongly disagree, disagree, not sure, agree and strongly agree. Furthermore, a questionnaire is a useful instrument for collection of statistical useful information, is highly structured and directly to the point (Cohen et al., 2011). The use of a questionnaire in my study was important since it assisted in collecting statistical data, as the study employed a mixed methods data collection approach. Questionnaires helped me to gather quantitative data, whereas with focus group interviews and learners' reflection journals I generated qualitative data.

3.7.2 Learner reflection journals

Meth (2003) states that using journals or diaries can give the researcher insight into the experiences and change the researcher-participant power dynamic. Furthermore, journal writing is useful, as when participants reflect on diaries they have the autonomy to share what they want. Researchers that study informal learning environments also use journaling to capture participants' experiences in these contexts (Falk & Dierking, 2000; Riedinger, 2011).

The purpose of reflection journals in this study was to gain access to the learners' dispositions on their experiences of the scientific inquiry experience at the marine science camp. I provided participants with exercise books and added guiding questions daily to prompt the reflection of their daily experience and their views on the experience (Appendix 10).

They were given reflection guiding questions as homework to do in their rooms every night before they went to bed. I was hoping to see more or less the same pattern of reflections from those sharing the same rooms, but it was not the case. It seemed as if they were writing their individual views without discussing them as I assumed they would do. In the reflection journals, I also realised that some participants would give an answer in one sentence, while others would dwell on the answer and give examples to explain their views. If I were to do this study again I would encourage reflection writing as a daily exercise. This also suggests that there is need for science teachers to encourage their learners to write reflections.

Camp participants were asked to write their pseudonyms on their reflection journals to protect their identity, as was agreed upon by both parents and schools through the consent forms. The reflection journals were collected every morning from the participants to avoid the risk of being lost. The data generated from the learner reflection journals and focus group interviews were then transcribed, coded and entered into categories, and then analysed using motivation constructs and indicators of dispositions developed by Atallah, Bryant and Dada (2010) as shown in Table 3.2 below.

Table 3.2: Shows indicators of science dispositions

D1	Describing their ability in science (themselves as learners)
D2	Describing their attitudes towards science
D3	Describing their expectations about science (what will it help them achieve)
D4	Describing the learning approaches used to study science (for example, deep/surface learning)
D5	Describing the perceived value of science
D6	Describing the evidence that they would provide to others as “proof” that they have learned science

3.7.3 Focus group interviews

For this study, focus group interviews were used as another data gathering tool. The aim of using focus group interviews was to generate rich data or dig deeper so that I could compare with what learners had indicated in the questionnaire, as suggested by Patton (2002), something which helped me to understand learners' motivation and dispositions from the viewpoint of the participants. Focus group interviews are recognised by the interaction within a group to discuss a topic and bring about the views of the participants that yield data and results (Cohen et al., 2018).

I conducted four focus group interviews with three learners from each of the four schools. I arranged times with them during their lunch break. I had a list of interview questions (Appendix 11). These learners had participated at the science camp and were from four different schools in Grahamstown. I chose these learners based on the fact that they were easily accessible. That is, if I wanted to go back for clarity, I would be able to do so with ease. I was conscious of the limitations of focus group interviews, that one talkative or confident learner might dominate the interview. In order to avoid one respondent dominating the interview, I made it clear that they were allowed to communicate in their mother tongue to voice their views. Furthermore, if they were in disagreement they should say so. Since all learners were isiXhosa speaking, this made them loosen up and speak openly quite easily.

All participants were asked the same questions following the same order as suggested by Cohen et al. (2011). There were times I realised when answering the questions that participants would answer the following question, and I tried to be flexible and skip some of those questions or reword questions where necessary. I asked open-ended questions to dig deeper for the information that might have been left out in the interview questions, so that I could get much more data from the respondents. Cohen et al. (2011) suggest that the researcher should provide some sort of support to the respondents, so that they know and understand what sort of reply is sought. For instance, in some cases when learners did not understand the questions, they asked me to repeat and rephrase it. In contrast, in some groups I had to probe to dig deeper to support the respondents so that I could get rich information.

All four focus group interviews were audio-taped with the permission from participants. The time of the interviews varied from 10 minutes to 15 minutes, depending on the members of the groups. Groups with more females were more talkative, whereas groups dominated by males were less talkative. My assumption for this is that females may have been motivated by interacting with a female scientist and they associated themselves with her. I later transcribed all interviews verbatim so that no information was lost. Although focus group interviews were used as a primary source of data, these were augmented or complemented with data from observations and field notes.

3.7.4 Observation and field notes

In this study, I used field notes and observations to complement narratives from the reflection journals and focus group interviews. I was particularly looking for learner social interactions during their inquiry activity, as indicated by social constructivist theory and communities of practice frameworks. I wrote my observations in my research journal which I kept throughout this study. This method was not entirely easy as I was a participant observer and missed some moments. However, what I managed to capture was documented, especially when camp participants were analysing their data and putting together their presentations. If I were to do this study again I would rather use a video recorder so that I could capture all the moments. When I wrote in my journal I also looked at how learning was taking place and noted the theory that was related to that particular activity. The example I can offer is when a scientist showed learners how to sample a transect line, and as proposed by Brunner (1996), she scaffolded learners in such a way that by the time they moved to the next quadrant, they were able to do it on their own.

Table 3.3 is the summary of data gathering tools and their purpose in the study. Furthermore the data analysis for this study is discussed.

Table 3.3: Shows methods of data collection, data collected and the purpose

Stage	Method used to gather data	Data collected	Purpose
Stage 1 Pilot	I piloted my research question with camp participants i.e. Grade 10s of 2016.	Learners' motivation and perceptions of participating at the science camp	To test research question and data gathering tools so that I could improve on them if there was a need to do so.
Stage 1	Pre-camp questionnaire	Statistical data on learner motivation towards science learning. Using SMTSL questionnaire.	To get graphical understanding of pre-camp learner motivation towards science learning before the rocky shore science camp.
Stage 2	Observations and field notes	Observe and document learner interaction within the CoP.	To observe (with or without participation) and to understand whether participants did what they say they did.
Stage 3	Learner reflection journal	Qualitative data written by learners themselves.	To understand learners' views from participants' narratives.
Stage 4	Post-camp questionnaire	Numerical data.	To understand learner motivations and shift in dispositions.
Stage 5	Focus group interviews	Focused (guided by a set of questions) and interactive session with a group small enough for everyone to have chance to talk. Qualitative data collected.	To understand diversity of opinions.

3.8 Data Analysis

Data analysis as described by Cohen et al. (2011) involves organising, managing and explaining the data in terms of participants' definitions so that they make sense and taking into account patterns, themes, categories and regularities.

The unit analysis for this study was social interactions which were going to help me understand the development motivation (if any) and dispositions of the learners participating at the camp.

I used the SMTSL instrument as a tool to gather data about learner motivations pre- and post-science camp. The instrument had 35 statements which were related to motivation. Tuan et al. (2005) developed six motivation constructs, self-efficacy, active learning strategies, science learning value, performance goal, achievement goal and learning environment, but I only focused on three constructs, that is, self-efficacy, active learning strategies as well as learning environment stimulus. These three motivation construct provided both aspects of extrinsic and intrinsic motivation. I administered these questionnaires so that if learners were unclear about any question, I could provide clarity immediately; also, I wanted to make sure that these were completed by these learners themselves and that they were all returned.

After the questionnaires were completed, I created a motivational rubric (Appendix 12) based on the questionnaire to understand each motivational construct. I allocated scores, for example, one, to show low levels of motivation, two, for moderate motivation and three, for high level of motivation. Secondly, I used these rubric scores to get a sense of learners' levels of motivation, such as if the learner scored 1 that meant that the learner had low motivation; two meant medium motivation and three meant high motivation as shown in the level of learners' motivation data table (Appendix 13). I also used these scores to find out which motivational construct showed a distinctive change.

When analysing the data, I analysed all the motivation constructs suggested by Tuan et al. (2005), but my main focus was only on three motivation constructs, namely: self-efficacy, active learning strategies and learning environment. The data were coded and categorised and were entered into the table. An example is provided below.

Table 3.4: Shows sample data on motivation constructs

Motivation construct	Item. no	Data Source
Self-efficacy	7	PCQ1 ² & PCQ2 ³ , FGI ⁴ , LRJ ⁵
Active learning strategies	8	PCQ1 & PCQ2, FGI,LRJ
Learning environment	6	PCQ1 & PCQ2, FGI,LRJ

In order to understand learner dispositions, I adapted a framework presented by Atallah et al. (2010, p. 48) for mathematical dispositions. I drew from their template and applied flexibility by developing an analytical memo which I found to be appropriate for analysing dispositions. I selected this tool as I thought it was closely aligned to the research questions. Themes that emerged from learner narratives fitted well with this framework.

² Pre-Camp questionnaire 1

³ Post-Camp Questionnaire

⁴ Focus group interview

⁵ Learner Reflection journal

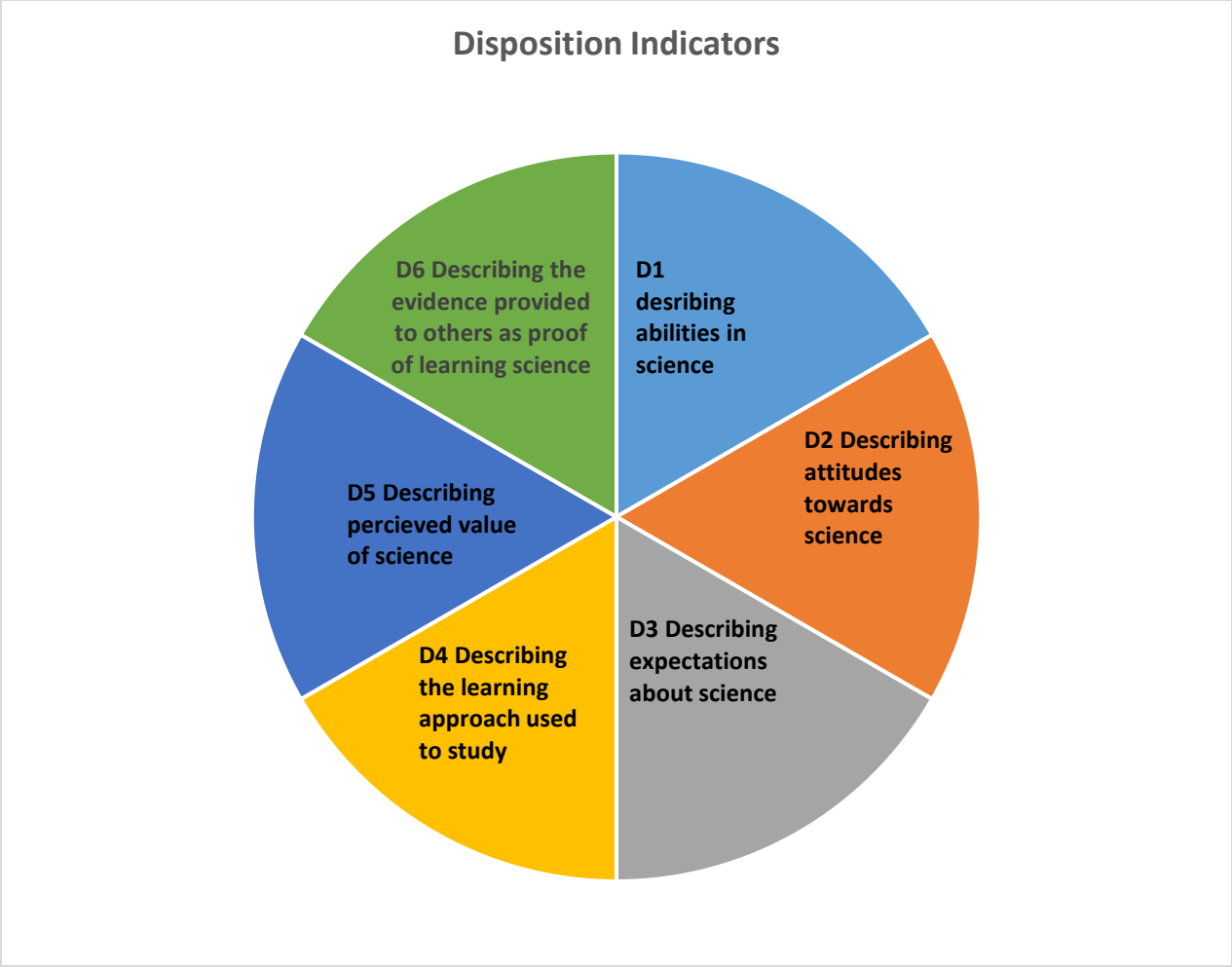


Figure 3.2: Shows disposition indicators

The use of the above diagram as a tool assisted in analysing disposition trends and patterns of learner narratives from both focus group interviews and reflection journals. The narratives were colour coded and placed according to disposition numbers, for instance, narratives that had to do with learners’ ability in science were highlighted in blue and then were put under the D1 column. Orange-red was for D2, grey for D3, yellow for D4, dark blue for D5, and green for D6.

3.8.1 Data Management and analysis

Bertram and Christiansen (2015) suggest that data analysis means drawing inferences from raw data. This study employed various data gathering techniques to strengthen and compliment data collected. Data analysis is explained below.

3.8.2 Data coding

Cohen et al. (2011) state that coding enables the researcher to identify similar patterns, trends and similarities and enables the researcher to retrieve information easily. I used all data from sources such as learner reflection journals, focus group interviews and observation notes. Before analysing the raw data, I labelled and filed it according to the source so that it was organised and easily retrievable. I transcribed all the reflection journal data and focus group interviews. I made sure that I had a special folder on my computer to store data and a hard copy as a back-up. From this, I commenced coding the raw data by organising it into categories. I came up with categories for all six indicators of dispositions shown in the diagram above and three themes for motivation. I then underlined all sentences that related to the categories. Thereafter, at the beginning of each underlined sentence I used different colour circles, for instance, for all the data that is related to learning approaches I used a blue circle, green circles for perceived value, red circles for ability to learn the subject, yellow circles for learning expectations and grey circles for attitudes towards science.

3.8.3 Creating analytical memo

The list was further synthesised in order to streamline the data in an analytical memo.

Table 3.5: A sample analytical memo, showing disposition indicators

Category (Disposition indicator)	Extract	Reference
D1.	I know I can do well in science	FG ⁶ I1-PG ⁷ 1
D2.	I watch science series like discovery channel during my spare time	FGI1-PG2
D3	I did not know we can learn what we learnt in a small space of time, computer skills, presentation skills, inquiry skills	FGI3-PG3
D4	The teacher here uses different techniques to clear our confusions	FG2-PG3
D5	Everything is all about science	LRJ ⁸ -PG1
D6	Although at first we were nervous , we were able to come up with our presentation as a group	LRJ-PG 3

3.9 Validity and Trustworthiness

Member checking: I verified the data with research participants during the data collection phase. For instance, I read back most of the things that were said during focus group interviews. The teachers that formed part of the CoP were not just participants, but also offered support as critical friends. They did not always concur with my thinking; however, they offered support where they saw the need and advised accordingly where possible and that helped me strengthen my data generation process. One of the examples was when I wanted to conduct focus group interviews with participants. They suggested that going after school would not be ideal as some learners are

⁶ Focus Group interview

⁷ Page

⁸ Learner Reflection Journal

involved in other extra-mural activities. They organised venues to meet with participants. I made draft findings available to some of the teachers to give them an opportunity to check the accuracy of the study to avoid researcher bias. Cohen et al. (2011) suggest that completion of the draft case provides a final opportunity to test the credibility of the inquiry report as a whole. With the respondents, the purpose is to check for accuracy but also to provide evidence of credibility.

Evidence: I made sure that I kept and stored all the data in a logical manner from raw data to the analytical statements to make it easily accessible and as evidence of my own hard work. In order to ensure validity, I piloted the questionnaire with the previous Grade 10 learners. Furthermore, the questionnaire I used was validated and mostly used in science education research to understand Students' Motivation Towards Science Learning. The reliability of the questionnaire has been validated in different cultural contexts for example, in Taiwan with high school learners Tuan et al (2005) and with Greek university science students by (Dermitzaki, Stavroussi, Vavougiou & Kotsis, 2013).

Triangulation: I used multiple sources of data generation techniques such as learner reflection journals, focus group interviews, field notes, and cellular phone recordings to enable me to go back and listen in case I had missed some aspect during interviews. Triangulation was an on-going process throughout this case study. This was done to check facts and clarity. Cohen et al. (2011) describe triangulation as the use of two or more methods of data collection in a study of aspects of human behaviour. They further explain that triangulation techniques attempt to map out or explain more fully the richness and complexity of human behaviour by studying it from more than one point and by making use of qualitative and quantitative data.

3.10 Ethical Considerations

I considered ethical issues as important during the research. Proper channels were followed such as getting permission and access to schools. Firstly, the proposal to conduct research with learners from participating schools was endorsed by the district department of education, school principals, as well as class teachers. The school principals were thrilled and asked me to communicate findings with them. Although I had a long working relation with the schools, I still requested written

confirmation giving me access to learners. Consent forms were also sent to parents asking for permission to work with their children in this study.

When I approached the learners to tell them about my research, they were happy to participate. Furthermore, they allowed me to take pictures and use them for the purpose of this study. I informed the research participants personally, that I would be using the data generated for the purpose of my research. Efforts were made to follow Bassey's (1999) advice that researchers need to respect the origin of the data and ensure the dignity and privacy of the respondents. I tried my absolute best to adhere to this statement.

3.11 Chapter Summary

In this chapter, I provided the research paradigm underpinning this study. I justified the use of a mixed method case study methodology to understand and gain some insights into the research questions. I described my methods for the case selection and sampling of study participants, as well as describing the study context – the rocky shore science camp. I discussed my sources of data and how data were generated, managed and analysed. In the next chapter, I present my data and discuss my findings.

CHAPTER FOUR: QUANTITATIVE DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

The aim of the study was to investigate the influence of marine science camps on learners' motivation and dispositions towards scientific inquiry. This chapter aims to answer question one:

What are the learners' motivation before and after the camp?

In this chapter, I present, analyse and discuss quantitative data from learners that participated at the camp. The data sets were derived from the SMTSL questionnaires before learners participated in the science camp and after the science camp. I start this chapter by presenting the learners' and I did this in accordance to their age, gender, grade and language. Similarly, their diverse schools are also profiled.

4.2 Learners' Profiles

Each of the 21 Grade 10 learners who participated in the study provided their age, gender, school and their grade. All learners take science subjects such as Life Sciences, Physical Sciences, Geography and Mathematics. Their profile is represented in Table 4.1 on the next page.

Table 4.1: Shows the biographical information of the learners

Biographical Information	Category	Learner code	No of learners
Age	15	L2; L5; L11; L13;	4
	16	L1; L3; L4; L7; L9; L10; L12; L14; L15; L16; L17; L18; L20; L21	14
	17	L6; L8, L19	3
	Males	L5; L8; L9; L11; L12; L18; L19	7
Grade	10	L1-L21	21
Home Language	IsiXhosa	L1-L19 & L21	20
	Afrikaans	L20	1
Languages they are able to speak	isiXhosa	L1-L21	21
	English	L1-L21	21

From the 21 learners who participated in this study, 14 were females and seven were males. These learners were identified using the ‘L’ for both the questionnaires and journal reflections. Their ages ranged between 15 and 17.

The questionnaire was administered and completed before and after learners attended the marine science camp (see section 3). The study participants were from only four schools that is, school A, B, C & D. Learners were identified as with code “L” and the number with learner initials to maintain anonymity.

Table 4.2: School profile and learner profile

School code	Learner code	Learner Initials	Gender
School A	L6	YM	Female
	L7	AM	Female
	L8	SK	Male
School B	L3	ZN	Female
	L5	SN	Male
	L14	SS	Female
School C	L15	AN	Female
	L16	SY	Female
	L17	SM	Female
School D	L10	NN	Female
	L11	AV	Male
	L12	MK	Male
School E	L18	MG	Male
	L19	VM	Male
	L20	AG	Female
School F	L1	LG	Female
	L2	AF	Female
	L4	SX	Female
School G	L9	SS	Male
	L13	ZT	Female
	L21	UT	Female

4.3 Nature of schools

Schools A, B, D, F & G are predominantly isiXhosa speaking learners, while schools C & E are mixed schools with IsiXhosa and Afrikaans speaking learners. In all these schools the language of teaching and learning (LoLT) is English.

School A

School A is a school that has been participating in the marine science camp for a number of years. The mathematics and science teacher who has a Bachelor of Science (BSc) (mathematics) once attended the marine science camp, but prior to this study. The majority of learners are isiXhosa speaking, while there are a few learners who speak Shona and IsiXhosa.

School B

School B is located not far from school A. The Physical Sciences teacher who obtained a Bachelor of Education (BEd Hons) (science education) in this school has attended the marine science camps twice. The majority of learners are isiXhosa speaking. However, similarly to School A there are a few learners who speak both Shona and IsiXhosa.

School C

School C is a mixed school with Afrikaans and English speaking learners. None of the teachers have attended the marine science camps since we started them way back in 2010.

School D

School D is characterised by mostly isiXhosa speaking learners. The Physical Sciences teacher with BEd Hons (science education) has attended the camp once.

School E

School E is also a mixed school with the majority of the learners speaking both Afrikaans and isiXhosa. This is a new school that was recently added to the SAEON list of schools.

School F

School F has mostly isiXhosa speaking learners. There has been a change of science teachers, but even so, none of the teachers have ever attended the marine science camp.

School G

In school G, the majority of learners are isiXhosa speakers and a few learners speak Shona. The principal and the science teacher have attended the marine science camp.

4.4 Motivation Data Distribution

In order to test learners' motivation towards science, they were given a SMTSL questionnaire so they could choose their opinions. The questionnaire consisted of six motivational constructs, that is: self-efficacy, active learning strategies, science learning value, performance goal, achievement goal and learning environment. From each construct, two questions were selected for analysis to observe consistency.

4.4.1 Self -Efficacy

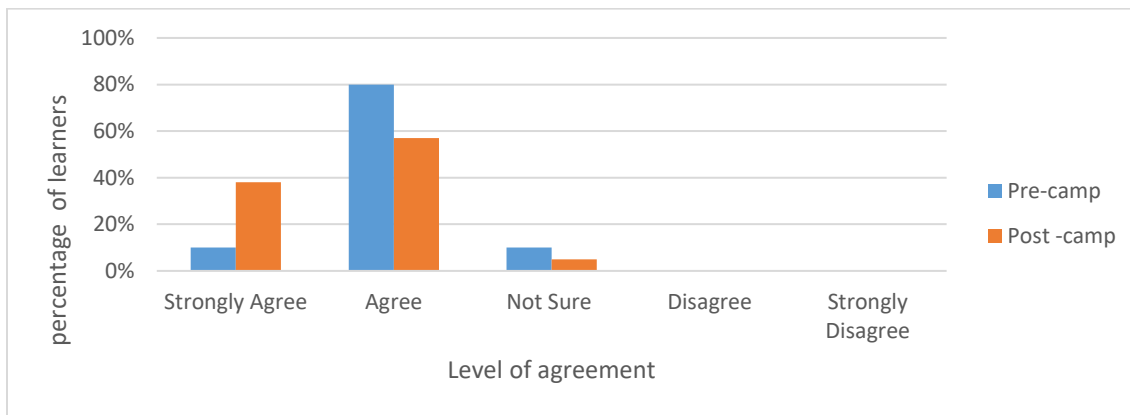


Figure 4.1: I am sure I can do well in a science test

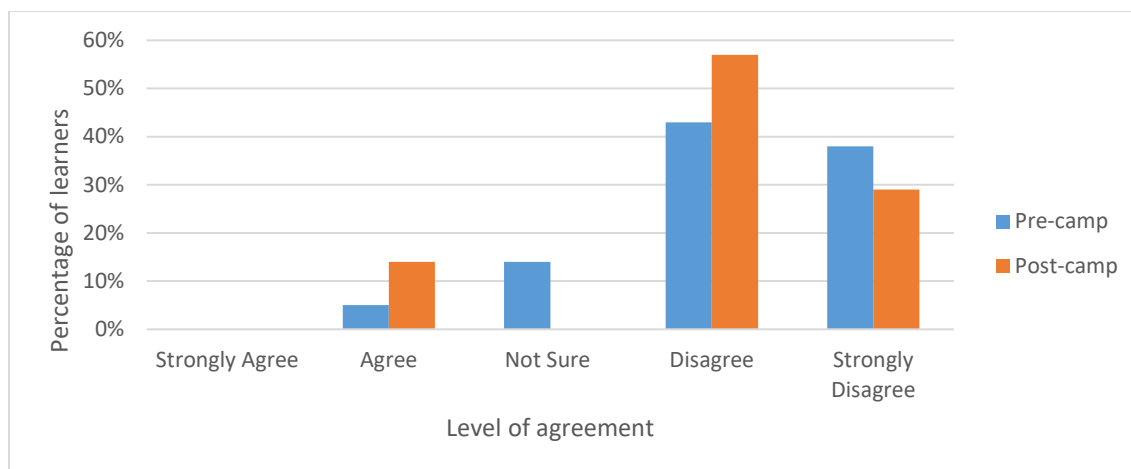


Figure 4.2: No matter how much effort I put in, I cannot learn science with understanding

The distribution of frequency reflected in Figure 4.1 revealed that when learners were given the self-efficacy statement: *“I am sure that I can do well in a science test”*, there were different responses before the camp with two (10%) learners not sure, another two (10%) who strongly agreed and 17 (80%) learners agreed. It is noticeable that after the camp, eight (38%) strongly agreed, 12 (57%) agreed, while only one (5%) was not sure.

Learners had varied responses from the statement which read: *“No matter how much effort I put in, I cannot learn science with understanding”*. Figure 4.2 shows that before learners participated at the camp only one learner (5%) agreed with the statement, while three (14%) were not sure, nine (43%) disagreed and eight (38%) strongly disagreed.

Surprisingly, after the camp there was a 9% increase whereby learners agreed with the statement – that is from one (5%) to three (14%) who agreed with the statement. The statement was asked in a negative form. Learners’ responses may have been affected by the nature of the statement or learners were giving their genuine views and it was their genuine answer. Twelve (57%) learners disagreed and six (29%) strongly disagreed. None of the learners were not sure after the camp.

4.4.2 Alternative learning strategies

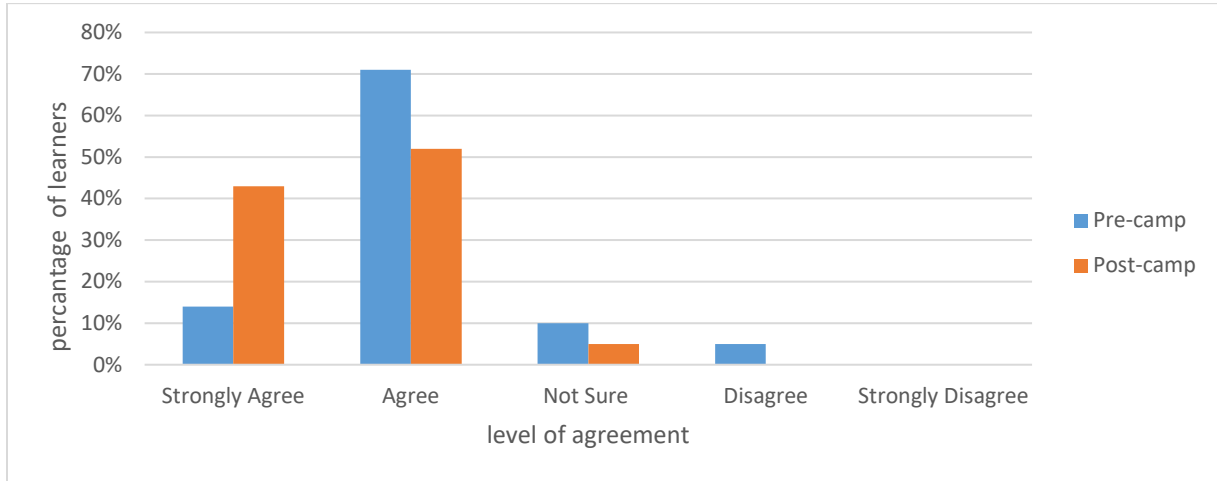


Figure 4.3: When learning new science concepts, I find relevant sources that will help me

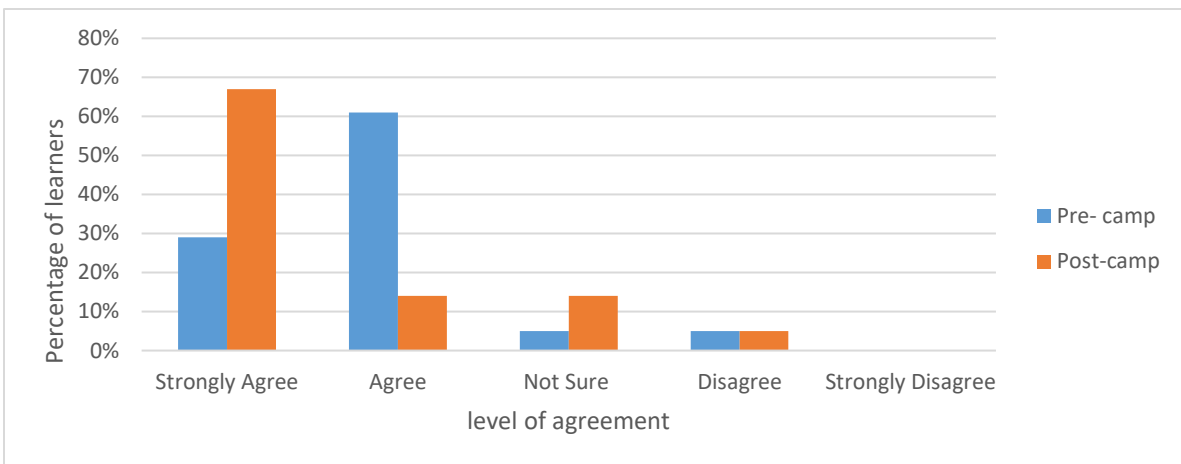


Figure 4.4: When I do not understand a science concept, I discuss with the teacher to clarify my understanding

Figure 4.3 shows learner responses to a statement that says that if learners are learning new science concepts they find other resources to help in the understanding of those new concepts. There was a big shift from three (14%) who strongly agreed with the statement before the camp, to nine (43%) who strongly disagreed after the camp. It was observed that 15 (71%) agreed with the statement before the camp, but after the camp 12 (52%) agreed with the statement. About four (19%) of the

learners moved from agree to strongly agree after the camp. The two (10%) not sure before the camp, became one (5%) after the camp. The one (5%) which disagreed before the camp shifted to agree after the camp.

Figure 4.4 shows that before the camp 13 (61%) agreed that when they do not understand science concepts they discuss these concepts with the teacher to clear their understanding. It was noted that after the camp, 14 (67%) of the learners strongly agreed with the statement. This resonates with the fact that the marine context is new to these township learners, as six (29%) agreed before the camp. It seems that the learners had asked the facilitator about the new marine concepts that they had never heard of previously.

There was only one (5%) who disagreed before and this remained the same after the science camp. There was one (5%) of learners who were unsure before the camp, interestingly, three (14%) indicated that they were unsure after the camp.

4.4.3 Science learning value

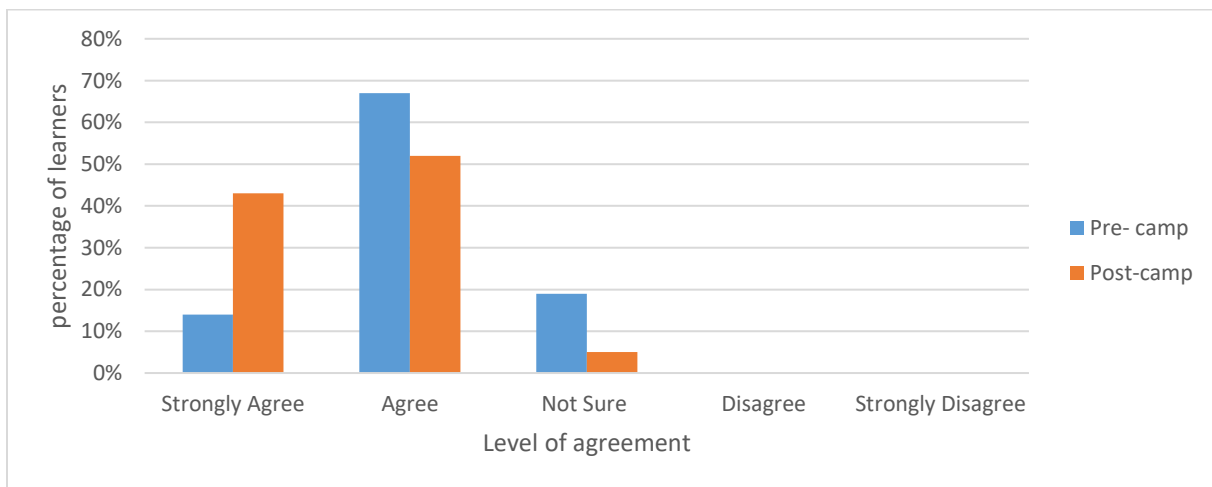


Figure 4.5: Learning science is important because it stimulates my thinking

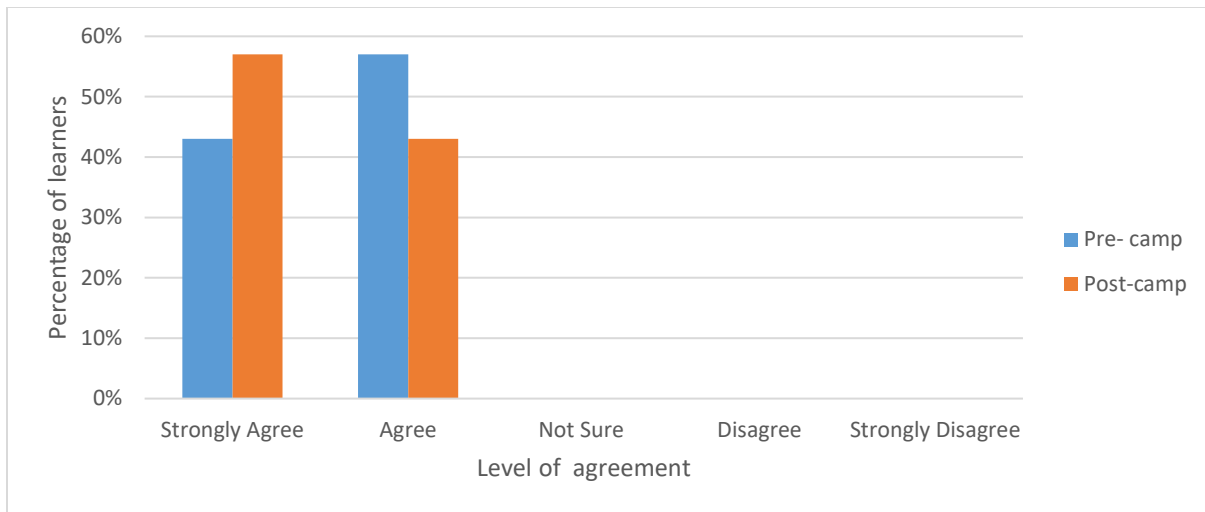


Figure 4.6: The importance of participating in inquiry/investigative activities in science

Figure 4.5 indicates that before the camp only three (14%) strongly agreed that science stimulates their thinking. After the camp, it was observed that nine (43%) strongly agreed. Interestingly, as the participants were science learners, this raised a question in that a few learners indicated they were not sure if science stimulates their thinking.

In Figure 4.6 the responses indicated a general tendency from agree towards strongly agree. In my opinion, learners were reasonably well informed about participating in science activities, as the responses indicated nine (43%) agree to 12 (57%) strongly agree. It was also noted that there were a few learners who were not sure if science stimulates their thinking, but they agreed that it is important to participate in science inquiry activities.

4.4.4 Performance goal

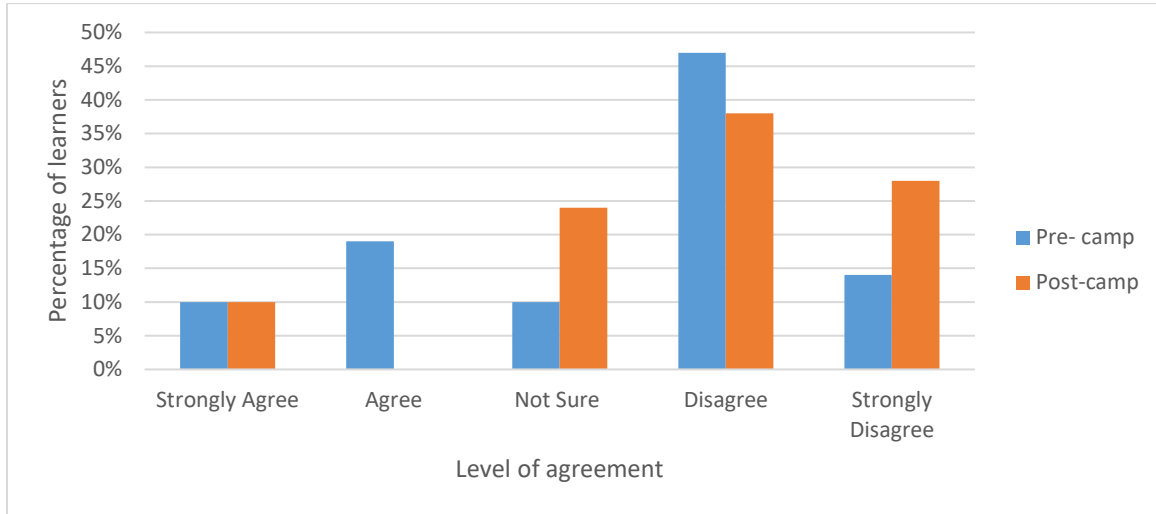


Figure 4.7: I participate in science class so that other students think I am smart

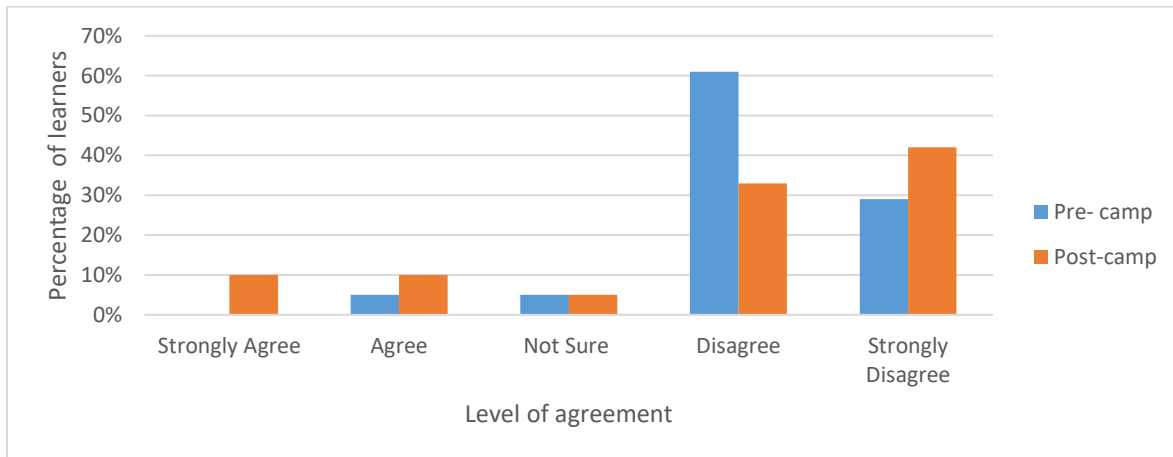


Figure 4.8: I participate in class so that the teacher pays attention to me

In Figure 4.7 there were varied responses; two (10%) strongly agreed before and after the camp that they participate in class so that other learners think they are smart. In my view, these are the competitive learners in class. About four (19%) agreed before, but after the camp they shifted to either not sure or disagree or strongly disagree with the statement. The majority of the learners 10

(47%) demonstrated that they did not agree with that statement, while six (28%) strongly disagreed.

In Figure 4.8, the statement wanted to assess if learners perform to attract the teacher's attention. There were different responses, but it was noted that the majority of the learners 13 (61%) disagreed with that statement, while one (5%) were not sure before and after participating at the camp. Given these responses, this suggests that the majority of learners perform for themselves and not to impress the teacher.

4.4.5 Achievement goal

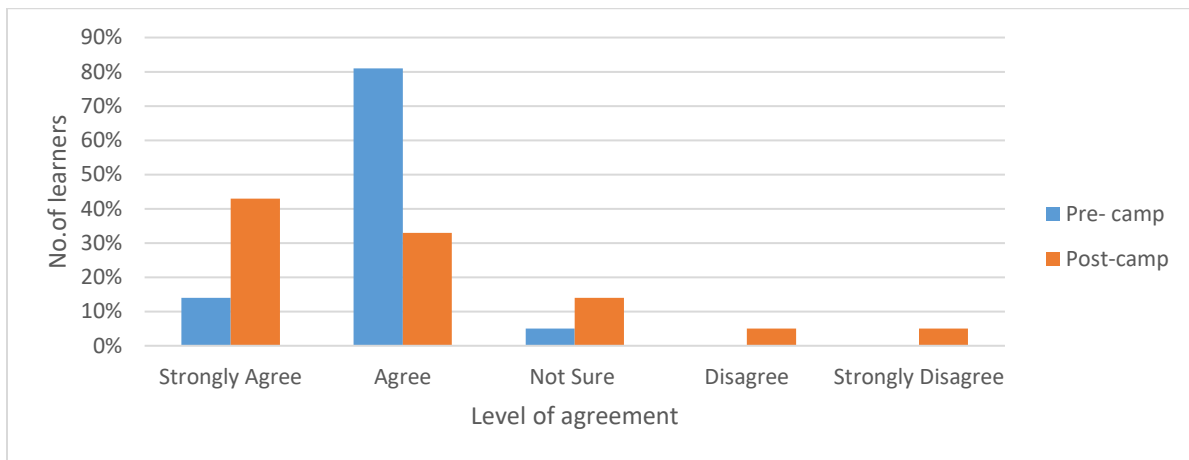


Figure 4.9: I feel most fulfilled when I feel confident about the content knowledge in science

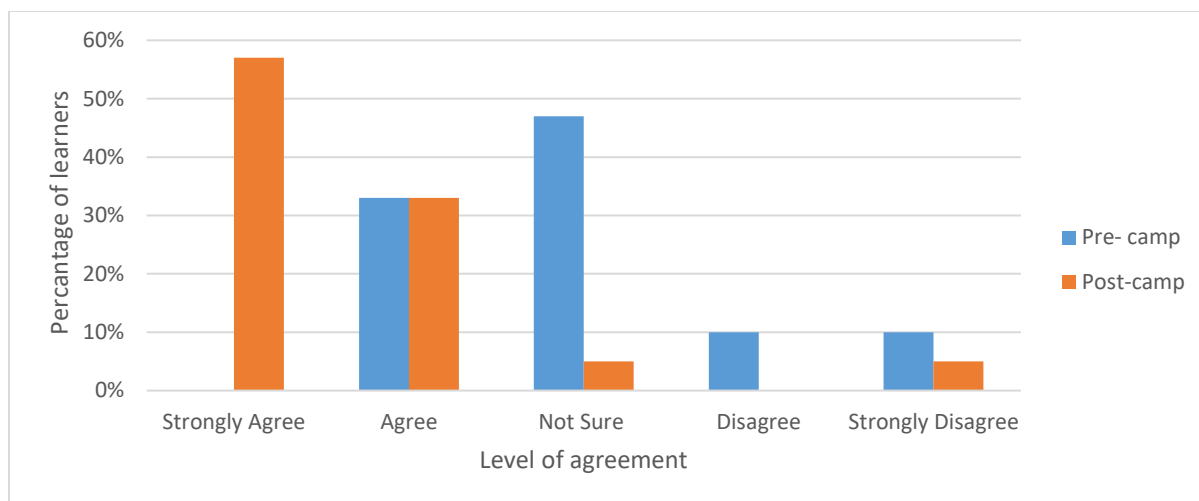


Figure 4.10: During science, I feel most fulfilled when I am able to solve a difficult problem

Figure 4.9 shows that when learners were asked how they feel about being confident about the content knowledge in science, learners' answers leaned towards agree and strongly agree. Before the camp 17 (81%) agreed with the statement; after the camp only seven (33%) agreed with the statement and nine (43%) strongly agreed after the camp. There was only one (5%) who disagreed and strongly disagreed after the camp.

In Fig 4.10, the statement sought to understand if learners are most fulfilled when they are able to solve difficult problems. It was observed that not a single learner strongly agreed with the statement before the camp; surprisingly after the camp, 12 (57%) strongly agreed that they feel most fulfilled when they are able to solve difficult problems. The not sure was 10 (47%) before the camp, which decreased to one (5%) after the camp.

It was also noticeable that there were a low percentage that disagreed with the statement. There are possible reasons these learners decided to disagree with the statement. One possibility could be that they disagreed due to the wording, such as 'most fulfilled' in the statement. There may be other areas that they feel more or most fulfilled. Before the camp, none of the learners strongly agreed with the statement; after the camp 12 (57%) strongly agree with the statement, while seven (33%) remained the same. The 10 (47%) that was not sure before the camp, was reduced

consequently to 5% after the camp. There was only one out of 21 (5%) who strongly disagreed with the statement.

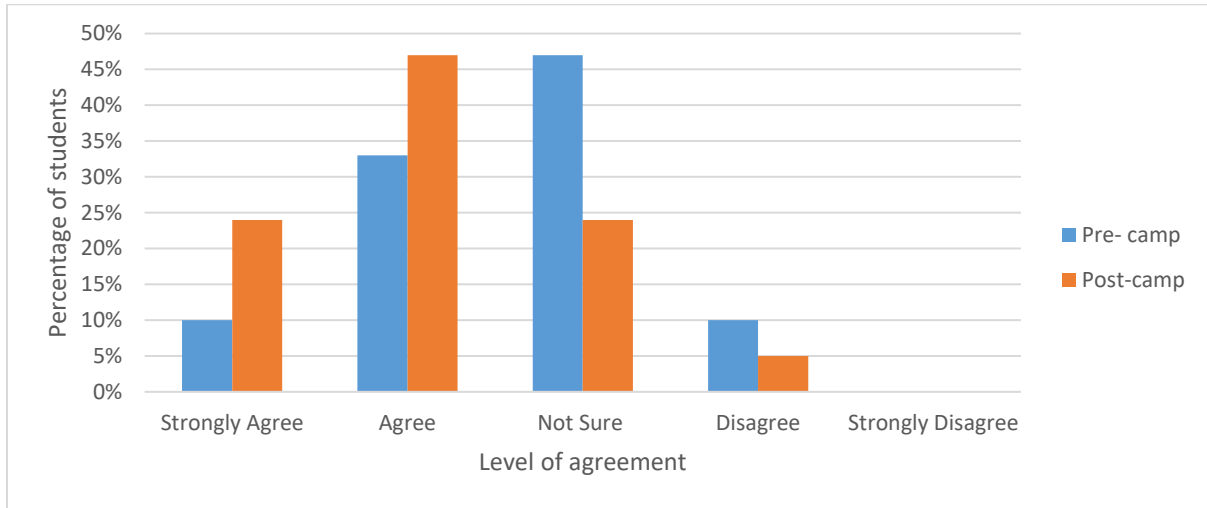


Figure 4.11: I am willing to participate in this science camp because the teacher uses a variety of teaching methods

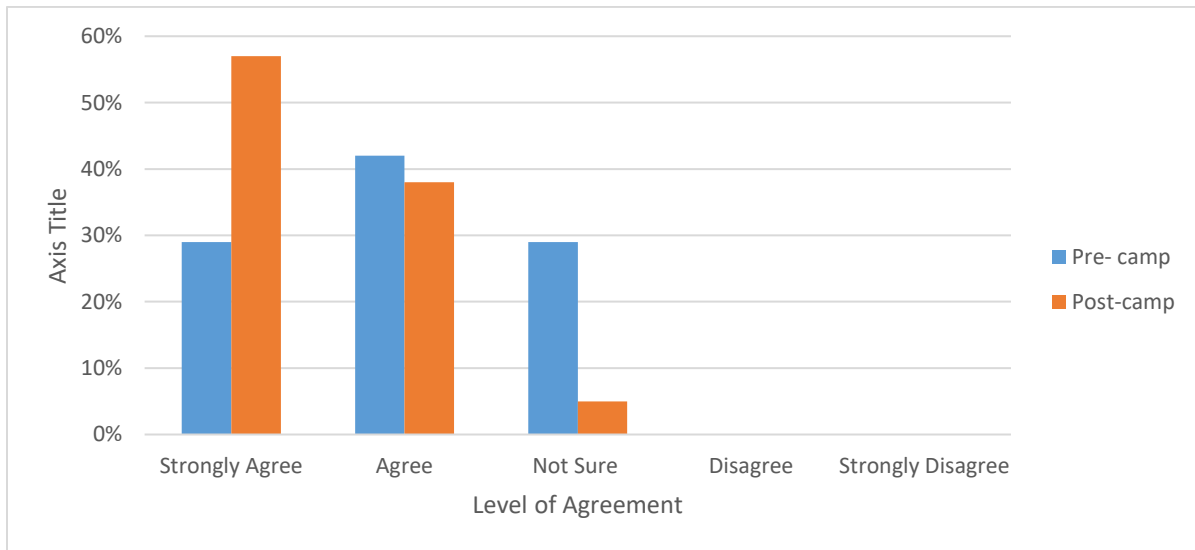


Figure 4.12: I am willing to participate in this science camp because the students are involved in discussions

4.5 Gender Difference in Motivation on Science in Grade 10 Township Learners

The research participants were 14 females (67 %) and seven males (33%). In order to understand learner's motivation, their views were separated according to males and females. One question was selected randomly from each motivation construct. Below, I present both genders' perceptions on self-efficacy, active learning strategies and science learning value.

4.5.1 Self-efficacy

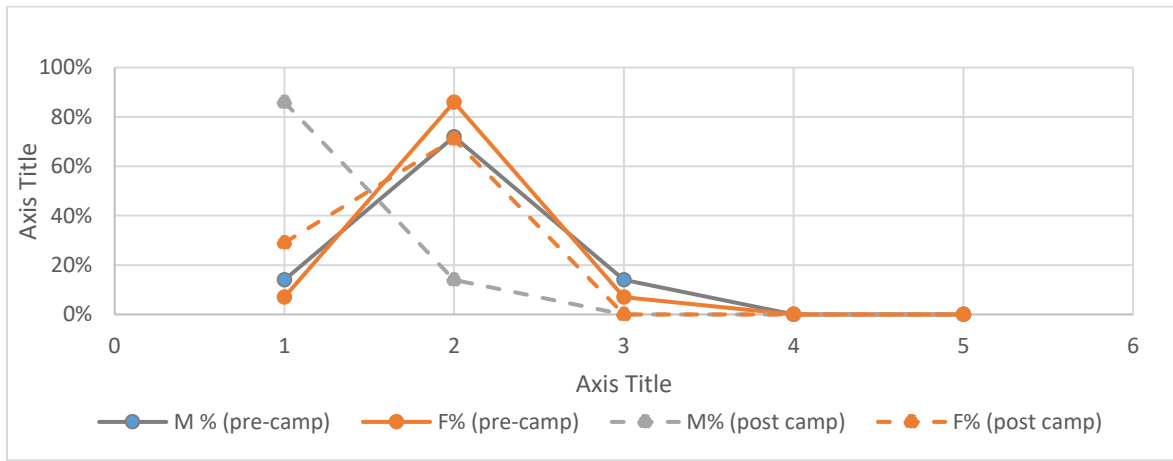


Figure 4.13: I am sure I can do well in science tests

Figure 4.13 represents learners' views on self-efficacy. When learners were asked if they are sure they can do well in science tests, males who strongly agreed before camp were at 14% to 86% post-camp, while 7% of females strongly agreed before the camp and only 29% strongly agreed after the camp. Both displayed high levels of agreement – males at 72% and females at 86% before the camp. There were a few not sure responses before and after the camp. These results suggested that males are more confident that they can do well in a science test compared to females.

4.5.2 Active learning strategies

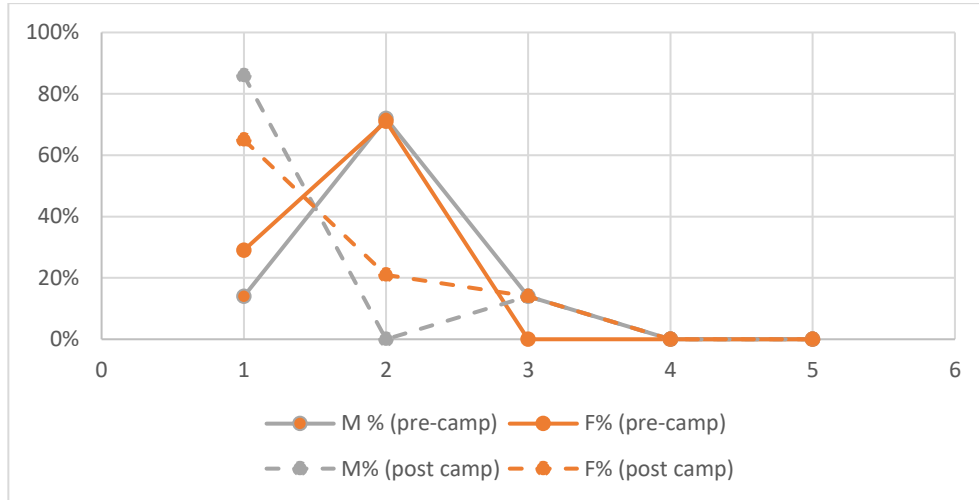


Figure 4.14: Shows responses from the statement “when I do not understand a science concept I discuss it with the teacher to clarify my understanding”

It was noticeable that before the camp only 14% of males strongly agreed with the statement; after the camp 86% of the males strongly agreed with the statement. Female responses indicated 29% strongly agreed before the camp, to 65% after the camp. None of the males agreed with the statement after the camp, only 21% of the females agreed. Only 14% of both genders were not sure after the camp. My assumption is that the majority of male learners wanted to talk to the teacher to clarify their understanding, while the girls preferred not to rely on clarity from the teacher.

4.5.3 Science learning value

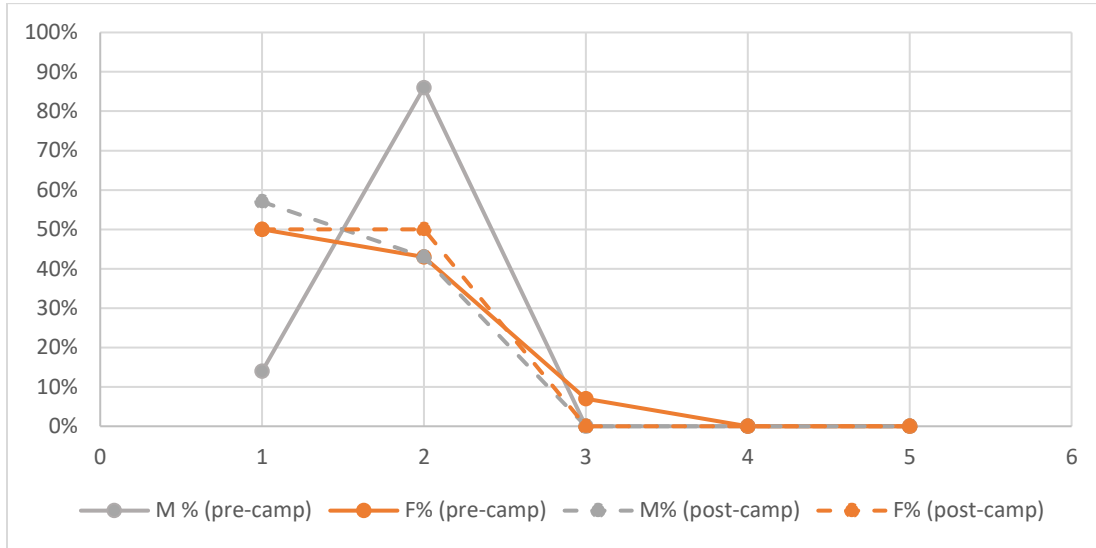


Figure 4.15: I think it is important to participate in inquiry or investigative activities in science

4.5.4 Performance goal

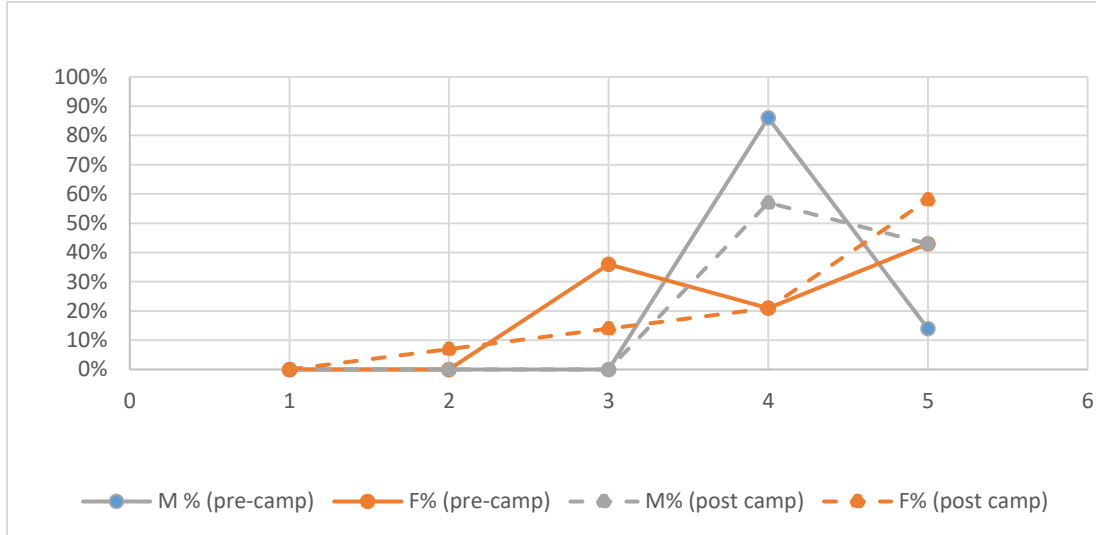


Figure 4.16: I participate in class so that other students think I am smart

Figure 4.16 shows learners' views about one aspect of motivation which is performance goal. The graph shows that most learners do not participate in class to impress other learners. One would assume that girls are more competitive than boys. Females' responses were 58% who strongly disagreed with the statement, whereas 43% of the males strongly agreed with the statement after the camp. It was noted that only 7% of the females agreed before the camp and none agreed with the statement after the camp.

4.4.5 Achievement goal

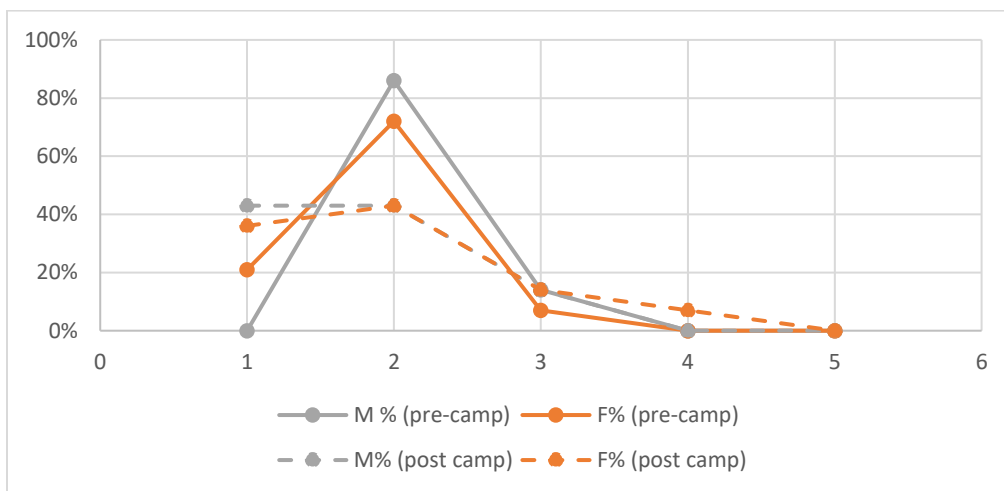


Figure 4.17: I feel most fulfilled when I feel confident about the content knowledge in science

Figure 4.17 shows learner responses to the statement: *I feel most fulfilled when I feel confident about the content knowledge in science*. 86% of males versus 72% of the females agreed with the statement before the camp. 43% of males versus 36% of the females strongly agreed with the statement after the camp. In my view, this shows the confidence males have in understanding the science content knowledge. Females seem to be less confident about understanding science content knowledge compared to males. Notably, the percentage of females who were not sure increased from 7% to 14% after the camp.

4.5.6 Learning environment stimulation

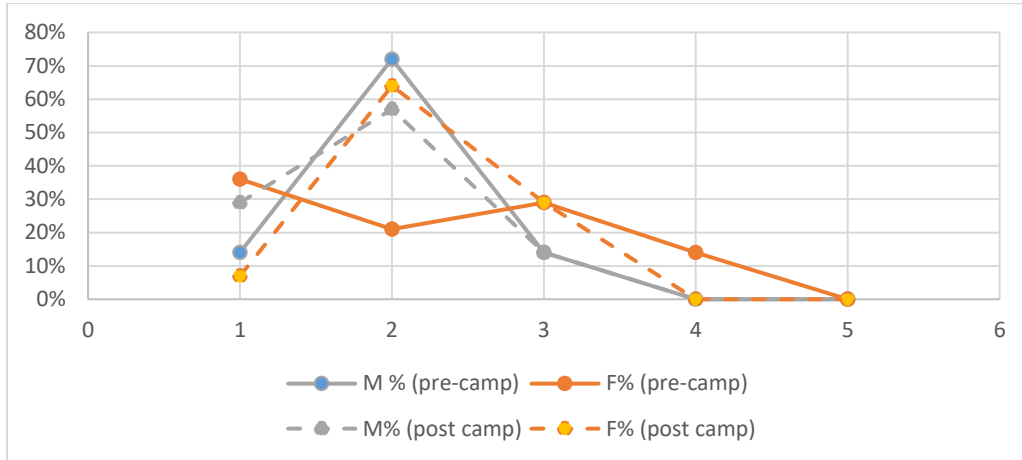


Figure 4.18: I am willing to participate in this camp because I think it will be fun

Fig 4.18 shows that the majority of the learners agreed with the statement. The graph shows that 64% of females agreed whilst 57% males agreed with the statement. It was also interesting to note that 36% of the females strongly agreed with the statement before the camp, but only 7% after the camp. 7% of the males strongly agreed before the camp and after the camp 29% agreed with the statement.

4.6 Representation of all Learners' Motivation Constructs

In order to compare the shifts between pre- and post- camp, it was necessary to compare the pre- and post-camp views. The scoring of the responses on three motivational constructs was generated from the pre- and post-camp data. The SMTSL was used as a tool to gather data. Learners were analysed using a rubric below for coherency. The focus was on self-efficacy, active learning strategies and learning environment stimulation as motivation constructs. The responses were scored using a three point rubric, where one indicated low motivation, two indicated motivation and three represented high motivation. This assisted in determining and understanding motivational levels of individual learners participating at the camp. In order to maintain anonymity, learners are referred to as L for learners and are given a number.

Table 4.3: A sample extract of motivation rubric level

Motivation component	Low Motivation (1)	Moderate Motivation (2)	High Motivation (3)
Self- efficacy	Does not think for himself but often asks help from others	Not sure about understanding of science concepts	Does not give up even if the content is difficult
Active learning strategy	Worries when making mistakes but does not take initiative to ask why	Tries to connect prior knowledge to new science concepts	Finds relevant resources to assist in learning science
Learning environment stimulation	Less or no input in learner discussions	Enjoyment of content and different teaching methods Displays willingness to enjoy a challenging course	Willingness to participate in exciting, changeable and challenging environment

Table 4.3: Pre- and post- camp scores per motivational construct

No	Camp Participants*	Gender	Learning environment		Self- Efficacy		Active learning strategies	
			pre-camp	post -camp	pre-camp	post- camp	pre-camp	post- camp
1	L1 (LG)	G	1	3	1	2	1	2
2	L2 (AF)	G	2	3	2	2	2	2
3	L3 (NZ)	G	1	3	2	2	2	3
4	L4 (SX)	G	2	2	2	2	2	3
5	L5 (SN)	B	1	2	1	2	1	2
6	L6 (YM)	G	2	3	2	3	2	3
7	L7 (AM)	G	1	3	1	3	2	3
8	L8 (SK)	B	1	3	2	2	2	3
9	L9 (SS)	B	1	3	1	2	1	3
10	L10 (NN)	G	1	2	2	2	2	2
11	L11 (AZ)	B	1	3	1	2	1	2
12	L12 (MK)	B	2	2	2	2	2	2
13	L13 (TZ)	G	1	3	1	1	2	3
14	L14 (SS)	G	1	3	1	2	1	3
15	L15 (AN)	G	1	3	1	3	1	3
16	L16 (SY)	G	1	3	1	3	1	3
17	L17 (SM)	G	1	2	2	2	2	2
18	L18 (MG)	B	1	3	1	2	1	3
19	L19 (VK)	B	2	3	2	2	1	3
20	L20 (AF)	G	1	2	2	2	1	3
21	L21 (UT)	G	1	3	1	2	1	2

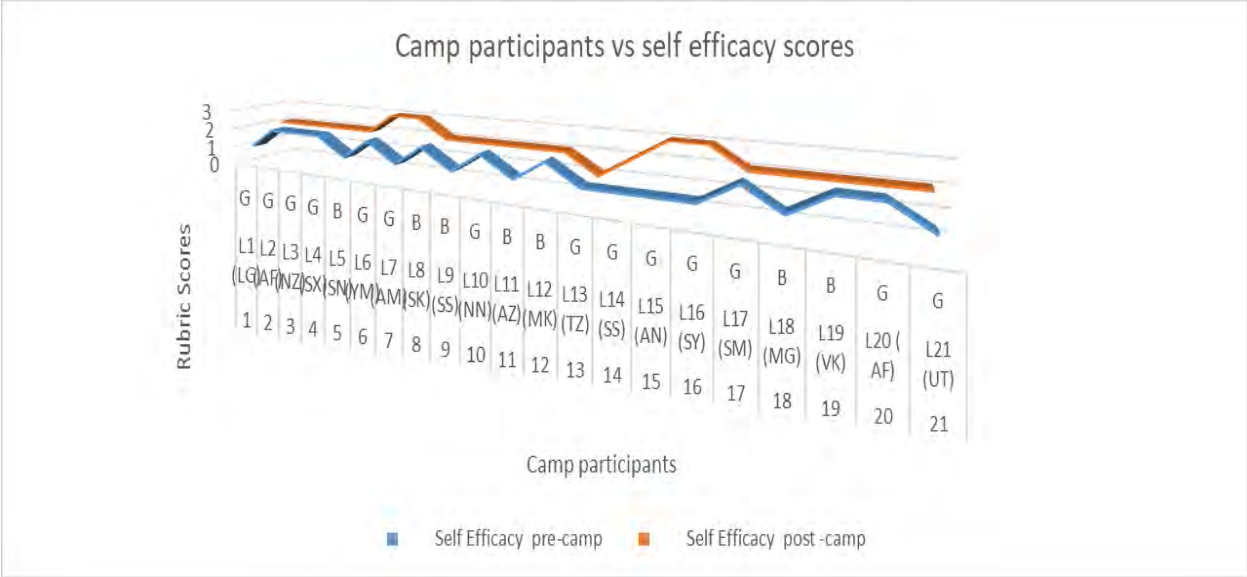


Figure 4.19: Graphical representation of the pre- and post-camp scores of self-efficacy as motivational construct

The scores indicated only one learner that is, L13, had not changed before and after the camp – she showed low levels of motivation. There were eight learners L2, L3, L4, L8, L12, L17, L19 & L20 who were positioned on medium motivation, as they remained on the same level before and after the camp. Some learners L7, L15 & L16, displayed a shift from low motivation before the camp to high motivation level after the camp. It was also observed that L1, L5, L9, L14, L18 & L21 moved from low motivation to medium motivation.

4.6.1 Active learning strategies motivations for all learners

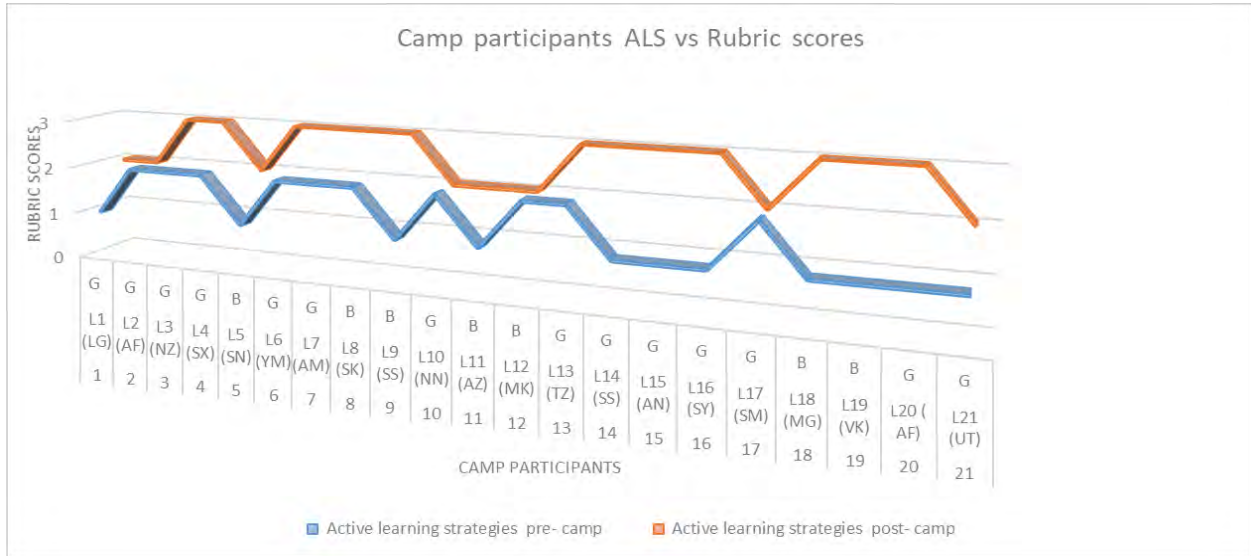


Figure 4.20: Graphical representation of the pre-post camp scores for active learning strategies as motivational construct

It was observed that three learners L2, L10, & L17 offered the same responses before and after the camp, which meant they were on the medium level of motivation, while L1, L5, L11, & L21 moved from low to medium motivation. It was also noted that there were other participants who moved from medium to high motivation. The majority of learners showed a big move from low motivation to high motivation (L9, L14, L15, L16, L18, L19, & L20).

4.6.2 Learning environmental stimulation of all learners

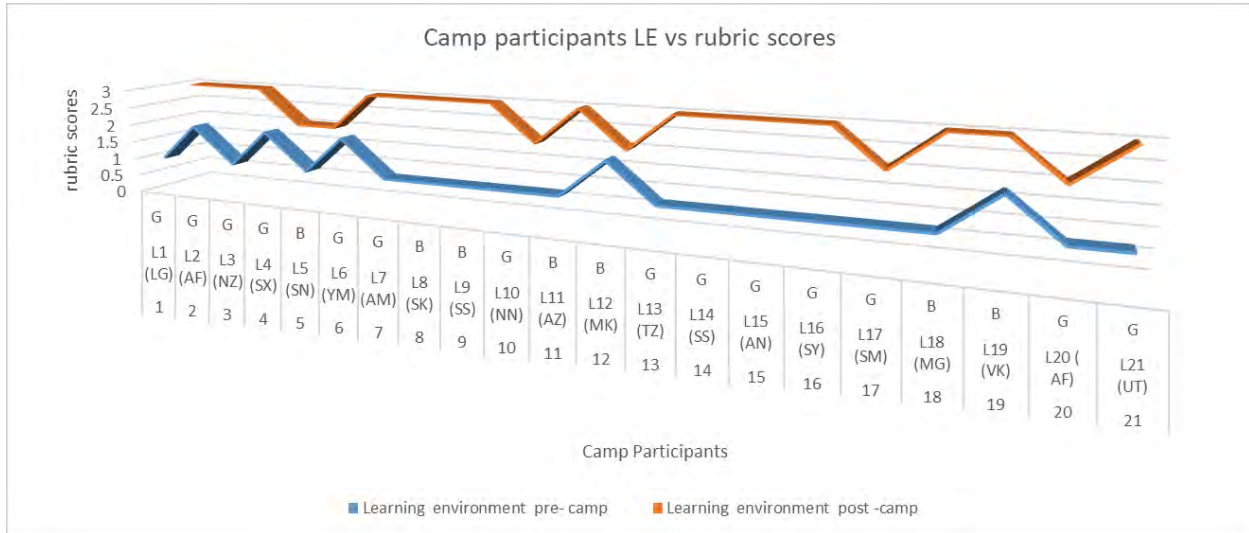


Figure 4.21: Graphical representation of the pre- and post-camp scores of learning environment as motivational construct

Learning environment stimulation proved to be the most motivational construct which had an impact on learners’ motivation. Figure 4.21 shows only two learners (L4 & L12) that did not present a change as they were on medium motivation before and after the camp. A few learners (L2, L6 & L19) shifted from medium motivation to high motivation. The majority of learners (L1, L3, L7, L8, L9, L11, L13, L14, L15, L16, L19 & L21) showed a major shift from low motivation before the camp to high motivation.

4.7 Chapter Summary

In this chapter I presented different motivational constructs based on all the learners’ views. I have shown comparison of both gender views, as well as individual learner’s views based on the three motivational constructs that emerged from my data. In the next chapter, I will be presenting narrative views retrieved from learners’ reflective journals and focus group interviews.

CHAPTER FIVE: QUALITATIVE DATA PRESENTATION, ANALYSIS AND DISCUSSION

5.1 Introduction

The aim of this study was to investigate the influence of marine science camps on learners' motivation and dispositions towards scientific inquiry. In the previous chapter, I presented analysis of learners' views that emerged from the SMTSL questionnaire.

In this chapter, I firstly present an overview of what happened at the marine science camp and then present the qualitative data gathered from learners who participated at the camp. The data were derived from learners' reflection journals and focus group interviews. All 21 learners completed their reflection journals, as this was done daily at the camp. Notably, the focus group interviews were only conducted with learners from Grahamstown schools.

Out of 12 learners from four schools, only nine learners were interviewed based on their availability and willingness (see Section 3.8). Learners from two schools were interviewed together. The data presented from the narratives were colour-coded (see Appendix 14 &15), I then categorised it into themes in the analytical framework (see Table 5.1). Below, I briefly explain the overview of the intervention.

5.2 The Intervention: Marine Science Camp and Rocky Shore Inquiry

The camp participants arrived on a Friday afternoon at the harbour and were taken on a research vessel (Agulhas 1⁹) tour by the vessel staff. They were shown the laboratory, classrooms, engine room and taken to the bridge where most of the navigation happens, as well as to the engine.



Figure 5.1: Learners at the bridge of Agulhas 1 research vessel

The tour guide was a young black lady of about 26 years and from a similar background as the participants. She explained how she became a Navigation Officer and the learners were inspired by her talk. This research vessel experiment excited many learners; moreover, that a young female could be part of the field that is mainly dominated by males and white males in particular.

Later on at the resort, learners were given ground rules and the science camp programme. The scientist gave an introduction about the scientific research process in relation to the rocky shore ecology. Thereafter, learners were introduced to the sampling equipment. The scientist, as a more knowledgeable other according to Vygotsky (1978), also gave guidance as to how the participants were going to collect data.

⁹ Agulhas 1 vessel : It is the South African former polar research vessel used for breaking ice and now used for training since there is a state of the art Agulhas 2

Also, learners were given reflection journals with guiding questions for them to reflect and record on the daily activities. The major activity of the science camp was the *scientific inquiry*, whereby learners surveyed rocky shores. Surveying rocky shores meant that learners had to identify, count the number of species or its abundance, types, size, adaptation and distribution along the transect line¹⁰ and then record all the information. The camp inquiry study was designed to ensure that information collected was reliable and allowed logical explanation for patterns and changes.

Learners were divided into groups of four with one group having five learners. The groups were asked to come up with their group names. Interestingly, the group names were: *Siwelele, Blue Wolves, Einsteins, Red Lions and Nature Lovers*. In each group, a scientist and/or research intern¹¹ provided guidance, from marking a transect line to identifying species and providing more information about specific plants or animal species found on the rocky shores.

This was a morning activity which lasted for about four hours during low tide. Each group came up with their own questions, for example:

- Are there more animals living on dry rocks than in rock pools?
- Do species change from lower shore to the upper shore?
- Do environmental parameters have an effect on species distribution on rocky shores?
- How does the richness and abundance of species affect species' diversity?
- Is there any biomass difference between species near the lower shore and upper?

In their groups, learners collected data relating to temperature, salinity, and identified and counted species occurring in different zones of the transect line as mentioned before. Tools used by the scientist and interns such as quadrats, refractometer, and species identification guide book were used by learners for their inquiry (Figure 5.2). After collecting and analysing their data in

¹⁰ Transect line: A path in a straight line measured by a measuring tape on the rocky shore from a low water mark to a high water mark in order to guide a sampling method to measure distribution of species.

¹¹ The research interns were Marine Science Master's or PhD students.

computers, learners had to prepare PowerPoint presentations (Appendix 16), which they presented on Sunday morning at the end of the marine science camp.

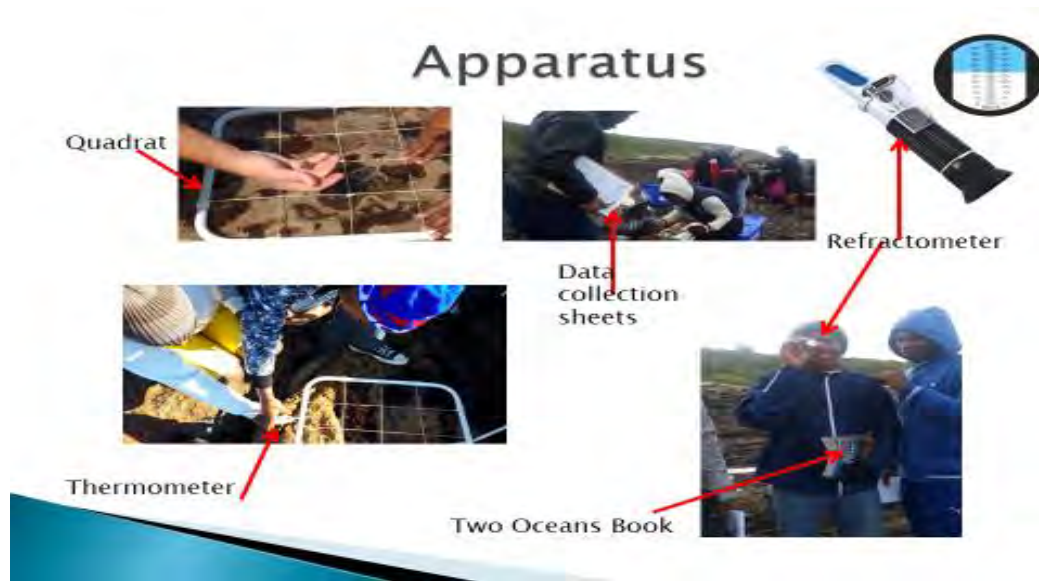


Figure 5.2: Tools used by learners to collect data on rocky shores

5.3 Analysis of the Focus Group Interviews and Learner Reflection Journals

This section comprises of data analysis from the responses given by science camp participants during focus group interviews (FGI), as well as the narratives from learner reflection journals (LRJ). I used these data gathering tools to answer the following research questions:

1. How do learners' motivation and dispositions evolve during the marine science camp experience?
2. How does Grade 10 learners' participation in a scientific inquiry learning influence (or not) their dispositions?

Themes were developed based on the prompt questions from learner reflection journals (see Appendix 4) and focus group interview questions (see Appendix 5). In the table below I present the alignment of themes from data sources and literature supporting the themes and the theories that informed the study.

Table 5.1: Themes emerging from focus group interviews and learner reflection journals

Research Question: How do learners' motivation and dispositions evolve during the marine science camp experience?			
Themes	Data Sources	Literature	Conceptual and Theoretical Framework
Sources of inspiration and motivation	FGI	Bourdieu (1993); Cavas (2011)	Dispositions, motivation
Perceptions about science and marine science camp	FGI	Atallah et al. (2010)	Dispositions
Participation and self-regulation , mediation	FGI , LRJ	Bischoff et al. (2008); ; Harrison & Muthivhi (2013); Stott (2016); Sedlacek & Sedova (2017)	Social Constructivism
ZPD Language Mediation	LRJ	Nakale (2012); Msimanga & Lelliot (2014); Mavuru & Ramnarain (2019)	Social Constructivism
Development of attitudes Resilience, self-efficacy	FGI, LRJ	Crick & Goldspink (2014)	Dispositions
How does Grade 10 learners' participation in scientific inquiry learning influence (or not) their dispositions?			
Understanding of scientific investigation	FGI , LRJ	Markowitz (2004); Lederman et al. (2014); Kahenge (2016)	Learning in communities of practice

I now discuss each of these themes below.

5.3.1 Learners' sources of science inspiration and motivation

Learners indicated varied responses about their sources of motivation when they were asked about where the inspiration to choose science subjects at school came from. This question was asked to create a relaxed and non-threatening environment during the interview. Most learners mentioned their science teachers as sources of inspiration, while some mentioned their siblings, out of school programmes and only two learners mentioned TV programmes.

L1, SB & L3, SC (FGI): *Although we do not have equipment to do practicals at school. My teacher finds ways of making science interesting even if we have to imagine things in our heads. ... I am also motivated by the fact that I can still learn and understand science.*

L1, SB (FGI): *I find science interesting, more especially in Khula Project (out of school programme) I attend. Mr Maselwa makes it fun and motivates us into philosophies of science and I ask myself so many questions.*

L1, LRJ & L17, Day 1: *My source of inspiration is my teacher she knows in and out of science.*

L3, SA (FGI): *I like to watch science programmes and documentaries on TV because they leave me wondering and keeps me inspired and wanting to know more.*

These excerpts indicate learners get their inspiration and motivation not only within themselves, but from external factors such as teachers. This insight is in line with Cavas (2011), who believes when teaching approaches are conducive for learning, learners who have positive motivation to learn science are more successful and develop more positive attitudes to learn science.

5.3.2 Learners' expectations of the marine science camp

I found it important to ask learners about their expectations of the marine science camp. They were asked just to understand if their mental picture before the marine science camp experience, was exactly the same as what they experienced. Their responses showed mixed emotions, fear and excitement. For instance, L2 and L3 commented that:

L2, SB (FGI): *I was excited just to be outside school, not that I don't like to be at school (laughs) but the camp was nice and different. I did not know what to expect first, I was nervous. Firstly, I am a shy person, hearing that we will meet learners from other schools made me more nervous. When we got to the camp, we mingled so well as if we were coming from the same school. I wish to attend another camp soon.*

L3, SB (FGI): *At first I did not understand when our teacher told us we made to the marine science camp, I asked myself what is science about the oceans. Little did I know that we live science in our daily lives and more exciting stuff out there.*

Most learners revealed that they did not know what to expect as some were participating in outside school learning for the first time. The marine science camp appeared to have helped these learners

to view science from a different perspective other than in the classroom. Vedder and Weiss (2011), assert that the nature of informal learning environments play a pivotal role in motivating learners during the learning process.

It emerged from most learners that the camp was their first experience of the sea. The majority mentioned that they had only even thought that science was just the mixing of chemicals in the laboratory.

5.3.3 Perceptions and attitudes towards science and marine science camp

The participating learners were asked about their perceptions of science and the marine science camp. The majority of the learners indicated that when they were told that they were accepted to attend the marine science camp they had mixed feelings, as they did not know what to expect since they were to participate at the camp for the first time. They expected the camp to have lots of chemistry experiments since it is science.

L1, SC (FGI): *Okay!!! As much as I do science at school I still had that belief that science is difficult even though I pass it well. I never knew that there was something called marine science until the camp. I am now familiar that is not only in the lab. It is at home and around us.*

L2, SC (FGI): *Science is not a difficult subject, one needs time to understand and just work hard. I always believe that I can do well in science no matter what if I put my mind into it.*

In addition, another learner now believes that science can be multi-faceted.

L1, SA & SD (FGI): *I thought science is hard but after going to the camp I realised science can be fun, I thought science is only in the lab mixing chemicals. I wish other learners can be involved too or there could be more of the science camps. The most enjoyable part for me was to touch and feel animals that I normally see in the books. I saw some animals for the first time, I never knew there was life on rocks up until saw those animals attaching themselves on rocks.*



Figure 5.3: Learners touching a starfish found during investigation

LRJ, L1, Day 1: *I enjoyed learning about rocky shore ecology.*

LRJ, L15, Day 1: *I love science.*

FGI, L1 & L3: *Science is fun, science is interesting.*

From these excerpts, it could be deduced that the learners before the marine science camp exposure saw science as a difficult or challenging subject. They alluded to the fact they chose science as a subject even though it is regarded as a difficult subject, yet, their eyes were opened to the variety of wider science learning, including marine science at the camp which changed their perception of it being a difficult subject.

5.3.4 Learners' experiences and participation at the marine science camp

Learners were asked about their experiences and participation at the marine science camp. It seemed as if the marine science camp experience was viewed as enjoyable. Learners revealed different aspects of what transpired through their participation.

L1, SB: *I can say, I have learnt a lot, for instance at school we are not allowed to use computers anytime we like or go to the computer lab but at the camp, I saw that even our teachers use computers when they set tests and exams. Yhaaa (Yes) and also I have learnt to communicate with other people, at first I was not sure ukuba ndizoncokola ntoni naba bantu (what was the conversation going to be with these people) the last day was awesome.*

L1, SA & SD (FGI): *One of the skills I have learnt is to work together, I used to like reading by myself but at the camp I have learnt that when you are in a group you are all able to contribute and get ideas from each other. I gained that experience. Group work made science easy.*

The exposure and participation at the marine science camp seemed to have encouraged group work for the learning to take place. This was evident when I observed learners arguing about a certain organism (limpet) they found in the quadrat they were sampling at, for example they said:

L1: *No its not this one!! It's that one!!! This is a granular limpet that one is a pear limpet: andithi ma'am (isn't it madam?).* (trying to get assurance from me).

L2: *I think this is a granular limpet, Ok, let's look in the book.*

This implies that through active participation (Sedlacek & Sedova, 2017), discussions and sharing of ideas within the group and peer to peer conversations, they were able to reach a consensus. In consequence, learners were able to move from what they did not know to what they had come to know when in a group. Lave and Wenger (1991) echo this insight and view peripheral participation as an empowering position where a newcomer gets initial access and moves from the boundary, towards gaining access to sources of understanding through growing participation in a community of practice (CoP) (see Section 2.2.1) .

5.3.5 Mediating and self-regulation at the marine science camp

It was important for this study to understand if learners through mediation strategies provided by the facilitators, were able (or not) to acquire self-regulation and problem solving skills.

L2, SA & SD (FGI): *Also ma'am we did not know when we started the camp that we will end up with those presentations but we will definitely use the foundation we received from the camp.*

L1, SC (FGI): *The camp has inspired me not to be afraid to do scientific things, after the camp, I now Google about more scientific investigation currently happening in South Africa.*

L2, SC (FGI): *But science camp got me thinking, I just cannot wait to do a research that will benefit the community and the country. I would like to do my own project.*

It emerged from these excerpts that the camp laid a foundation for the learners to start their own investigations. There was a significant shift in terms of their goals, as they had never thought of developing their own projects before their participation at the marine science camp. It was evident that the mediating of learning did not only help learners to conduct their inquiry at the camp, but also sparked interest to develop their own projects. For example, one learner from school A, with the help of a student intern participated at the marine science camp and developed a marine science fair project (*investigating fish habitat preferences at the estuary*) (Appendix 17), which saw the learner awarded a gold medal at the regional fair and bronze award at the national fair. The learner was also awarded the opportunity to present his project out of South Africa.

According to these results, I presumed that the marine science camp motivated learners to conduct their scientific inquiry based science projects. Osborne et al. (2003) believe that positive attitudes towards science promotes working harder and more positive motivations are developed. Harrison and Muthivhi (2013) posit that self-regulation involves internal and thoughtful goal-orientated behaviour which allows and motivates learners to start something new. Stott (2016) argues that mediation is important in learning in order for learners to reach their ZPD, which could potentially lead to self-regulation as proposed by Harrison and Muthivhi (2013).

5.3.6 Building marine concepts and literacy and knowledge through ZPD

It is important to note that the majority of the learners who participated at the camp indicated that they came closer to the sea for the first time. Although some had come to the beach to swim a few times, none of them had ever been to the rocky shores or dealt with marine topics before. In other words, they only knew a few common species, like starfish, mussels and octopus. The rocky shore jargon was important to understand how it afforded or hindered the communication between the scientist, interns and learners.

Learners were asked how they understood the marine concepts and also how they communicated in their groups:

L2, SB (FGI): *Sometimes in our group were mostly discussing in isiXhosa but there were times when we talk about investigation we had use English words that are in the investigation but do not have direct translation in IsiXhosa but mostly it was isiXhosa.*

L3, SA & SD (FGI): *I think as a group we were unable to understand marine science language as it my first time near the ocean. I did not know much about sea creatures except the most common ones that I have seen from TV or books. That challenged us but with no time we were able to know and understand.*

L2, SA & SD (FGI): *I struggled a bit when Dr Shirley did a presentation to us. I did not have a clue what was she talking about. I never heard of any species name. I only know fish and shark in the ocean. I was much better when I saw some of the species in the two oceans book we were given. It made more sense when we were down on the rocky shores, when we saw those animals with our naked eyes. Coming up with the question was bit challenging for me but we did it by the support of the teachers at the camp.*

L1, SA & SD (FGI): *We called for help when we were stuck, other groups helped us facilitators and other students helped us a lot.*

L2, LRJ, Day 2: *Ootishala balapha baluncedo bendenza ndizive special (The teachers make me feel special) because they don't ignore you when you ask questions but give you great clues).*

The above excerpts demonstrate that learners, through the support of more knowledgeable others, in this case the scientist and research interns, were able to move from a point where they could not make sense of the marine jargon to a point where they were able to confidently understand the marine language. Importantly, it was noticeable that peer to peer learning took place. Meaning, when other group members were confident enough about the information, they were able to scaffold other groups until they were able to understand what was required. Building on Vygotsky's (1978) seminal work, Stott (2016) also ascertains that the ZPD is created through collaboration with capable peers.

When learners are unable to communicate in scientific language it becomes a challenge for the scientists involving those learners in marine scientific activities, particularly when introducing scientific vocabulary (Mellors et al., 2008). In the case of this study, learners were resilient in learning to understand not only scientific language, but also gaining marine literacy which made sense to them. This was also evident when learners were presenting their group projects (Appendix 16) as I observed them mentioning concepts such as, subtidal, intertidal, and zonation, which all referred to the rocky shores.

Though language and artefacts they were able to make sense of their learning, which helped them move from the periphery to the core of the group and became active members of the CoP. This finding is supported by Wenger (1998), who believes that members interact with one another, establishing norms and relationships through *mutual engagement*. Secondly, members are bound together by an understanding of a sense of *joint enterprise*. Finally, members produce over time a *shared repertoire* of communal tools such as language, routines, artefacts and stories. For Wenger (1998), learning is a process which places individuals as active participants in the social practices.

5.3.7 Development of motivation, self-efficacy and resilience

Learners expressed their self-efficacy towards science learning in general. Below, I give narratives from learners' perceptions of their self-efficacy as it related to resilience and motivation.

L3, SB (FGI): *I don't only learn science at school and accept that I also go and do more research about the topic. Who does not want to be part of the camp ma'am? Once you hear other learners talking about it you just want to work as twice as hard so that you stand out. I think mna xa kuthethwa nge camp yase SAEON (when they talk about the SAEON camp) we all pull up our socks. As learners who attended the camp before do not stop talking about it. In our school I think the camp has created a hype which in return motivates us to learn hard.*

L2, SB (FGI): *Yhu kaloku ma'am. Science camp is exceptional, I enjoyed it throughout.*

L1, LRJ, Day 1: *I am confident in my ability to learn science, because whatever I do I try my utmost best and I also believe in dedication, so that I don't give up until I get something done.*

L6, LRJ, Day 1: *I am willing to learn.*

L7, LRJ, Day 1: *I am a self-driven learner who is curious about everything that relates to science.*

L9, LRJ, Day 1: *I am a hard working person so I will definitely do well.*

L13, LRJ, Day 1: *I work hard so that I perform well.*

These excerpts illustrate that most learners had higher self-efficacy and resilience to learn science as a result of the science camp. As was mentioned before, learners who were unfamiliar with the

marine environment did not give up, as they showed eagerness to learn. Velayutham et al. (2011) accentuate that learners who have developed self-efficacy in science learning will probably regulate their effort in learning it. Interestingly, when comparing learners' self-efficacy in terms of gender, before and after the marine science camp (see Figure 4.13), both genders (girls and boys) showed positive dispositions as they had higher self-efficacy scores after the marine science camp. Having said that, however, seven out of eight boys strongly believed in their abilities. In contrast, only four out of 14 girls strongly believed in their abilities. This suggests that the boys indicated a higher ability and interest compared to the girls. This finding corroborates with Meece and Eccles's (1993) assertion that in general, females have lower self-perception of their academic ability even when they can perform better than males.

5.3.8 Understanding of scientific investigation approach

The rocky shores scientific inquiry was designed to teach scientific investigation methods to Grade 10 learners. This was done in such a way that learners were able to do their own inquiry, as well as to find out if they understood the inquiry itself. In this regard, learners commented that:

L1, SA & SD (FGI): *Ma'am, I thought because we were doing the same study of rocky shores and following the same procedure, I thought we were going to have the same results but come presentation time, people had different findings. So nyhani, it depends on the area where you did your investigation. What I can say is that science can be fun and interesting.*

L20, LRJ, Day 3: *My understanding of scientific inquiry about science is that we did at the camp I can now do my own investigation.*

L2, SB (FGI): *The way we were taught SI at the , I will be comfortable to conduct my own project.*

L3, SB (FGI): *I am ready to conduct any project, as long as I get apparatus to do so, hopefully for the project I have in mind I won't need lots of apparatus, I will do it the way I did it at the camp.*

L2, SC (FGI): *I attended expo and science festivals before kukhona few things that caught my interest at that time, I would then have interest only at that time after I leave that I will forget what I have learnt or what I was interested in. But science camp got me thinking I just cannot wait to do a research that will benefit the community and the country. I have*

now developed logical thinking skills. I always wanted to become mechanical engineer but I am not sure but whatever I choose it will have something to do with science.

The above narratives indicate that, as result of participating at the marine science camp, learners used different strategies to learn a scientific inquiry approach and as a result they developed curiosity, interest and were motivated to develop their own scientific investigation projects. Aulls and Shore (2008) posit that through scientific inquiry, a conducive learning environment is created which then contributes to learners' motivation. These scholars are adamant that learners can become inquiry literate when they get instruction from a more knowledgeable other.

5.4 Chapter Summary

In this chapter, I presented, analysed, interpreted and discussed qualitative data from learners' reflections journals and focus group interviews. I concluded with learners' understanding of scientific inquiry, as well as the potential of developing their own science projects. In the next chapter, I present a summary of findings of the study, some recommendations and potential areas for future research and a conclusion.

CHAPTER SIX: SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1 Introduction

The aim of the study was to explore the influence of a marine science camp on learners' motivation and dispositions towards scientific inquiry. The study was informed by Vygotsky's social constructivist theory and Wenger's community of practice theory. The participants were 21 Grade 10 learners from seven high schools in the Eastern Cape in South Africa.

In order to answer the research questions, data were collected through the use of a Student Motivation Towards Science Learning (SMTSL) questionnaire pre- and post- science camp, learner reflection journals and focus group interviews. Excel was used to analyse quantitative data and an inductive-deductive thematic approach was used to analyse the qualitative data. The analysed data were discussed in relation to the following questions.

1. What are learners' science motivation and disposition levels prior to the marine science camp experiences?
2. How do learners' motivation and dispositions evolve during the marine science camp scientific inquiry experience?
3. How does grade 10 learners' participation in scientific inquiry learning affect their disposition?

In this chapter, I thus present a summary of my findings followed by some recommendations thereof. I also present limitations of the study, as well as gaps for possible future research and a conclusion.

6.2 Summary of Findings

Below I summarise the findings in relation to the research questions that guided this study.

6.2.1 Research question one:

What are learners' science motivation and disposition levels prior to the marine science camp experiences?

Figure 4.5 shows that prior to the marine science camp, out of 21 learners, three showed high motivation while 14 learners displayed positive but moderate motivation, and four learners showed low motivation. After the marine science camp, nine learners indicated high motivation while 11 learners displayed moderate motivation; only one displayed low levels of motivation. This means that fewer learners prior to the camp already had positive motivation, but after the marine science camp exposure, more learners developed increased motivation.

In Figure 4.19, the scores indicate that only 14% had not changed before and after the camp and they showed low levels of motivation. There was 38% who were positioned on medium motivation and they remained on that same level before and after the camp. This indicates that these learners were already motivated prior to their participation in the marine science camp. Some learners, 14%, displayed a shift from low motivation before the camp to high motivation level after the camp. I also observed that 34% moved from low motivation to medium motivation. It could be deduced, therefore, that learners had an average to high motivation towards science before participating at the science camp.

This suggests that the majority of the learners' motivation increased towards science after their participation at the marine science camp. This finding is echoed by Foster and Shiel-Rolle (2011) who believe that efforts to build positive attitudes to science learning should include the use of informal learning settings, such as after-school programmes and science camps to complement classroom settings. This finding further resonates with Ngozo et al.'s (2016), as well as Agunbiade et al.'s (2017) findings that participation in out-of-school science learning experiences, have a positive influence on participants' attitudes towards science in both the short and long term.

6.2.2 Research question two:

How do learners' motivation and dispositions evolve during the marine science camp scientific inquiry experience?

In Figure 4.2, learners had varied responses from the statement which read: *No matter how much effort I put in, I cannot learn science with understanding.* Figure 4. 2 shows that before learners participated at the camp only one learner out of 21 agreed with the statement while three out of 21 was not sure, nine out of 21 disagreed and eight out of 21 strongly disagreed.

Surprisingly, after the camp there was a 9% increase whereby three out of 21 learners agreed with the statement. Twelve out of 21 (57%) learners disagreed and six out of 21 (29%) learners strongly disagreed. None of these learners were not sure after the camp and the majority of the learners moved to strongly disagree, which means they could learn science with understanding. This means after participation at the marine science camp, learners changed dispositions and developed increased motivations to learn and understand science.

This change of disposition towards science corresponds with Walshaw's (2012) views who ascertained that teaching and learning in a form of projects or experiments helps to foster connections between the real-world experiences and motivates learners to learn.

The shift in disposition and increased motivation could be linked to the conducive environment and active learning strategies used during the marine science camp. Accordingly, Clegg and Kolodner (2014) proffer that after the experience, learners develop dispositions to reason scientifically only if they have a chance to develop understanding, develop interest, and have social interactions that help them to sustain their interests; additionally, they need to see the value in what they are learning to do, and make connections between what they are learning and their own lives.

6.2.3 Research question three

How does Grade 10 learners' participation in a scientific inquiry learning affect their disposition?

Based on Figure 4.6, the study found that when learners were introduced and engaged in a rocky shore inquiry activity, they developed more understanding of the importance of participation in scientific inquiry activities. This is in line with Lederman et al.'s (2014) assertion, that to better understand learners' views about scientific inquiry, they should be involved in an inquiry experience.

Furthermore, this study found that participating in a scientific inquiry not only developed skills, interest and new knowledge, but also motivated learners to conduct their own scientific inquiry projects. Ultimately, as a result of their participation in a marine science camp they developed positive attitudes towards science. Likewise, Field (2009) posits that science camps improve learners' understanding of scientific inquiry. Furthermore, Fields (2007) contends that science camps play a crucial role by addressing affective aspects of learning such as attitudes and interest, to attempt to increase motivation and confidence among science camp participants.

6.3 Recommendations

The study recommends that there should be more science engagement activities to expose learners to science learning in informal learning environments such as science camps. The reason for this is that these environments are conducive for learners to freely voice their thoughts and opinions. Furthermore, these science engagement activities should not only be targeted at Grade 10 learners, but should extend to Grade 9 learners before they choose their school subjects.

In order to build the next generation of scientists, the study also recommends that social sciences and pure science at universities should not work in isolation, but should consider collaborative efforts among themselves. This extends to outside organisations as well.

Lastly, to improve science learning, scientific inquiry or project based learning should be encouraged for all high school learners so that they can create new knowledge.

6.4 Areas for Future Research

Koballa and Glynn (2007) have explored learners' motivation in the science classroom situation, while Kahenge (2013) investigated informal learning environments such as out-of-school extra-

curricular support programmes. Similarly to Kahenge's study, this study also used informal learning environments, that is, marine science camps to introduce Grade 10 science learners to scientific inquiry-based learning.

The main aim was to understand if these marine science camps influence (or not) Grade 10 learners' motivation towards scientific inquiry. Participants in this study came from coastal and semi-coastal¹² towns.

One area to investigate would be to compare if learners from inland would have the same motivation as coastal and semi-coastal learners, using the same methods as used in this study.

Alternatively, one could look at the difference in motivation between learners who attend the marine science camp and participate in scientific inquiry activities and those who do not.

Lastly, one could seek to understand teachers' perspectives of whether after the science camps, learners are motivated in science or not.

6.5 Limitations to the Study

There were limitations that were experienced during this research due to my inexperience as a researcher. During the pilot stage, for instance, I only scratched the surface in terms of data generation and as a result I had less data to code. However, that experience helped me gain confidence and I revised my data gathering tools and restructured some of the tools and research questions.

Throughout this research, I worked with only 21 learners and four educators, and it worked well because it was a manageable group. However, this denied me an opportunity of working with a wider audience. If I had worked with a bigger group, the results might have been slightly different. Having said that, though, the aim of the study was not to generalise the findings, as the sample

¹² Semi-coastal – 60 km from the coast.

size was adequate and provided some insights on the learners' dispositions and motivation to learn science as a result of the rocky shore science camp.

It was also evident in the data, that when learners were interviewed they did not openly and clearly express their views. It could have been the language barrier, although they were told upfront to express themselves in whatever way they felt comfortable with. One example was, that all group members were supposed to present, but in one group there was one person presenting for all group members. I did not pick up on this from the focused group interviews, but it was stated in learner reflection journals. Obviously there were power dynamics in the groups and learners were taking leadership roles.

In light of these limitations, if I were to do this study again, I would conduct interviews in the learners' mother tongue. Also I would use a video to record, not as a main data source, but as an additional source of data so as to see if I had missed something, since I was a participant observer.

6.6 Conclusion

The aim of the study was to explore the influence of marine science camps on Grade 10 learners' motivation and dispositions towards science. The study employed a mixed method approach to gather data. There was consistency in what was reflected in both quantitative and qualitative data. For instance, the study revealed increased motivation in science after learners participated in a rocky shore scientific inquiry activity. Having said so, in some cases before they participated in the marine science camp experience, learners were unsure due to the fact that they did not know what to expect at the camp.

It was clear that when learners participated in the rocky shore inquiry activity they developed a variety of skills such as scientific inquiry skills, marine literacy, communication skills and increased motivation for science learning. As a result of participating at the camp, they were able to develop their own scientific inquiry projects. The camp provided context for learning science in the real world and as a result increased motivation was observed after participation at the marine science camp. The increased motivation has implication for classroom learning as it needs to include scientific inquiry based activities. Schools should make efforts to involve experts in the

learning so that they can have access to resources they may not have in the classroom. Additionally, collaborative efforts within universities, businesses and other institutions of learning are needed to encourage and motivate learners to develop and participate in inquiry based science learning activities.

References

- Agunbiade, E. A. (2016). *Exploring the influence of learners' participation in an after-school science enrichment programme on their disposition towards science: A case study of Khanya Maths and Science Club*. Unpublished master's thesis, Education Department, Rhodes University, Grahamstown.
- Aikenhead, G. S. (1997). Toward a first nation cross-cultural science and technology curriculum. *Science Education, 81*, 217-238.
- Aldridge, J., & Fraser, F. (2008). *Outcomes-focused learning environments*. Rotterdam, The Netherlands: Sense Publishers.
- Asheela, E. N. (2017). *An intervention on how using easily accessible resources to carry out hands-on practical activities in science influences science teachers' conceptual development and dispositions*. Unpublished master's thesis, Education Department, Rhodes University, Grahamstown.
- Atallah, F., Bryant, S., & Dada, R. (2010). Learners' and teachers' conceptions and dispositions of mathematics from Middle Eastern perspectives. *Us-China Educational Review, 7*(8), 43-49.
- Aulls, M. W., & Shore, B. M. (2008). *Inquiry in education: The conceptual foundations for research as a curricular imperative*. New York, NY: Routledge.
- Bandura, A., Locke, E. 2003. Negative self-efficacy and goal effects revisited. *Journal of Applied Psychology, 88*(1), 87-99.
- Bantwini, D. (2010). How teachers perceive the new curriculum reform: Lessons from a school district in the Eastern Cape, South Africa. *International Journal of Educational Development, 30*(1), 83-90.

- Barlia, L. (1999). *High school students' motivation to engage in conceptual change learning in science*. Unpublished doctoral thesis, Ohio State University, Columbus.
- Bassey, M. (1999). *Case study research in educational setting*. Buckingham. Philadelphia: Open University Press.
- Bertram, C., & Christiansen, I. (2015). *Understanding research: An introduction to reading research*. Pretoria: Van Schaik Publishers
- Bischoff, P. J., Castendyk, D., Gallagher, H., Schaumlöffel, J., & Labroo, S. (2008). A summer science camp as an effective way to recruit high school student to major in the Physical Science and Science education. *International Journal of Environmental & Science Education*, 3(3), 131-141.
- Bodner, G. M & Orgill, M, (2007). *Theoretical frameworks for research in chemistry/science education*. Pearson Prentice Hall, Upper Saddle River, NJ
- Bourdieu, P. (1993). *Sociology in question*. London: Sage Publications.
- Brophy, J. (1983). Classroom organization and management. *The Elementary School Journal*, 83, 205-285.
- Bruner, J. (1996). *The culture of education*. Cambridge, MA: Harvard University Press.
- Cavas, P. (2011). Factors affecting the motivation of Turkish primary students for science learning. *Science Education International*, 22(1) 31-42.
- Clegg, T., & Kolodner, J. (2014). Scientizing and cooking: Helping middle-school learners develop scientific dispositions. *Science Education*, 98, 36-63.
- Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education* (7th ed.). London: Routledge.

- Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education* (8th ed.). London: Routledge.
- Crick, D. R. (2009). Assessment in schools - dispositions. In B. McGaw, P. Peterson & E. Baker (Eds.), *The international encyclopedia of education* (3rd ed.). Amsterdam: Elsevier.
- Crick, D. R. (2012). Student engagement: Identity, learning power and enquiry - a complex systems approach. In S. Christenson, A. Reschley & C. Wylie (Eds.), *The handbook of research on student engagement*. New York: Springer.
- Crick, D. R., & Goldspink, C. (2014). Learner dispositions, self-theories and student engagement. *British Journal of Educational Studies*, 1-17.
doi:10.1080/00071005.2014.904038
- Damon, W. (2005). Personality Test: The dispositional dispute in teacher preparation today, and what to do about it. *Journal of Teacher Education - Issues on Dispositions*, 2, 1- 6.
- Dermitzaki, I., Stavroussi, P., Vavougiou, D., & Kotsis, K. (2013). Adaptation of the Students' Motivation Towards Science Learning (SMTSL) questionnaire in the Greek language. *European Journal of Psychology of Education*, 28(3), 747-766.
- Falk, J. H., & Dierking, L. D. (2000). *Learning from museums: Visitors experiences and the making of meaning*. Lanham, MD: Alta Mira Press.
- Fields, D. A. (2009). What do students gain from a week at science camp? Youth perceptions and the design of an immersive, research-oriented astronomy camp. *International Journal of Science Education*, 31(2), 151-171.
- Foster, J. S., & Shiel-Rolle, N. (2011). Building scientific literacy through summer science camps: A strategy for design, implementation and assessment. *Science Education International*, 22(2), 85-98.

- Fraser, B. J. (2012). Classroom learning environments: Retrospect, context and prospect. In B. Fraser, K. G. Tobin & C. J. McRobbie (Ed.), *Second international handbook of science education* (pp. 1191-1239). Dordrecht: Springer.
- Friedman, A. (2008). *Framework for evaluating impacts of informal science education projects*. Retrieved on 12 March, 2019 from http://insci.org/resources/Eval_Framework.pdf
- Glynn, S., Brickman, P., Armstrong, N., & Taasoobshirazi, G. (2011). Science motivation questionnaire II: Validation with science majors and nonscience majors. *Journal of Research in Science Teaching*, 48, 1159-1176.
- Grant, C., & Osanloo, A. (2014). Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blue print for your house. *Administrative Issues Journal*, 4(2), 1-16.
- Harrison, G., & Muthivhi, A. (2013). Mediating self-regulation in kindergarten classrooms: An exploratory case study of early childhood education in South Africa. *Journal of Education*, (57), 79-101.
- Kahenge, W. N. (2013). *Understanding educators' and learners' perceptions and experiences of their participation in the Science Fair/Expo*. Unpublished master's thesis, Rhodes University, Grahamstown.
- Kelle, U. (2006). Combining qualitative and quantitative methods in research practice: Purposes and advantages. *Qualitative Research in Psychology*, 3(4), 293-311.
- Kelly, A.E., & Lesh, R. (2000). *Handbook of research design in mathematics and science education*. UK: Routledge.
- Koballa, T. R., & Glynn, S. M. (2007). Attitudinal and motivational constructs in science learning. *International Journal of Science Education*, 24, 661-679.

- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- Lederman, J. S., Lederman, N. G., Bartos, A. S., Bartels, L. S., Meyer, A. A., & Schwartz, R. S. (2014). Meaningful assessment of learners' understanding about Scientific Inquiry: The views about scientific inquiry (VASI) questionnaire. *Journal of Research in Science Teaching*, 51(1), 65-83.
- Lederman, N. G., & Lederman, J. S. (2014). Research on teaching and learning of nature of science. In N. G. Lederman & S. K. Abell (Eds.), *Handbook of research on science education Vol 2* (pp. 600-620). New York, NY: Routledge.
- Lemke, J. L. (1990). *Talking science: Language, learning, and values*. Norwood, NJ: Ablex Publishing Corporation
- Lin, P., & Schunn, D. (2016). The dimensions and impact of informal science learning experiences on middle schoolers' attitudes and abilities in science. *International Journal of Science Education*, 38(17) 2551-2572.
- Markowitz, D. G. (2004). Evaluation of the long-term impact of a university high school summer science program on students' interest and perceived abilities in science. *Journal of Science Education and Technology*, 13(3), 395-407.
- Martin, A. J. (2002). Motivation and academic resilience: Developing a model for student enhancement. *Australian Journal of Education*, 46(I), 34-49.
- Mavuru, L., & Ramnarain, U. (2017). Teachers' knowledge and views on the use of learners' socio-cultural background in teaching natural sciences in grade 9 township classes. *African Journal of Research in Mathematics, Science and Technology Education*, 21(2), 176-186.
- Mavuru, L., & Ramnarain, U. (2019). Language affordances and pedagogical challenges in multilingual grade 9 natural sciences classrooms in South Africa. *International Journal of Science Education*, 1-21.

- McRobbie, C., & Tobin, K. (1997). A social constructivist perspective on learning environments. *International Journal of Science Education, 19*(2), 193-208.
- McRobbie, C. J., & Fraser, B. J. (1993). Associations between student outcomes and psychosocial science environment. *Journal of Educational Research, 87*(2), 78-85.
- Meece, J., & Eccles, J. (1993). Introduction: Recent trends in research on gender and education. *Educational Psychologist, 28*, 313-319.
- Mellors, J., McKenzie, L. J., & Coles, R. G. (2008). Sea grass-watch: Engaging Torres Strait Islanders in marine habitat monitoring. *Continental Shelf Research, 28*, 2339-2350.
- Mertens, D. (2007). Transformative paradigm: Mixed methods and social justice. *Journal of Mixed Methods Research, 1*, 212-225.
- Msimanga, A., & Lelliott, A. (2014). Talking science in multilingual contexts in South Africa: Possibilities and challenges for engagement in learners home languages in high school classrooms. *International Journal of Science Education, 36*(7), 1159-1183.
- National Research Council. (1996). *Inquiry and the national Science education standards: A guide for teaching and learning*. Washington, DC: The National Academies Press.
- Ndevahoma, M. K. (2109). *Enactment of hands-on practical activities through using easily accessible resources in a Grade 10 Physical Science classroom*. Unpublished master's thesis, Rhodes University, Grahamstown.
- Ngcoza, K. M., Sewry, J., Chikunda, C., & Kahenge, W. (2016). Stakeholders' perceptions of participation in science expos: A South African case study. *African Journal of Research in Mathematics, Science and Technology Education, 20*(2), 189-199.
- Nhase, Z. (2019). *An exploration of how grade 3 foundation phase teachers develop basic scientific process skills using inquiry based approach in their classroom*. Unpublished PhD thesis, Rhodes University, Grahamstown.

- Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and implications. *International Journal of Science Education*, 25(9), 1049-1079.
- Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications
- Palmer, D. (2005). A motivational view of constructivist-informed teaching. *International Journal of Science Education*, 27(15), 1853-1881.
- Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and Psychological Measurement*, (53), 801-813.
- Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research*, 63(2), 167-199.
- Raths, J. (2001). Teachers' beliefs and teaching beliefs. *Early Childhood Research & Practice*, 3(1). Retrieved January 15, 2007, from <http://ecrp.uiuc.edu/v3n1/raths.html>
- Reddy, V., Van der Berg, S., Janse van Rensburg, D., & Taylor, S. (2012). Educational outcomes: Pathways and performance in South African high schools. *South African Journal of Science*, 108(3-4), 1-8.
- Reddy, V. Zuze, T. L, Visser, M., Winnar, L., Juan, A., Prinsloo, C. H., Arends, F., & Rogers, S. (2015). *Beyond benchmarks: What twenty years of TIMMS data tell us about South African education*. Cape Town: HSRC Press. 1-19.
- Riedinger, K. (2011). Middle school students' identity development as learners of science at an informal science education camp. In the *2011 Proceedings of the National Association for Research in Science Teaching Annual Meeting*.

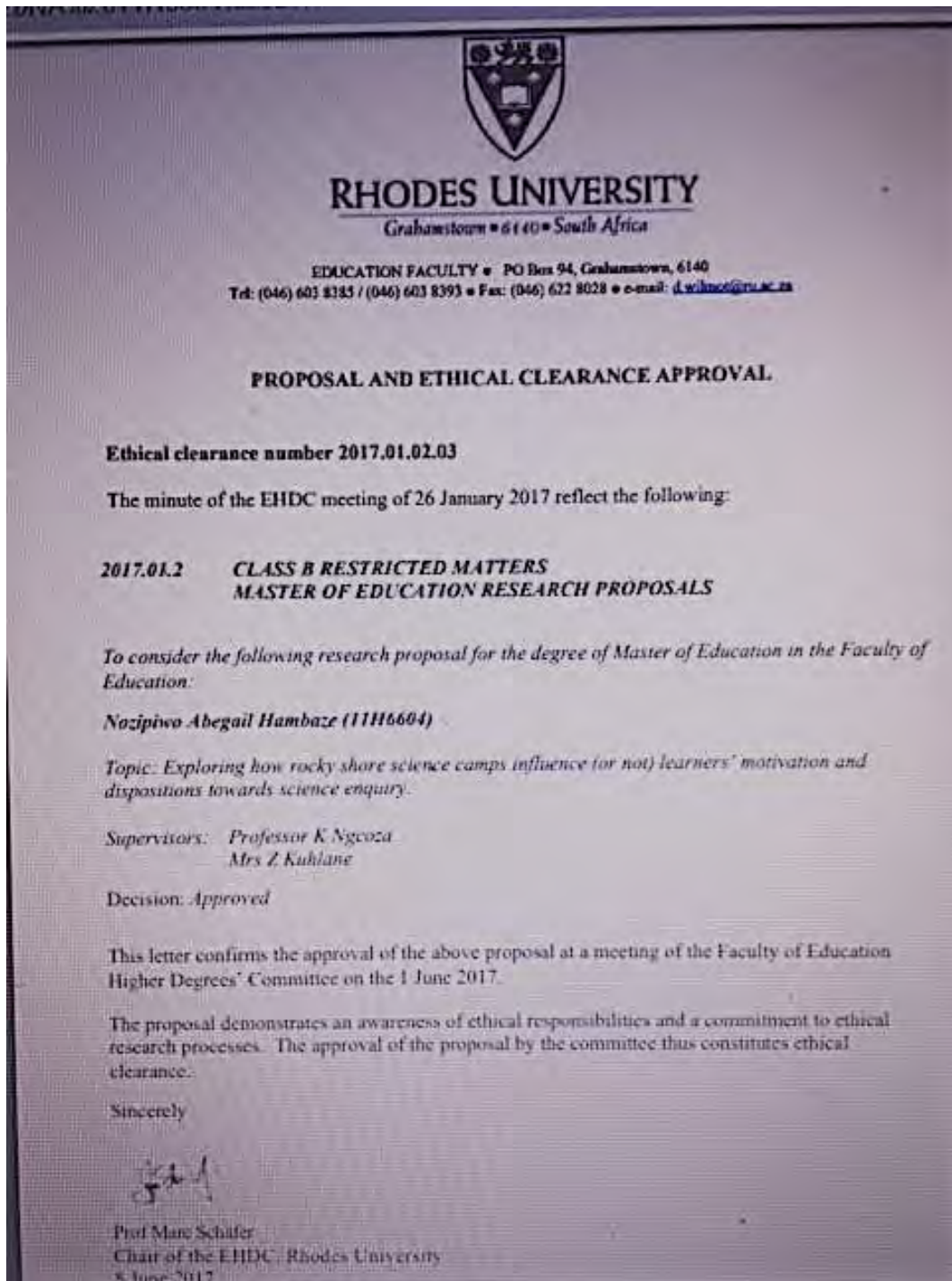
- Riedinger, K. (2015). Identity development of youth during participation at an informal science education camp. *International Journal of Environmental and Science Education*, 10(3), 453-475.
- Roberts, J. (2006). Limits to communities of practice. *Journal of Management Studies*, 43(3), 623-639.
- Sadler, T. D. (2014). Communities of practice. In R. Gunstone (Ed.), *Encyclopedia of science education* (pp. 1-6). New York, NY: Springer.
- Schulze, S., & van Heerden, M. (2015). Learning environments matter: Identifying influences on the motivation to learn science. *South African Journal of Education*, 35(2), 1-9.
- Sedlacek, M., & Sedova, K (2017). How many are talking? The role of collective dialogue in teaching. *International Journal of Educational Research*, 85, 99-108.
- Seroto, J. (2012). Rural education in South Africa: A critical reflection on government reconstruction and development efforts. *Journal of Human Ecology*, 37(2), 77-78.
- Sibiya, J. R. (2015). *The South African Environmental Observation Network science education camps and science career choice: A 4-year case study among grade 11 Phalaborwa learners*. Unpublished master's thesis, Witwatersrand University, Johannesburg.
- South Africa. Department of Basic Education. (2011). *National Curriculum Statement (NCS) Curriculum and Assessment Policy Statement Further Education and Training Phase Grades 10-12: Life Sciences*. Pretoria: Government Printer.
- Stott, D. (2016). Making sense of the ZPD: An organising framework for mathematics education research. *African Journal of Research in Mathematics, Science and Technology Education*, 20(1), 25-34.
- Taylor, P. C., Fraser, B. J., & Fisher, D. L. (1997). Monitoring constructivist classroom learning environments. *International Journal of Educational Research*, 27, 293-302.

- Tshiningayamwe, S. (2016). *Exploring functioning and conversion factors in biodiversity teacher professional learning communities*. Unpublished doctoral thesis, Rhodes University, Grahamstown.
- Tuan, H., Chin, C., & Shieh, S. (2005). The development of a questionnaire to measure students' motivation towards science learning. *International Journal of Science Education*, 27(6), 639-654.
- Varelas, M., Martin, D. B., & Kane, J. M. (2012). Content learning and identity construction: A framework to strengthen African American students' mathematics and science learning in urban elementary schools. *Human Development*, 55, 319-339. doi: 10.1159/000345324
- Vedder-Weiss, D., & Fortus, D. (2011). Adolescents' declining motivation to learn science: A follow-up study. *Journal of Research in Science Teaching*, 49(9), 1057-1095.
- Velayutham, S., Aldridge, J., & Frazer, B. (2011). Development and validation to measure students' motivation and self-regulation in science learning. *International Journal of Science Education*, 33(15), 2159-2179.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Walker, C. L., & Shore, B. M. (2015). Understanding classroom roles in inquiry education: Linking role theory and social constructivism to the concept of role diversification. *Sage Open*, 5, 1-13.
- Walshaw, M. (2012). Teacher knowledge as fundamental to effective teaching practice. *Journal of Mathematics Teacher Education*, 15(3), 181-185.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York, NY: Cambridge University Press.


- Wenger, E., & Wenger-Trayner, B. (2015). *A brief introduction to communities of practice*. Retrieved on 14 April, 2019, from <http://wenger-trayner.com/wp-content/uploads/2015/04/07-Brief-introduction-to-communities-of-practice.pdf>
- Writer, S. (2015). *South African mathematics and science ranked worst in the world*. *World Economic forum's Global Information Technology Report 2015*. Retrieved on June 10, 2015, from <http://mybroadband.co.za/news/government/12424-south-african-mathematics-science-education-ranked-worst-in-the-world.html>
- Yanow, D. (2004). Translating local knowledge at organizational peripheries. *British Journal of Management*, 15(1), 9-25.
- Yin, R. K. (2009). *Case study research design and methods* (4th ed.). Thousand Oaks, CA: Sage Publications.

Appendices

Appendix 1: Ethical Clearance



Appendix 2: Permission form the Department of Education (District Office)


RHODES UNIVERSITY
Grahamstown • 6140 • South Africa

EDUCATION DEPARTMENT
Tel: +27 (0) 46 603 8383
Fax: +27 (0) 46 622 8028
PO Box 94, Grahamstown, 6140
E-mail: education@ru.ac.za

The District Director
District of Education

Re: Request for permission and access to conduct educational research with learners from Nombulelo, Ntsika, Mary Waters and Nathaniel Nyaluza Secondary Schools in your district.

I am Nozipiwo Hambaze, a part –time registered Master in Education (Science Education) student at Rhodes University and a Science Engagement Officer at South African Environmental Observation Network (SAEON) responsible for grade 10 and 11 science camps. I humbly request your permission to conduct a research study with learners from the schools mentioned above whilst we are still at the camp and at the schools.

In this research, I am using science camps to explore learner motivation and disposition towards scientific inquiry.

The study will be conducted in **three** phases. The first phase requires participants to complete a questionnaire. The **second phase** of the study involves an intervention in the form of science camp. After the science camp, **the third phase** of the study requires research participants to be interviewed in their school.

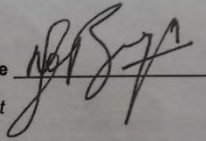
I would like to assure your office that, should I be granted permission, the research ethics will be adhere to at all times throughout out my research. The identity of participants, schools and their views will be treated with confidentiality and anonymity.

Kindly sign and stamp the form attached to show that you allow me to do the research

Yours sincerely
Nozi Hambaze
MEd candidate (Rhodes University)

I hereby grant permission to the researcher.

Signature

A handwritten signature in black ink, appearing to be 'S. Baartman', written over a horizontal line.

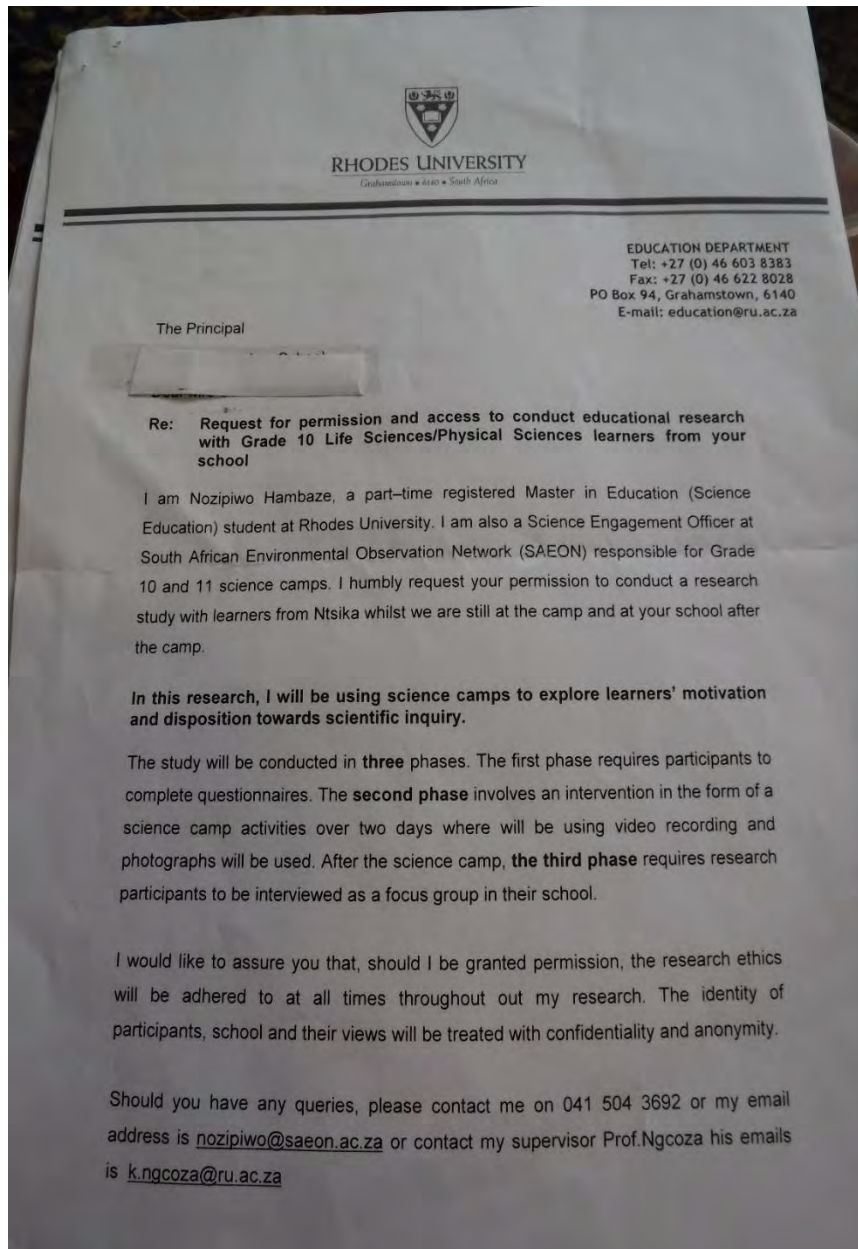
Designation *Distict* Director for Sarah Baartman Education District

Date 17 May 2017

Stamp:

DEPARTMENT OF EDUCATION
2017 -05- 17
GRAHAMSTOWN DISTRICT
PRIVATE BAG X1001
GRAHAMSTOWN 6140

Appendix 3: Permission letter for school A



Appendix 4: Permission letter from school



██████████ HIGH SCHOOL
P.O BOX 112 ██████████ 6130
03 GRIFFTH STREET ██████████ 6130
TEL /FAX 042 235 1023

To whom it may concern

Sir / Madam

Re: GRANTING OF PERMISSION TO NOZIPIWO HAMBAZE TO CONDUCT EDUCATIONAL RESEARCH WITH GRADE 10 LIFE SCIENCES /PHYSICAL SCIENCE.

This letter serves to inform that permission has been granted to Nozipiwo Hambaze to conduct educational research with Grade 10, with effect from 10/05/2017 up to the last date of the research.


For any further information that you might need for assistance, don't hesitate to contact the undersigned persons.

Thanking you

M.C Tata (0835494063)

Z.Mame (0839766785)

Appendix 5: Consent letter to the parents


RHODES UNIVERSITY
Grahamstown • 6140 • South Africa

EDUCATION DEPARTMENT
Tel: +27 (0) 46 603 8383
Fax: +27 (0) 46 622 8028
PO Box 94, Grahamstown, 6140
E-mail: education@ru.ac.za

26 April 2017

Mzali obekekileyo,

Ndivuyisana nawe ngokuchongwa komntwana wakho ukuba abe ngomnye wabafumene ithuba lokuyokuchitha iintsuku ngaselunxwemeni efunda ngenzulwazi emalunga nolwandle. Siye ke safumanisa ukuba masenze uphando lokuba sazi ukuba yintoni eyenza umdla nendlela abacinga ngayo abantwana xa beyinxalenye kusenziwa uphando nzulu kwizifundo zenzululwazi ingakumbi kwizinto ezinxulemene nonxweme.

Kuloko ndicela imvume yakho yokuba umntwana abe yinxalenye yoluphando olwakwenziwa ngempela veki le siya kuyo (12-14 May 2017). Olu phando ke lwakwenziwa xa sihleli nabantwana elunxwemeni ngempela-veki ze emva koko ke batyelelwe kwizikolo zabo xa sele bebeyele emagumbini okufunda. ngemvume yenqununu kwakunye nabefundisintsapho babo.

Olu phando ke ndilwenzela mna nedyunivesithi yase Rhodes ndakuthi ke ndakuligqiba uphando ndibanike abantwana kwanabazali balifunde ukuze ukuba zikhona iziphene okanye izinto esingangqinelaniyo ngako sikulingise.

Umntwana wakho uyakuthatha inxaxheba ngemvume yakho mzali. Kodwa ke umntwana wakho wamkelekile ukuba angarhoxa nangawuphina umzuzu koluphando. Igama lo mntwana wakho lokwenyani alusayi kuvela sakusebenzisa osingagama kolu phando.

Xa ndikhankanya izinto malunga namagumbi okufundela okanye ukuthetha nomntwana wakho, ndiyakuthemba ukuba umntwana wakho akayikuvela kuba ndizakusebenzisa amagama angengawo ukutsho amagama emboleko.


Ukuba unombuzo malunga noluphando, nceda uqhagamishelane nam kolu cingo 072 2026134, nozipiwo@saeon.ac.za okanye uProf. Ken Ngcoza (k.ngcoza@ru.ac.za) (046-6037269) okwiSebe lwezeMfundo eRhodes Dyunivesiti.

Ndiyakucela kananjalo ukuba uncede uzalise esi siqendu silalndelayo uze uncede unike umntwana wakho ukuba aze naso esikolweni. Maz'enethole!

Ozithobileyo
Nozi Hambaze
041-5043692

Umzali:
Mme mzali [redacted] ndiyavuma/ andivumi umntwana wam abe koluphando
Igama [redacted]
Tyikitya M. G. [redacted]
Inombolo yomxeba 061 569 3980

Appendix 6: Participant consent letter


RHODES UNIVERSITY
Grahamstown • 6140 • South Africa

EDUCATION DEPARTMENT
Tel: +27 (0) 46 603 8383
Fax: +27 (0) 46 622 8028
PO Box 94, Grahamstown, 6140
E-mail: education@ru.ac.za

26 April 2017

Dear Research Participant

Re: Participation in research on the use of science camps to explore learner motivation and disposition towards scientific inquiry

Thank you for agreeing to attend the science camp and be a research participant in this study. My research area is using science camp to explore learners' motivation and disposition towards scientific inquiry.

The study will be conducted in **three** phases. The first phase requires participants to complete a questionnaire. The **second phase** involves an intervention in the form of science camp. After the science camp, **the third phase** requires research participants to be interviewed as a focus group in their respective schools.

Your participation in this research study is completely voluntary and you can withdraw at any time should you wish to do so. The data collected in this study will be published as a Rhodes University full thesis. The identity of each participant and their views or contributions will be treated with a high degree of confidentiality and anonymity.

Yours sincerely,
Nozi Hambaze

Learner:

I agree to participate in the research on condition that I can withdraw at any time if I wish to.

Name.....

Signature..... *AG Louw*

Contact number.....

Appendix 7: Indemnity form



SOUTH AFRICAN ENVIRONMENTAL OBSERVATION NETWORK

Indemnity Form

Surname: (as in your identity document/passport)
First Names: Title (Mr/Ms) Ms
Residential Address during term: 73 MOLESOR
PATERSON 6130
Telephone: Cell phone: 061 569 3980
Identity number: 8006130274086 Date of Birth:
Citizenship: SOUTH AFRICAN
Issuing Country and Passport No.:
Person to contact in case of emergency:
Name: CP Contact numbers: 061 569 3980

Any other information the fieldwork co-ordinator / project or programme manager should know?
.....
.....

I, the undersigned acknowledge that I have read and have been made aware and agree to the terms of the indemnity pertaining to the education outreach programme field trips. I understand last mentioned and accept the inherent risks.

By signing below, I hereby indemnify and absolve the National Research Foundation, its business unit the South African Environmental Observation Network (SAEON), its Board, executive management, management, employees, officers, agents and representatives and Corporate Executives from any liability to me of any claim, of any nature whatsoever and howsoever caused to me which may arise from injury, illness, damage, loss, mishap, accident or any other occurrence, resulting from my taking part in the education outreach programme under the auspices of the National Research Foundation.

In so doing I acknowledge that I am aware of the risks to which I might be exposed as a result of such participation and voluntarily accept all such risks. I further indemnify the National Research Foundation, its board, executive management, management, employees, officers, agents and representatives against any claim or legal proceedings instituted by myself or any third party which may arise from taking part in this activity.

Thus done and signed at PATERSON on this the 12 day of MAY 2017

.....
UNDERSIGNED

S. Skymar
WITNESS

NB: Please return this Indemnity Form to the fieldtrip co-ordinator/ project or programme manager

Appendix 8: Marine Science Camp Programme

		SAEON MARINE SCIENCE CAMP : 12-14 MAY	
		PINE LODGE, PORT ELIZABETH	
DAY	DATE	TIME	ACTIVITY
Friday	12-May	14:00	ARRIVAL AT HABOUR
		14:30-15:30	TOUR OF AGULHAS 1
		15:30-16:00	ARRIVAL AT PINE LODGE
		16:00-17:00	WELCOME, RULES, ROOM ALLOC, GROUPS
		17:00-18:00	INTRODUCTION TO ROCKY SHORES
		18:00-19:00	SUPPER
			COMPUTER SKILLS
Saturday	13-May	07:00-08:00	BREAKFAST
		08:30-11:30	TRANSECTS -DATA COLLECTION (Low tide 10:53)
		11:30-12:00	PLANKTON SAMPLING
		12:00-12:30	MICROSCOPES
		12:30-13:30	LUNCH
		14.00-18:00	DATA ANALYSIS
		18:00-19:00	SUPPER
		19:00-till late	PREPARING PRESENTATIONS
Sunday	14-May	07:30-08:30	BREAKFAST
		09:00 -10:30	POLISH -UP PRESENTATIONS
		11:00-12:30	PRESENTATIONS
		12:30-13:00	PRESENTATION OF CERTIFICATES
		13:00-14:00	LUNCH
		14:00	Depart

Appendix 9: The SMTSL questionnaire

WHAT DO YOU THINK ABOUT SCIENCE?

Pre-science camp questionnaire

This survey is completely confidential and your participation is voluntary.

Gender: Male _____ Female _____ Name: (optional) _____

Grade _____

Please indicate your level of agreement with each of the following statements by circling the best response.

	ITEMS	RESPONSE				
		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1	Whether science is difficult I am sure I can understand it.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
2	I am not confident about understanding difficult science concepts	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
3	I am sure I can do well on science tests.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
4	No matter how much effort I put in .I cannot learn science	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
5	When science activities are too difficult, I give up or do the easy parts	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
6	During science activities I prefer to ask other people for the answer rather than think for myself.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
7	When I find science content difficult, I do not try to learn.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
8	When learning new science concepts, I attempt to understand them.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
9	When learning new science concepts, I connect them to my previous experiences	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
10	When I do not understand a science concept, I find relevant resources that will help me.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

11	When I do not understand a science concept, I would discuss it with the teacher to clarify my understanding.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
12	During the learning process, I attempt to make connections between the concepts that I learn.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
13	When I make a mistake , I try to find out why	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
14	When I meet science concepts that I do not understand, I still try to learn them.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
15	When new science concepts that I have learned conflict with my previous understanding, I try to understand why	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
16	I think learning science is important because I can use it in my daily life	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
17	I think learning science is important because it stimulates my thinking	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
18	In science is important I can use it in my daily life	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
19	In science, I think it is important to participate in inquiry activities.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
20	It is important to have the opportunity to satisfy my own curiosity when learning science.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
21	I participate in science class to get good marks.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
22	I participate in science class to perform better than other students	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
23	I participate in science class so that other students think I am smart	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
24	I participate in science class so that the teacher pays attention to me	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
25	During a science class, I feel most fulfilled when I attain a good score in test.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
26	I feel most fulfilled when I feel confident about the content in a science course	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
27	During a science class, I feel most fulfilled when I am able to solve a difficult problem.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
28	During a science class I feel most fulfilled when the teacher accepts my ideas.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
29	During the science class I feel most fulfilled when other students accept my ideas.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
30	I am willing to participate in this science camp because the content is exciting.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
31	I am willing to participate in this science camp because its challenging	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

32	I am willing to participate in this science camp because it does not put pressure on me.	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
33	I am willing to participate in this science camp because students are involved in discussions	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
34	I am willing to participate in this camp it uses variety of teaching methods	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
35	I am willing to participate in this camp it is a learning outside the classroom	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

Appendix 10: Learner reflection journal prompt questions

Day 1 Reflections

- What motivates you to do science at school
- What or who inspires you to do science?
- Do you find science boring or interesting at school?
- How were you chosen to be part of the camp
- What is your ability to do learn science
- What are your expectation of the science
- What did you enjoy about today's activities?

Day 2. Reflections

- How different are you in a camp compared to when you are in the classroom?
- How did the conversations with your group members and facilitators impact how you think about scientific inquiry.

Day 3 Reflections:

- Explain if the science camp has motivated you or not?
- Explain how is your scientific understanding after the camp?
- Did you encounter any challenges, if so how did you solve them?

Appendix 11: Focus group interview schedule:

Taking you back to the camp

1. Would you please tell me why you have chosen science in grade 10?
2. Who inspires or motivates you?
3. What are your perceptions about science or marine science?
4. What excited you about doing scientific inquiry?
5. How did your participation and experiences at the camp influence your perceptions about science?
6. What challenges did you encounter?
7. What kept you going?
8. Do you think your participation at the camp has improved your understanding of scientific inquiry? How.
9. What sort of career you would like to follow when you finish high school?

Appendix 12: Motivation Rubric

Motivation component	Low Motivation (1)	Moderate Motivation (2)	High Motivation (3)
Self- efficacy	Does not think for himself but often asks help from others	Not sure about understanding of science concepts	Does not give up even if the content is difficult
Active learning strategy	Worries when making mistakes but not take initiative to ask why	Tries to connect prior knowledge to new science concepts	Finding relevant resources to assist in learning science
Learning environment stimulation	Less or no input in learner discussions	<p>Enjoyment of content and different teaching methods</p> <p>Displays willingness to enjoy a challenging course</p>	Willingness to participate in exciting, changeable and challenging environment

Appendix 13: Motivational constructs scores data based on rubric

No	Camp Participants*	Gender	Learning environment		Self- Efficacy		Active learning strategies	
			pre-camp	post -camp	pre-camp	post- camp	pre-camp	post- camp
1	L1 (LG)	G	1	3	1	2	1	2
2	L2 (AF)	G	2	3	2	2	2	2
3	L3 (NZ)	G	1	3	2	2	2	3
4	L4 (SX)	G	2	2	2	2	2	3
5	L5 (SN)	B	1	2	1	2	1	2
6	L6 (YM)	G	2	3	2	3	2	3
7	L7 (AM)	G	1	3	1	3	2	3
8	L8 (SK)	B	1	3	2	2	2	3
9	L9 (SS)	B	1	3	1	2	1	3
10	L10 (NN)	G	1	2	2	2	2	2
11	L11 (AZ)	B	1	3	1	2	1	2
12	L12 (MK)	B	2	2	2	2	2	2
13	L13 (TZ)	G	1	3	1	1	2	3
14	L14 (SS)	G	1	3	1	2	1	3
15	L15 (AN)	G	1	3	1	3	1	3
16	L16 (SY)	G	1	3	1	3	1	3
17	L17 (SM)	G	1	2	2	2	2	2
18	L18 (MG)	B	1	3	1	2	1	3
19	L19 (VK)	B	2	3	2	2	1	3
20	L20 (AF)	G	1	2	2	2	1	3
21	L21 (UT)	G	1	3	1	2	1	2

Appendix 14: Learner Reflection Journals Transcripts

Day 1 Reflections

- What motivates you to do science at school
- What or who inspires you to do science?
- Do you find science boring or interesting at school?
- How were you chosen to be part of the camp
- What is your ability to do learn science
- What are your expectation of the science
- What did you enjoy about today's activities?

L1. I am a science learner because I want to learn more about the world, why things are the way they are and I want to learn about things around me.

My inspiration to do science is my teacher, she knows ins and outs of science

Science is interesting and also boring at school its interesting when we learn or got thought new things in and about the world.

But it get boring when it comes to practical's we don't have much equipment to do a practical so we kinda have like have to imagine in our heads.

I was chosen to be part of the camp because there are 6 learners who attend the Khula so our teacher took 3 students, so our teacher took 3 students from those 6 who attend Khula so I was part of the 3.

In this camp I expect to learn more about science and its involvement in a lot of things in the world.

I am confident in my ability to learn science, because whatever I do I try my utmost best and I also believe in dedication , so that I don't give up until I get something done.

From today's activities I **enjoyed** being on a boat and being showed the different stations and I also enjoyed learning about rocky shore ecology which helped me to know more about animals in the sea or the different species around the sea.

L2: I found the controlling system of the ship very interesting. I have never seen anything like that before and I like the fact that its complicated (not easy to learn)

Science opens up job opportunities and I've been considering doing a career in science other than that the trip is new to me and,

I am that kind of a person who likes to see things in order to improve my knowledge and make my thinking more advance.

I think that science doesn't depend on how the teacher is teaching

L3: **I love science** because it is a good subject with great job opportunities. Science is a successful career What inspires me the most is my brother, because he is doing great at the university and also he did the same subjects as I do so that puts pressure on me that is why I am dedicated in my books.

It is an interesting subject because almost every session there will new stuff experience and new information gained, which is great for me a curious person.

I was chosen to take part in this camp because of **my performance last term** because I made it in the top 5.

I expect to gain new information because that's what science is good at " bringing new information"

I am a hard worker so I will do well in science because of my dedication .

When I was told about how the boat is driven, I felt in love with the strategy they use, you drive unseated to drive it so that you cannot fall asleep.

L4. In this science camp I am expecting to learn a lot from the teachers who will be teaching us or showing us something.

The thing that motivated me to do science is that is more like the study of the earth and I wanted to learn more about the earth that I live in.

I am not confident in my ability to learn science, but I am working on building my confidence and may be this camp will help me .

Science at school is interesting because every day there is always something new that you will learn but sometimes it becomes boring when you know the topic of that day.

In today's activities the thing that I enjoyed the most was the tour around the ship .I enjoyed it as it was my first time on a ship.

I am looking forward to learning more things tomorrow.

L5: I am inspired by the proving of how things should be done.

I have learnt so much about the boat and how it is amazing.

Science can bore me when I do not understand the topic but sometimes it could just be amazing by looking at what should the science do to improve this world

I think I was chosen because I am willing to learn, just that I need someone who will explain to me and make me understand

My teacher Mrs Mhleka put at sometimes I think if you know the purpose to go to school you will fall in love with it

Science is to make sure that our nature is taken in good hands

I enjoyed many things just because It was my first time to know that there are small species like algae but they are not harmful to us

L6. Science is interesting I love it since grade 9 I enjoy studying it because it teaches us about happening and everything is about science.

I do science because science the career I want to do includes sciences and I must do science in order to become what I want to be.

When doing science I can get any job I want

Science has lots of job opportunities

I told myself that I can be anything I want to be.

Science tells us about everything like nature.

Science teaches us about things happening in nature that cannot be seen with naked eye for some you would need a microscope

Science tells us about what happens in the ocean.

What inspires me is that lot of things we do are all in science and what is around us.

I am inspired by the teachers they always inspire us to do science because science opens many job opportunities

I am inspired by the doctors out there because they make me want to achieve my dream of being a doctor. My parents support me to do what I want to do at school.

When I get good marks on science I also get inspired by that which makes me want to do more

I find science at school very interesting because it tell us about the things that are happening in nature.

I was chosen because I did good at March exams and got good marks **because I worked hard to get good marks**

I'm expecting to see things I have never seen, Im expecting to learn about lots of things that I didn't know they exist or happening .I am expecting to see very exciting things that will increase my confidence in science which will make me want to know more about science.

I am confident to learn science because I want to know more things about science I want to have more knowledge about everything about science

I enjoyed being on a ship because I learned lot of things about it which I didn't know. I enjoyed it when we were being told about it and what subjects you should do if you want to work on a boat, and **I loved it when we got here and were taught about different species and marine life.**

I really liked it when taught about rocky shores

L7: I am a self-driven learner who is curious about everything that relates to science. I am **very much confident about my abilities to learn science.** **During my spare time I watch science documentaries.** In this camp I am expecting to learn more about science. **I just love science.** I get inspiration from a lot of people especially scientist who have discovered lots of thing. **I always go an extra mile to learn** science **believe science is the beginning of all on Earth** I was chosen to be part of the camp based on my science marks. Science is supposed to answer all the questions and challenges we have. I enjoyed today's activities more especially the ship tour. I have never been on a ship but the bridge where the ship is steered gave me an idea of how navigation works.

L8: In this camp I am expecting to learn a lot from the teachers who will be teaching us. The thing that motivated me to do science was the fact that science is more like the study of the earth and I wanted to learn and I wanted to learn more about the earth we live in.

I am not that confident in my ability to learn science but I am working on building my confidence and may be this camp will help me.

Science at school is interesting there is always something new but sometimes it becomes boring when you know the topic of that day.

In today's activities the thing I enjoyed the most was the tour around the ship. I enjoyed it because it was my first time on a ship. I am looking forward to learning more things tomorrow.

L9: I love science because it is a good subject with great job opportunities. Science is a successful career. What inspires the most is my brother because he is doing great at the university and he did the same subject as I do so , that puts a pressure on me and that is why I am dedicated in my books.

It is an interesting subject because almost every session there will be new stuff, experience and new information gained which is great for me as a curious person

I was chosen to take part in this camp because of my performance in last term because I made it in the top 5.

I expect to gain new information because that's what science is good at bringing new information.

I am a hard worker so I will do well in science because of my dedication.

When I was told about how the boat is driven I felt in love with the strategy that they use>you drive it unseated so that you can fall asleep.

I expect to gain new knowledge since science is full of information.

Yes, I am a hard working person so I will definitely do well.

L10t is because I want to change the way we look at science, some say science is very hard.

It is my sister because she wants what best for me and she supports my decisions a lot.

It is interesting because when you are in science class you want to know more about it.

I think I was chosen because of my science marks

My expectation is to learn more and have fun.

Yes, I am confident, I enjoyed the topic about rocks, it was amazing.

L11. Firstly I get motivations to do science and do well in science at school from my teacher as well as other learners who share the same vision and goals just like me. In this camp I expect to learn a lot about science. I will be disappointed if we will do what we normally do at school. I need want to learn something different when I am outside the classroom. I know the value of science in the society and hope in future I will be able to use science in one way or another. In fact we use science at home without realizing that we are doing science. Science is in our everyday life. I was chosen to be part of the camp based on my performance in Science subjects. I expect to learn lots of science in this camp in a fun and interesting way.

In today's activities I enjoyed

L12: I love science as I love myself even in my free time, I like to do some science activities. And science opens many doors and it gives many job opportunities. Other learners run away in science but I told myself that I will do it and will put all my efforts into it The teacher that teaches me science I like the way she teaches me and she likes to say

that science is not too hard you just need to give it time and understand it in this camp I chose to be part of it because I didn't know what would happen and now I have a better information

My expectations in this camp is fun, information and get to know other learners from different schools. I would like to learn more about science and get some different information I really y enjoyed our first activity and I got interested because I never got inside the ship it was my first time and to know how things work inside it. And also the last one I enjoyed it too because I learnt about different types of sea animals

I love science because it gives me information about the things we are using but we are not aware where they come from. It is also nice to learn out of the classroom .I enjoyed marine ship and the seaweed.

L13: I like to learn about science because it is very interesting and it gives a lot of knowledge for instance we have question about Earth and we found out that science is the only thing that will give us answers.

It is very interesting because most of the things we learn from science are the things we manage to see and we can be able to understand it easy. The people that inspire me in science is my teacher and scientists they want to know everything that is on Earth dead or alive and they also like to discover new things.

I was chosen to be part of science camp by my performance, my teachers believe and trust me in everything I do. I try to do my outmost best and I work hard so that I can perform well and also I that I am very confident and I always want to learn more and get more knowledge.

Given the information about this camp, I think here we will learn about water and all the things that surround the ocean.

Today I have learnt about boat, inside of the boat and all the things that are found in it. I also learnt about different kinds of animals and different kinds of stuff found in the sea.

L14: The fact that I want a career in science is one of the reasons I do science and maybe I think and maybe I am more interested in science more than any other subjects.

The fact that I did well in natural science in grade 9 inspired me more and my mother and my parents and I think I can do well also I love those people in the museum in Grahamstown who teaches us science and motivates us as black students to do science so we suffer when we science so we suffer when we look for job.

I expect to learn more about the marine life and also anything that far to do with the sea.

I loved the fact that we get to know that we get to know that in the science field there are .And also see a lot of thing that we taught rather than we are taught rather than being taught theory only in class.

L15: Something that inspires me to do science at school is because I love science and I believe that with science are so many opportunities for you. For me to do science, I was inspired by my big cousin brother who does mechanical engineering but also teaches at school. I find science very interesting because most in fact everything around us is science but people don't notice and also science helps you to study the world and how everything works also but how it happens. I was chosen to be part of this camp at school as one of the learners who attend some Maths and science extra lessons. I am hoping to learn more about the water and also how it is cleaned. I am very confident about my science . Today I enjoyed, Marine vessel tour and the study about the aquatic family.

L16: My reflection from this trip is that I get to learn more about how marine science works. And doing science at school is that science brings new vision to people and also gives a new thinking in mind. I find science very interesting because it makes me use my brain and gets more thinking out of the box. I was chosen because I attend the Khula project by Mr Maselwa and he motivates me to philosophies in science and ask many questions.

I am very confident about science as I have stated why the bridge that controls the ship to learn new things

L17: I am a science learner because I want to learn more about the world. I want to learn about the world and the things that surrounds me. My inspiration to do science is my teacher, because she really knows about the ins and outs of the world. Science is interesting and also boring at school its interesting when we learn or get taught new things in and about the world but it gets boring when it comes to practicals, we don't have equipment to do a practical so we kind like have to imagine in our heads.

I was chosen to be part of the camp because first, there are 6 children who attended the project called Khula so our teachers took 3 students from those who attended Khula which I also attend so I was part of the 3.

In this camp I expect to learn a lot of things about science and its involvement in a lot of things in the world

I am confident in my ability to learn science, because whatever that I do, I try my utmost best and I believe in dedication so I don't give up until I get something done.

From today's activities I enjoyed being on the boat and being showed the different stations and I also enjoyed learning about rocky shore ecology which helped me to know more about animals in the sea or the different types of species around the sea

L18: When I was in grade 9 my NS teacher told me I had a potential of becoming a scientist.

My bigger brother is my source of inspiration because he is the second best at school. I find it interesting, because we learn some of the things that we never thought they exist.

I am the only learner that got level 6 on the recent term.

Yes, I believe that science is the only subject that helped me to brainstorm and think out of the box

L19: What motivated me to do science is my career and also I like to know about human being and plants. My mom inspired me to do science she is a nurse. It is interesting because you learn about organic and non-organic plants and compounds.

I was chosen because of my hard work and my input in life sciences. I am expecting to learn new exciting things like ocean creatures

L20: It seems to me learning about the nature world that surrounds us should be more interesting to everyone and learning about it at school.

The person that inspires me to do science is my science teacher Miss Wood. She makes everything in order for you so that you can understand her.

Sometimes I find it interesting because to learn about sciences is good so that no matter what you learn for as in your career you can always include science

L21: What motivates me to do science is that in science there is a lot of work to do and I involve working and my career falls under the science subjects and that career is being an Engineer but I am not sure which one. What motivates me to do science are the experiments. There are a lot of experiments and I love them. It is interesting because there are a lot of experiments and I love them. It is interesting because we learn a lot of things in science and what I like about science is that it explains about nature.

Our teacher chose the focused students, students who are willing to sacrifice on books.

In this camp I expect to learn a lot of new things that we haven't learned at school yet and I will give feedback to those who did not attend that camp.

I am very much confident about learning science because firstly, I am a hard worker and I am serious about learning. Today's activities were fun and I learnt about a lot of things. It was very fun.

Day 2. Reflections

- How different are you in a camp compared to when you are in the classroom?
- How did the conversations with your group members and facilitators impact how you think about scientific inquiry.

L1: I am not different in the camp. I am myself everywhere I go. So the person that I am at school, will be the same person outdoors.

Conversations with other peers and teachers influenced how I think about science in a good way because I learnt a lot especially for the learners.

It makes me know everything world and its operations and also how the other things are made

L2: Being part of the science camp make me feel free and I got to know how other mind form other schools think.

I think science is all about learning new things and how they operate

Ootishala balapha baluncedo bendenza ndizive special because they don't ignore you when you ask questions but give you great clue.

L3: because I am in the top 5, I was given this opportunity based on my performance.

I expect to gain knowledge since science is full of information. I am a hardworking person so I will do well.

Without science job opportunities will be scarce and things that revolve around us won't be discovered

L4: Firstly to be honest this is my first science camp I am different here than in my classroom because here most of the time we worked in groups whereas in the classroom I usually work alone for most of the time and I must say working as a group was a good thing.

My teacher and group members impacted my thinking about science in a way they made that made science look easier and fun to learn.

Today was a very good day because I got to see many species which I never saw before and the fun part was that could hold and take pictures.

With all that being said, thank you to my teachers for a wonderful camp and also to my group members.

L5: This day was great and we went to the beach enjoyed lot of things

Finding these species and the wave came to us .It was an interesting night.

We have to do our presentation and all the work that we have learn so much and I thank Ma for creating such an opportunity I hope she could do for other learners who are still smaller than me .

I want to thank my teacher who chose me to come to the camp

L6: We were mostly talking in isiXhosa when we discussed alone but reported in English. It was good

L7: **It was fun** , I we asked each other and made sure that all of us in the group have something to do.

L8: Firstly, to be honest, this is my first science camp

L9: It was fun but at the same time I was learning especially talking to my teachers it was so inspiring. I feel blessed to get this opportunity.

L10: There's a difference between classroom and science camp. In a camp you can ask anything and want to know more.

It was nice because we were working together. I think science is interesting. Science makes you want to know more. You can explore in science and have fun.

L11: In the classroom there are things you need to do individually no discussions. Here always it's group that is good for learners to show up ideas to others. Science is where you need to know about things that are living on earth and science explains those things around us.

L12: In the camp I feel more comfortable than in the classroom because here in the camp, I learnt a lot especially today's activity it was very nice and I wish to come again in the next camp if it will happen I love my conversations with my group members. We worked by all means

The teachers, I like what they teach us, I've been learning and experiencing a lot Science is one of the best subjects because we learn/taught we think they no longer exist.

I now know how to use a refractometer. I wish my school could organize some science camp or maybe one day we could be taught more about seeing animals.

L13: In this camp I have gained a lot of knowledge that I must take with me to my school and to our classmates.

When I came here, I was not good with team work but because I came to this camp I got to be familiar in working with others but because I came to this camp I got to be familiar in working with others and now I am better in group work. At first I was a bit nervous as we were the only school from KwaNobuhle but it does not take long for me to be free and now I am able to communicate my views with other learners.

L14: I feel the lessons here are very much fun than they are in class and you get to see what is talked about, better than being just taught in class and make an example you don't even know sometimes so I think if a person get to see what different careers do, will get to choose the kind of science career field he/she want to get into.

I think science is a very big field with different thing to deal with and I think that I have to add more careers in my career list.

L15: I am different from school from the science camp because at school a day can pass by with me not really understanding the work and I would have to teach myself.

At school I am not as comfortable and it takes time for me to voice out my scientific opinion but here I feel free as I know if I am wrong , I will be corrected , also in this camp we get opportunities like using the computer and also doing field work whilst at school we just read books

My conversation with everyone impacted my thoughts about science in different ways. Firstly, it the importance of science in our ways as we were exposed to different sections of science, you are also given a chance to hear what other people are saying and the more they say I become very interested in science when I saw that and heard that navigational officer talk about marine, the tour played a part to me as now, I would love to finish / do mechanical Engineering and become a Maritime Engineer. Talking with the peers and hearing what they have to say about science and to actually feel comfort because you are chatting about something you love that some learner think it's boring , so this camp has helped me to see the importance of networking. The teaches and staff inspired that my dream I goal is possible. This camp has been a lovely experience.

L16: I am opened when I am camp because I am starting to understand more about something new that I have never thought of doing. It made me think out of the box and learn new communication skills with people from different and new thinking mindset.

L17 I am not different in the camp than at school . I am myself everywhere I go. The person that I am in school I will be the same in outdoors.

Conversation with peers and teachers influenced how I think about science in a good way because **I learnt a lot especially from the learners**. It makes me know everything about the world and its operations and also know how other things are made.

L18: Today was lit, I enjoyed the part when we went to the sea and were doing the counting of species. The difference between school and this camp. We don't get the opportunity to use computers and practical li we do. We barely do group work and today I've gained more knowledge. In our groups we were taking turns to type on the laptop and we also shared our own opinions on how projects should be like

L19 At the science camp you meet new people which is cool. It was great impact to me.

L20 : At the science camp there are ways and time that the teacher is with you and can show you the real science nature. As in class you only get to see them only on computers They impact me by showing and telling me about more science natures and made me feel more interested.

L21: Well in the science camp we do experiments, we visit a place we will do our experiments and the way it is easy to observe what is happening.

At school we do experiments in class we do not have all the equipment to do science experiments.

What is taught by our teacher here is taught easily . Our conversations we had great time and our teachers helped us when we do not understand something but then we are told what we do not understand and the we understand it first.

Day 3 Reflections:

- Explain if the science camp has motivated you or not?
- Explain how is your scientific understanding after the camp?
- Did you encounter any challenges, if so how did you solve them

L1 Science camp has motivated me in a way that it has taught me a lot of new things that I intend keeping and practicing throughout the days of my life.

My scientific understating has grown a lot as the camp has taught me about the ways I did not know

Rocky shore science camp has been a big privilege as I have learnt about some marine life, different species on the shore and how they survive.

My scientific inquiry is a lot more broader than before because I now understand the rocky shore ecology and its resources how it operates and species.

L2: The science camp has motivated me in such a way that I want to go further with studying about the ocean, its species living in it and why they live in different areas.

I understand that our research was not perfect so next time I do any sort of research I will be careful not to make the same mistake but improve them like my elders here told me

Im that kind of a person who like being involved in scientific things but Im very shy at the same time.

So when I noticed here, people were comfortable and I don't know how it happened but I wasn't shy anymore because teachers and learners are so easy to connect with.

I now see science in a different way than I saw it before going to the camp.

And that science continues it does not stop .We have to come up with new adventures to improve the world.

L3: I have realized that we as black people have the potential to succeed in life but we just look down at ourselves. I have learnt that in order for great results there is hard work and sacrifices to deal with in order to succeed in future. Thank you my beloved mother, without my mind would not have been opened.

L4: This science expo has motivated me a lot.

At school there is a science expo and I wasn't going to be part of it but this camp has changed my mind.

This camp has taught me many things like analyzing data and a how to present that data.

After our presentations I was happy that the teachers gave us feedback on how we presented. I now have a knowledge about rocky shores and species in the shores.

I will also do my own research about them and compare the info.

Thank you to the programme director and the teachers who joined us. Also the group members.

Esixhoseni kukho into ethi intake yakha ngoboya benye.

L5: Science camp motivated me very well because after what I have learnt it makes me think big.

I now understand a lot about the oceans

And I understand how other learners help themselves to practice science

L6: The camp experience has motivated me a lot. I enjoyed, a lot.

L7: I did not know I was learning it was more fun but I realized that we were learning when we put the group presentations when we did the

L8: This science camp has motivated me a lot. At school there is science expo and I was not going to be part of but the camp has changed my mind. The camp has taught me many things like analyzing data. After our presentations I was happy the teacher gave us feedback on how we presented. I now have knowledge about rocky shore and species found in each shore. I will also do my own research about them and compare the info I have.

Thank you to the programme director and to the teachers who joined us. Thank you to the group members who I worked with,

L9. I have realized that, we as black people have the potential to succeed in life, but we just look down at ourselves. I have learnt that in order for great results there is no hard work and sacrifices to deal with.

And the camp made me realized that I still have much work to deal with in order to succeed in future. Thank you my beloved mother without you my mind would not have opened.

L10. Science camp is very motivating I feel life rejuvenated. I now know more about the nature and how nature survives.

L11. I finally understand that science explains the things that around us and how they work.

Science camp had motivated me because everything on Earth is science and I am a product of science.

L12: Science camp has motivated me in many things, I learnt a lot about rocky shores and sea animals > I have experienced a lot of things such as computer skills and so on

My understanding is clear now because I didn't know that there are lots of sea animals especially nutrients and how they get food. If I would stay for a month I would experience

a lot from this science camp. Since I've experienced a lot I would share what I learnt in this science camp in other learners of school.

L13: Being in this camp has taught me a lot it taught me how to work with other and it also taught me how to use computers and it gave me a lot of knowledge about the animals from the sea or specie.

From this science camp I have learnt a lot about the different kinds of species which at first I thought they were not alive and some of them I thought they were stones and I also learnt on how they function and how they survive in the water.

This camp has given me interest on the sea and all the things that are found around it and the inside and the outside. This camp and all the people who was with us through this camp has motivated me more in doing science, it was fun, inspiring and interesting and it made me realise that without science we could have talking something different because science is playing a big role in our lives.

L14: Yes, the camp has motivated me in the form of career, I think what I have learnt in terms of science knowledge, how to present your data, and use a computer so that for me is interesting and has motivated me to do science because science career field is big.

I have understood more even somethings I did not even understand but has noted them down for research on the internet and I think the knowledge I have is much more advanced for a grade 10 learner at a township school.

L15: Yes, science camp has motivated me a lot because now I know it feels to be a researchers and also to gain knowledge on how to do power point using the computer, analyzing data and also presenting it. I know how to fix my mistakes. It has improved because after the camp I now know how to define some of the scientific terms and how to write a scientific presentation in a more scientific way.

L16: The camp has motivated me a lot because I got to learn more about marine life. It has been very motivational to be part of **this camp and has opened my mind to new things**

L17: Science camp has motivated in a way that it has taught me a lot of new things that I intend on keeping and practicing throughout the days of my life. My scientific understanding has grown a lot as the camp has taught me about many things I didn't know.

Rocky shore has been a big privilege as I have learnt about some marine life, different species on shore and how they survive.

My scientific inquiry is a lot broader than before because I now understand the rocky shore ecology and its resources and how it operates.

L18: The camp has inspired me to learn more about science and science is the only thing that helps us in everything we do.

L19: The camp has motivated me to know more about science. I have a lot of understanding after the camp. And I have learnt plenty of things about marine life and nature so I think it's the great experience.

L20: Yes, science camp has motivated me because I've learnt more things about nature things I never thought that I will experience in life but the camp has made me realize about science. My understanding of scientific inquiry about science is that we did at the camp I can now do my own investigation.

L21: Being at science camp has been an inspiration to me. I had a great time and I learnt lots of things that I did not know. Like it was fun but at the same time we study a lot. When we were doing our investigation at the rocky shore, I had great time and I learnt a lot of stuff. It was the first time for me to see a live starfish and touch it. I got a chance to be here so I have to use this chance that I got. I want to thank our teacher she has taught us so much.

Appendix 15: Focus group interviews transcript

SCHOOL B:

1. Could you please tell me why you have chosen science in grade 10? Who inspires or motivates you?

L1 : Mna ma`am I think I chose science because I liked it in grade 9 and then I thought masele ndiqhubekela. Bhuti wam motivates me .and my teacher also inspired me.

L2: I love science as in general, cause ma`am science is everything. Science is life. We cannot do anything without science. Like even now Ma`am we breathe the air its science. We use science everyday sometimes we are not aware.

L3: I chose science because I am very good at it be it Life Science or physical science. I know I get good marks. My teacher and I also motivate myself I always want to do more?

Why do you mean wanting to do more?

I mean like ma`am I don't only learn science at school and accept that I also go and do more research about the topic.

2. What are your perceptions about science or marine science?

L3: In grade 9 I never like science because we never had enough time to do science, because our teacher was not always at school and I developed a bad attitude in science but towards the end of the year, I changed. I wanted to do science because I want to pursue a career in mechanical engineering.

L2 I was excited just to be outside school, not that I don't like to be at school (laughs) but the camp was nice and different. I did not know what to expect first, I was nervous. Firstly, I am a shy person, hearing that we will meet learners from other schools made me more nervous. When we got to the camp, we mingled so well as if we were coming from the same school. I wish to attend another camp soon".

At first I did not understand when our teacher told us we made to the marine science camp, I asked myself what is science about the oceans. Little did I knew that we live science in our daily lives

L1: We never had enough time to study science and I had a bad attitude towards science.

Please explain you never had time

Our teacher was most of the time not at school but even so I did not think that science was difficult. Most of the time we studied as groups.

....and now what are you r views of science or the science camp?

L1: Even if we were to have a camp tomorrow ma`am soze ndithi hayi (will never say no).(smiles)

L2. Yhu kaloku maam I science camp yona is exceptional, I enjoyed it throughout.

L3: If bekunothwa we learn science they way we learnt at the camp.

L1: Science is very interesting and I have developed a good attitude I want to learn more.

L2: Science is not about reading it is about doing things practical.

L3: Science is fun but have some challenges:

.....What did you learn at the camp that you don't learn at school?

L3: At the camp ma`am we do like hands on stuff,

L1: We touched and saw things literally, things that we only see in the textbook

..... What motivated you do be part of the camp?

L1: Some learners they were talking about being at the camp and knew it was fun and I always wanted to pull up my socks as I knew I need to be selected so that I can experience what other learners were talking about. Little did I know that kanti ngalo lonke ixesha we can learn that there is life in the oceans and rocky.

L2: Ja!! We were chosen because we so to Khula also based on our performance in Maths and Science I think At school were told we were going to do research at sea. I was so interested because being in public school

L3: Who does not want to be part of the camp ma'am? Once you hear other learners talking about it you just want to work as twice as hard so that you stand out. I think mna xa kuthethwa nge camp yase SAEON we all pull up our socks. As learners who attended the camp before do not stop talking about it. In our school I think the camp has created a hype which in return motivates us to learn hard

3. What excites you about doing scientific inquiry?

L1: think was to learn about rocky shore species but before the camp I thought were going to learn about things on chemistry and periodic table., things like hydrogen and other elements. But I think it was really to teach us about sea species and how to collect and analyse data

L2:I thought there was going to be lots of pressure and Thought we were going to learn how to study without getting bored or maybe there was not going to be fun. But working in group made if fun and easy to understand scientific inquiry. To me scientific methods was just an abstract term which made no sense up until I was part of it.

L3: For instance mna I thought it's going to be hard as it was also my first time to be away from home, at first I was reserved but then there was lots of fun which made it easier to communicate with other learners

4. How did your participation at the camp influence your perceptions about science?

L1. Mna I can say, I have learnt a lot, for instance at school we are not allowed to use computers anytime we like or go to the computer lab but at the camp yhooh, I saw that even our teachers use computers when they set tests and exams. Yhaaa and also I have learnt to communicate with other people your, at first I was not sure ukuba ndizoncokola ntoni naba bantu, the last day was awesome.

Participating at the camp meant that I now know that science is everywhere I am even more curious to learn more and now that I have seen sea creatures I will also watch discovery channels. I think science is fun

L2. Eee . Okokuqala mna I thought aba bantu bakwela iboats and ships they are doing it nje for fun .Kahnage ndiyazi it is science . Now I now science is not limited in the lab, people can go out there in the environment and do science. At sea there are things that leave there they get food during high tide but still survive and the way we communicate with other group members was wonderful.

Sometime in our group were mostly discussing in isiXhosa but there were times when we talk about investigation we had use English words that are in the investigation but do not have direct translation in IsiXhosa but mostly it was isiXhosa.

L3. Ja !! to me everything is connected to science. Like how to use computers from species data, communications skills about science but I was not a leader in our group we selected our leader.

5. What challenges did you encounter?

L1.Yha in our group we were not sure about some of the species as that was our first time we encountered rocky shore animals. But with the help of others we managed.

L2: The things is , at school we were only thought verbally what scientific inquiry is we never done it before so we were challenged as to come up with our question to investigate. We were told science is about asking questions. So like!! We don't ask many questions at school sometime we are just afraid to ask. Coming up with the question was a bit a challenge for me but we did it by the support of the teachers form

6. What kept you going?

L1: Our group members were there and helping each other was the only way to go. As we were all new on rocky shores.

L 2: From the moment were taken to the rocky shores, we were taught to identify and count species. What was interesting to me when we moved to another area we found different species. For me I was curious to see if we go to the next area are we going to find the same species as move away from the sea. That was really interesting and finding group members who we all shared responsibilities

L3: Using both English and IsiXhosa and we were all comfortable with that. What was important was that we that we were all able to understand and we called for help all the time we were stuck

7. Do you think your participation at the camp has improved your understanding of scientific inquiry? How?

L1: I feel more motivated and interested, science is not difficult especially if you are hands on.

Einstein was our group name at the camp but now I want to understand more about this. I want to do more and get involved science

L2: The way we were taught SI at the camp, I will be comfortable to conduct my own project

L3: I am ready to conduct any project, as long as I get apparatus to do so, hopefully for the project I have in mind I won't need lots of apparatus .I will do it the way I did it at the camp.

8. What sort of career you would like to follow when you finish high school?

Climatology, Mechanical Engineering , Science Researcher, Astronomer.

SCHOOL A & D:

1. Could you please tell me why you have chosen science in grade 10? Who inspires or motivates you?

L1: I was chosen to join the camp because of the attitude I have towards my studies. I am sure I can do well in my test. My teacher inspires me a lot but I get support from home as well from my siblings. I also like watching science documentaries because I would like to become a scientist. I would like to invent something

L2: Yhoo, I think science is fun even though other kids don't believe that. I think science is what we do daily we were all excited to go, jumping and screaming with joy

L3: I was bit excited and nervous at the same time this was going to be my first camp. I did not know what to expect. I knew we were going to learn.

2 What are your perceptions about science or marine science?

L1: Mna ma`am I thought because we were doing the same study of rocky shores and following the same procedure , I thought we were going to have the same results but yhooh come presentation time ,yhooo people had different findings. So nyhani it depends on the area where you did your investigation. What I can say is that science can be fun and interesting.

L2: Ndingathi mna when you put your mind onto something one can achive. Like, as much as I do science at school, my focus was only the science that was in the text book. But now I have a different view that science can be learnt anywhere even ngapha kwamasango eskolo.

L3: If science can be taught in a practical way as it was at the camp. It will more sense and interesting . But I think I would like to conduct my own research, for instance here in Grahamstown there is a shortage of water, now we need to think of ways on how can we reduce the problem or finding alternative ways of finding water

L1: I think my marks in maths and science test. Because our teacher told us that if people want to attend the science camp they must get good marks. I tried to push myself so that I can be selected.

L2: Soloko mna ndisiva xa kuthethwa nge camp nangezinto ezenzekayo kwi camp so I wanted to be part of the camp. And ken am ndazibonela.

L3: The idea of knowing that you need to push 12 times harder to be part of the camp is what exactly motivated me to work hard. I could not miss out the opportunity. The other that I noticed was that most learners who go to the camp would do science expo project. I wanted to do an expo project but I did not know how to do it .

3 What excites you about doing scientific inquiry?

L1: Ndicinga mna , you just doing something not knowing what results will be like. That's exactly what makes it exciting yi curiosity to want to know.

L2: yindlela le yenziwa ngayo. Okokuqala akuyazi into ozayifunama xa ugqibile lonto ubuyikhangela.

L3: I think mna the way you do repeated investigation so that ube sure that what you did you did not just thumb suck it you have. But to me its science you need to do experiment many times before you decide if it is right.

4 How did your participation at the camp influence your perceptions about science?

L1. One of the skills I have learnt is to work together, I used to like reading by myself but at the camp I have learnt that when you are in a group you are all able to contribute and get ideas from each other. I gained that experience. Group work made science easy.

L2. Group works, doing the inquiry study itself, using excel to enter your data and power point for and presentation skills. because bendingakwazi . That alone influenced the way I think about

L.3 *Hahahahah. Yhoo ma`am. If I did not participate in this camp I would have known that there is science at sea. I have changed my mind. Like ma`am now I know science is in our daily lives. We use science every day. After the camp we were going to give report back to other learners who did not come, but the camp made it easy to do presentation but at least now we have gained that skills. But we have not given the presentation yet, we think we will do it in the next term, at least we are ready to do.*

5 What challenges did you encounter?

L1: *Everything was fine until we were to start working on computers, that was a challenge for me as I have never worked on a computer before to enter and analysed our data we collected on rocky shores. We were lucky we had one person who knew computers. I must say I have learnt a lot because at the end I was also given a chance to work on computers. But presenting our research yhooo (covering eyes) it was my worst nightmare.*

L2: *I struggles a bit when Dr Shirley did a presentation to us. I did not have a clue what was she talking about. I never heard of any species name. I only know fish and shark in the ocean. I was much better when I saw some of the species in the two oceans book we were given. It made more sense when we were down on the rocky shores, when we saw those animals with our naked eyes.*

L3: *I think as a group were unable to understand marine science concepts such as tides, tidal pools as it my first time near the ocean. I did not know much about sea creatures except the most common ones that I have seen form TV or books . That challenged us but with no time we were able to know and understand.*

6 What kept you going?

L1. *Group members and looking from other groups were able to assist us , the facilitator and other students helped us a lot. My group was enjoying so much especially on the rocks and we started singing igwijo.(songs)*

L2: I think also group members did not give up they were keen to make sure that the task we were given we wanted to finish. Also it was nice to learn new things we wanted to get done so that we get to know what we will do next.

7 Do you think your participation at the camp has improved your understanding of scientific inquiry? How.

L1. Yes, it has, ikhona enye I experiment besiyenza in class yathethea ngeza hypothesis, aims, methods and results. So besisenza at least with understanding thina since we have been to the camp. Isincedile kakhulu thina I camp. Enye into since we were working in groups, we did not know each other but we had to learn to work together and be patient.

L2. Also ma`am we did not know when we started the camp that we will end up with those presentations. Now we know that science needs to be communicated. But we will definitely use the foundation we received from the camp.

No one wants to add anything (all nodding).

L3. One of the skills I have learnt is to work together, I used to like reading by myself but I have learnt that when you are in a group you are all able to contribute and get ideas from each other. I gained that experience.

8 What sort of career you would like to follow when you finish high school?

L1: I think I would like to do pharmacy

L2: Mna , engineering

L13: Biotechnology kodwa I may change I will see when I am in grade 12 biotechnology

TRANSCRIBED FOCUS GROUP INTERVIEW SCHOOL C:

1. Could you please tell me why you have chosen science in grade 10? Who inspires or motivates you?

L1: I chose science because I think science can unlock doors. Into eyenzekayo, We were chosen as learners that attend Khula project, Maths and science but then they said they wanted only 3 learners. So mna as someone who is always interested in learning something knew, so I said, I am interested. I must say Mr Maselwa inspires me as he makes sciences fun with all his jokes in between.

L2: in grade 9 I did well in science and I decided to continue in grade 10 and also the teacher is my inspiration she tries by all means to make it easy. Ja we were chosen because we go to Khula and also as based on our performance in Maths and Science test we wrote I think. I also wanted to know what is going to happen. Also at school we were told that we are going to do research at sea. I was so interested being at public school we do not get an opportunity to do research. Since I like doing things with my hands, I was so interested to go.

2. What are your perceptions about science or marine science?

L1: Okay!!! As much as I do science at school I still had that belief that science is difficult even though I pass it well. I never knew that there was something called marine science until the camp. I am now familiar that is not only in the lab. It is at home and around us.

L2: Science is not a difficult subject, one needs time to understand and just work hard. I always believe that I can do well in science no matter what if I put my mind into it.

3. What excites you about doing scientific inquiry?

L1: Finding out something you don't know is really exciting, because when you do the inquiry you get curious.

L2: Hands on stuff ma`am. I am one of those learners that learn easily by doing hands on stuff. The camp did exactly that. We were kept busy and taken from a point where we didn't not know anything about rocky shores to a point where we were able to present our findings

4. How did your participation and experiences at the camp influence your perceptions about

science?

L1: First of all, I did not know that I myself I can do what scientists do. Or I can refer to myself as a young scientist. I did not know science can be made that easily . I have learnt without even realising that I was learning I had so much fun. I did not know how to use excel, I was not sure how to make a graph using a computer and also I never used the type of it was the first time for me to use the apparatus we used like the one you has to face to the sun to see (refractometer) the one we used to measure salinity.

Presentation for me is like an everyday thing , maybe I like to talk for instance when we get an essay or something in class , I like to go first , because I want my views to heard first before everyone else . I like to get everybody`s attention

L2: I have learnt that when doing science you must be honest and observant as a scientist , also the apparatus we used , we only see these things on our books but we never ask ourselves what it is but if lento yenza ntoni.

For me presentation skills, there are orals at school as L1 has said, there are orals at school but this time it was different it was a science presentation which is something I never done in my life as long the thing is gonna make me pass , if its gonna make I felt I was . That time I thought I was presenting for my expo or varsity or presenting in a certain company at the same time I thought I was at varsity. Mna ndingathi I have gained presentation skills and now I no more not just science in the classroom and lab.

5. What challenges did you encounter?

L1: Yhoo, firstly working with learners from other schools. People you have never seen before but we made it work.

L2: Not knowing the species name took longer for us to identify as a result we were the last group to finish on the rocks. Yhoooo presentations !!! hahaha yhooo but we managed

6. What kept you going?

L1: when you experience you get more interested, I did not know about marine stuff but I was kept motivated Knowing that we were there to learn and the support and the relaxed atmosphere that was created there. We not scared to ask anything. SAEON staff helped us.

L2: Working with a group that did and like giving each other things to do. All our group members had a role . yhaa . Like besisebenzisana kakuhle

7. Do you think your participation at the camp has improved your understanding of scientific inquiry? How.

L1. At first I did not understand, as L2 has said. I can now but now I can easily show someone else how it is done. Now that I have been shown I will be able to show someone else how to do it.

L2. My way of understanding scientific inquiry has improved, at school it was verbal our teacher told us about hypothesis, aim and all that but at the camp we did it practically. And now I would like to do my own project because now I know what is required. I know the steps of scientific method, I can do my own project easily, jhaa.

L1: Camp has inspired me not to afraid to do scientific things after the camp I now google about more scientific investigation currently happening in South Africa. After a camp a lot has changed with about science. Am not sure how this thing about science was developed but my interest

L2: Mna, I attended expo and science festivals before kukhona few things that caught my interest at that time, I would then have interest only at that time after I leave that I will forget what I have learnt or what I was interested in. But science camp got me thinking I just cannot wait to do a research that will benefit the community and the country. I have now developed logical thinking skills. I always wanted to become mechanical engineer but I am not sure but whatever I choose it will have something to do with science.

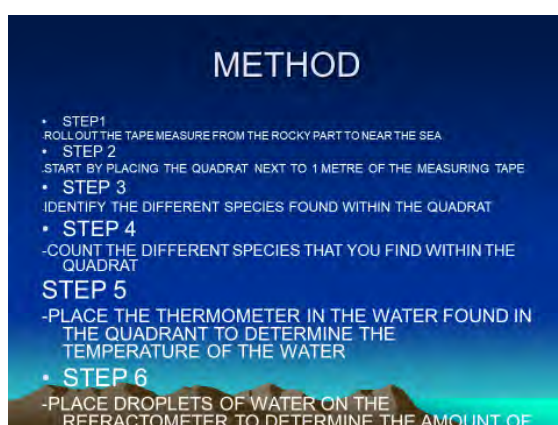
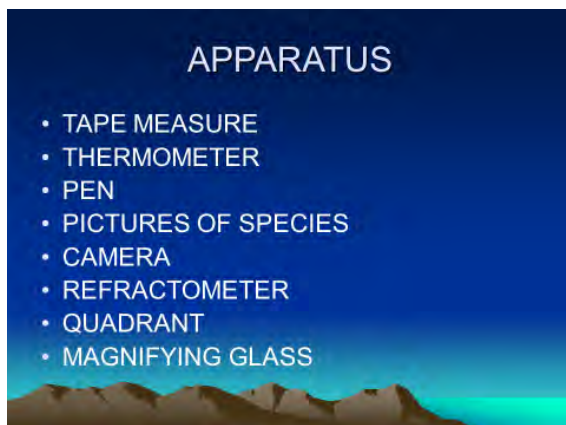
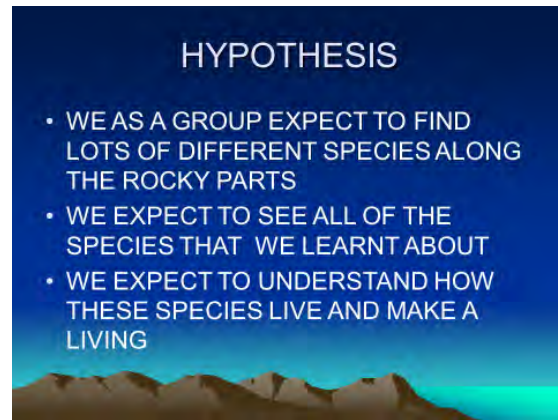
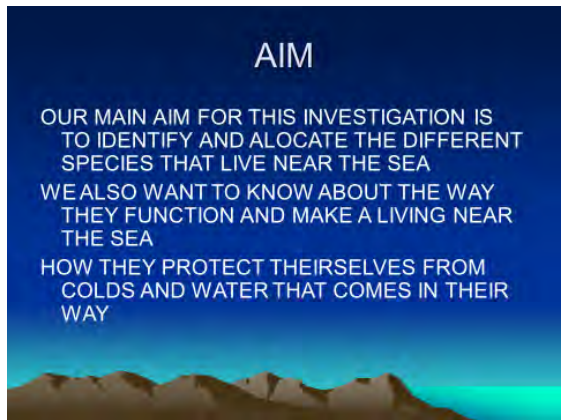
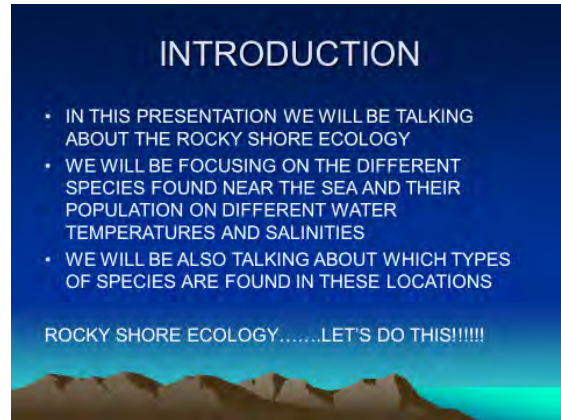
8. What sort of career you would like to follow when you finish high school?

L1: I wanted to be an optometrists

L2: I medicine, biology side but not certain.

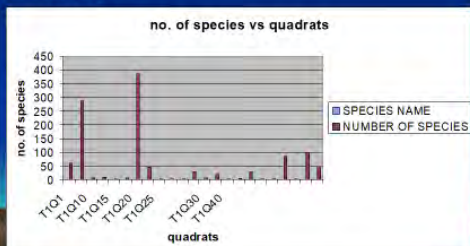
Appendix 16: Learner presentations

GROUP 1

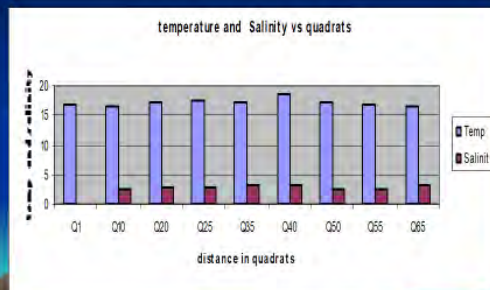


RESULTS

RESULTS FOR TRANSECT 1

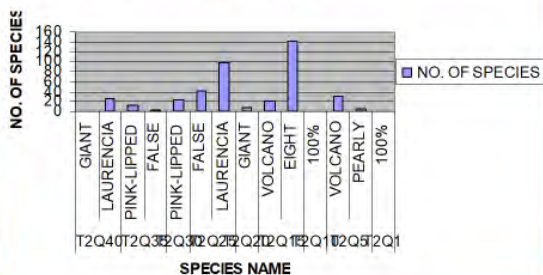


RESULTS FOR TEMPERATURE AND SALINITY

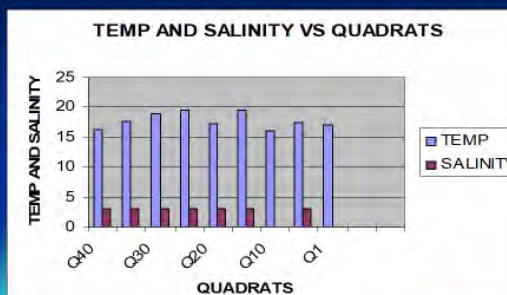


RESULTS FOR TRANSECT 2

NO. OF SPECIES VS SPECIES NAME



TEMPERATURE AND SALINITY



DISCUSSION

FROM THE GRAPHS ABOVE THAT REPRESENT THE NUMBER OF SPECIES FOUND IN DIFFERENT QUADRATS... WE HAVE SEEN THAT WE GOT TO FIND A WHOLE LOT OF DIFFERENT SPECIES NEAR THE SEA THAN ALONG THE ROCKY PARTS
 THE MORE METERS THAT YOU GO FROM THE ROCKY PARTS THE MORE SPECIES YOU FIND AND THE WATER TEMPERATURE ALSO INCREASES
 WE FOUND THAT ALONG THE ROCKY PARTS WE TEND TO FIND FRESH WATER BUT THE MORE METERS YOU GO THE SALTIER THE WATER GETS AND THAT WE FIND SMALLER INSECTS AT THE ROCKY PARTS BUT AT A DISTANCE THE SIZE OF THE DIFFERENT SPECIES INCREASE
 THE MORE DISTANCE THAT YOU WALK TOWARDS THE SEA, THE DEEPER THE WATER GETS
 IN THE GRAPHS WE SEE THAT THE NUMBER OF SPECIES FOUND THE QUADRATS DIFFERS WE GET DIFFERENT NUMBERS OF DIFFERENT SPECIES ON DIFFERENT QUADRATS

CONCLUSION

IN CONCLUSION THE RESULTS THAT WE GOT WERE VERY ACCURATE AS WE COULD SEE FOR OURSELVES, WITH OUR OWN NAKED EYE THE DIFFERENT KINDS OF SPECIES THAT WE WERE TAUGHT BY OUR TEACHER
 ALL IN ALL WE GAINED A LOT OF KNOWLEDGE ON THE SPECIES THAT WE FOUND AT THE SEA HOW THEY LIVE AND ACTUALLY MAKE A LIVING AT THE SEA OR NEAR THE SEA

ANIMALS OR SPECIES NEAR THE SEA ARE ALSO LIVING THING, THEY MIGHT NOT LOOK LIKE IT BUT THEY ACTUALLY HAVE A LIFE AND A SOUL
 KILLING, HUNTING AND FEASTING ON THESE ANIMALS OR SPECIES DECREASES THEIR POPULATION
 SO NEXT TIME YOU EAT AN OYSTER FOR EXAMPLE THINK OF IT AS IF YOU ARE KILLING SOMEONE'S FAMILY MEMBER

ACKNOWLEDGEMENTS

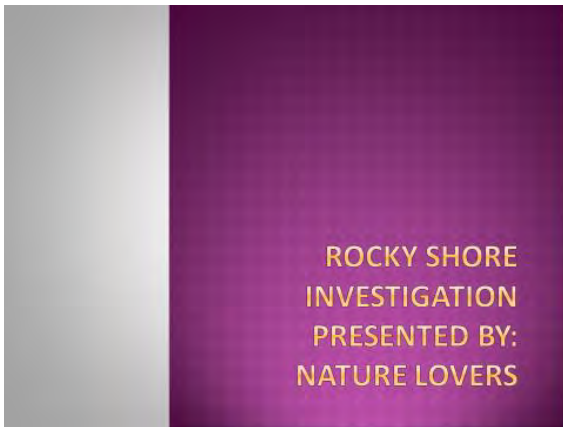
WE AS THE BLUE WOLVES WOULD LIKE TO SAY THANK YOU TO OUR BEAUTIFUL,INSPIRING TEACHERS WHO HELPED US WITH OUR INVESTIGATIONS AND DATA COLLECTING WE WOULD LIKE TO SAY A SPECIAL THANK YOU TO SIS NOZI,THE ORGANISER OF THIS CAMP,THE PERSON WHO MADE ALL OF THIS POSSIBLE

FROM THE BOTTOM OF OUR HEARTS... WE SAY THANK YOU FOR ALL THAT YOU HAVE DONE FOR US AND FOR ALL THAT YOU WILL YET TO DO FOR OUR FUTURE LEADERS

FROM US TO YOU WE SAY; IYABULELA ILALI!!!!

THANK YOU!!!!

GROUP 2



CONTENT

- ⦿ INTRODUCTION
- ⦿ AIM
- ⦿ HYPOTHESIS
- ⦿ METHODOLOGY
- ⦿ APPARATUS
- ⦿ RESULT
- ⦿ OTHERS
- ⦿ DISCUSSION
- ⦿ CONCLUSION

INTRODUCTION

WE ARE ABOUT TO INTRODUCE RESULTS ON THE INVESTIGATION OF ROCKY SHORES.
BUT FIRSTLY WHAT ARE ROCKY SHORES?
A ROCKY SHORE IS AN INTERTIDAL AREA OF SEACOAST WHERE SOLID ROCK PREDOMINATES AND HERE ARE SOME OF THE MAIN FACTORS THAT INFLUENCE THE DISTRIBUTION OF ORGANISMS ON THE SEA SHORES:
TEMPARETURE
SLOPE
WAVE ACTION
LIGHT

AIM

THE aim is to relate rocky shore species distribution to physical and biological factors

HYPOTHESIS

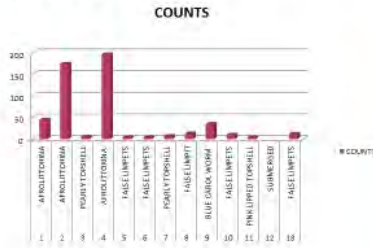
More Rocky shore species will be found in the lower shore then in the middle , and upper shore

METHODOLOGY

STEP 1 :
ORGANISED THE APARATUS THAT WE WERE GOING TO USE FOR THE INVESTIGATION
STEP 2 :
MEASURED THE ROUTE FROM UPPER SHORE TO LOWER SHORE WITH A MEASURING TAPE
STEP 3 :
DIVIDED THE MEASURED ROUTE INTO MULTIPLES OF 5
STEP 4 :
TOOK THE QUADRAT POLE AND STARTED LOOKING FOR SPECIES WITHIN THE QUADRAT POLE
STEP 5 :
STARTED TO RECORD THE TYPES OF SPECIES AND THE NUMBER OF SPECIES THAT WERE THERE WITHIN THE QUADRAT
STEP 6 :
CHECKED THE TEMPERATURE OF THE WATER IN EACH QUADRANT
STEP 7 :
CHECKED THE AMOUNT OF SODIUM CHLORIDE IN THE SEA WATER WITH THE REFRACTOMETER

TRANSECT 1

GRAPH SHOWING HOW MANY SPECIES IN EACH QUAD IN TRANSECT 1



OTHER THINGS WE SAW

- GREEN ALGAE ABOUT 75% IN TRANSECT 1 QUAD 7.
- PINK ALGAE ABOUT 35% IN TRANSECT1 QUAD 4 AND TRANSECT 2 QUAD 7.
- BLUE CORAL WORMS ABOUT 45% IN TRANSECT ONE QUAD 6 AND 8
- RED STARFISH

DISCUSSION

FIRSTLY FROM THE RESULTS THAT WE GOT WE SAW THAT THERE IS NO RELATIONSHIP BETWEEN THE TEMPERATURE AND THE NUMBER OF SPECIES SECONDLY FROM THE RESULTS WE SAW THAT THERE IS NO RELATIONSHIP BETWEEN QUADRANTS AND THE NUMBER OF SPECIES

CONCLUSION

SO ALL IN ALL ROCKY SHORE IS A DIVERSE OF DYNAMIC ECOSYSTEMS WHERE THE INHABITING COMMUNITIES SURVIVE AND ALSO ROCKY SHORE IS DEVIDED INTO THREE TYPES OF SHORES :

UPPER : MOSTLY CONSIST OF ROCKS

MIDDLE : CONSIST OF WATER , ROCKS AND SOME SPECIES.

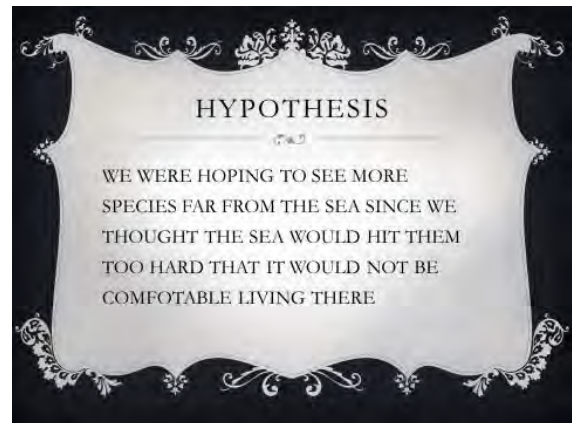
LOWER : CONTAINS MANY SPECIES THEN OTHER SHORES

ACKNOWLEDGEMENTS

THANK YOU FOR PAYING ATTENTION AND LISTENING TO OUR PRESENTATION HOPE WE MADE SENSE WITH INTRODUCING THE ROCKY SHORE INVESTIGATION AND ALSO THANK YOU FOR TEACHING US NEW WAYS TO THINK ABOUT THE OCEAN AND ALSO WE NEVER KNEW THAT THERE WERE SPECIES LIVING OUTSIDE THE SEA SURVING IN ROCKS BUT WE ONLY KNEW THAT FISHES LIVED UNDER WATER BUT WE DID NOT KNOW THEIR SCIENTIFIC NAMES

THE END

GROUP 3



APPARATUS

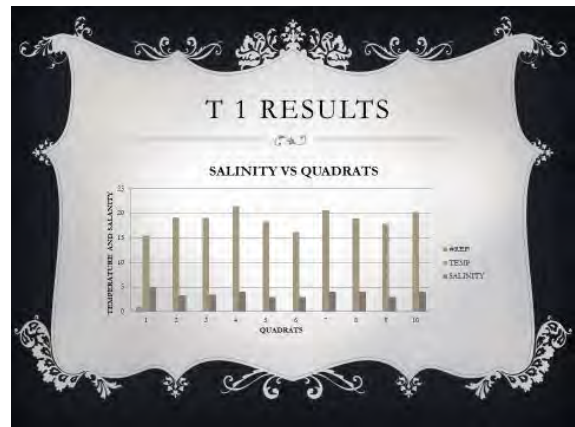
- 1.THERMOMETER
- 2.REFRACTORMETER
- 3.TRANSECT LINE MEASURE
- 4.PLASTIC PIPES
- 5.TWO OCEAN GUIDE BOOK

METHODOLOGY

- ❖ STEP 1:
WE ORGANISED OUR EQUIPMENT
- ❖ STEP 2:
WE USED THE PLASTIC WHITE PIPES TO FORM A QUADRAT
- ❖ STEP 3:
WE LINED THE TAPE MEASURE FROM THE ROCKY AREA TO THE SEA

METHODOLOGY CONTINUED

- ❖ STEP 4
WE MEASURED THE TEMPERATURE AND SALINITY EVERY 3 METERS TILL WE REACHED 30 METERS
- ❖ STEP 5:
WE IDENTIFIED THE TYPE OF SPECIES WE COULD FIND AND HOW MANY THEY WERE EVERY 3 METERS
- ❖ STEP 6
THEN WE LINED UP THE TAPE MEASURE FROM THE SEA TO THE ROCKS
- ❖ STEP 7 WE MEASURED THE TEMPERATURE AND SALINITY
- ❖ FOUND OUT THE KINDS OF SPECIES THAT WERE THERE AND COUNTED THEM



DISCUSSIONS T1

- ❖ WE DISCOVERED THAT IN THE UPPER SHORE WE HAVE LOTS OF AFRICAN PERIWINKLES
- ❖ THE SALINITY IS ABOUT 3‰ IN THE FIRST QUADRANTS MOST OF THE TIMES SINCE ITS FRESH WATER FROM THE RAIN, NOT SEA WATER. BUT WHEN WE AT THE LOW SHORE THE SALINITY IS LOW WE THINK THAT ITS BECAUSE ITS NOT FRESH WATER
- ❖ WE ONLY FOUND THE SILVER PEARLY TOPSHELLS
- ❖ THE TEMPERATURE KEEPS GOING UP AND DOWN
- ❖ WE ALSO DISCOVERED THAT WHEN THE SALINITY IS LOW, THE TEMPERATURE IS HIGH
- ❖ LIMPETS WERE NOT RARE EITHER

DISCUSSIONS T2

- ❖ THE MOST COMMON KIND OF SPECIES WE SAW WAS PEARLY TOPSHELLS
- ❖ THE TEMPERATURE WAS RISING AS WE WERE FAR FROM THE SEA
- ❖ THE SALINITY WAS DECREASING AS WE WERE FROM THE LOW SHORE TO THE UPPER SHORE
- ❖ WE FOUND THE PINK LIPPED SHELLS
- ❖ THE PEAR LIMPETS WERE RARE

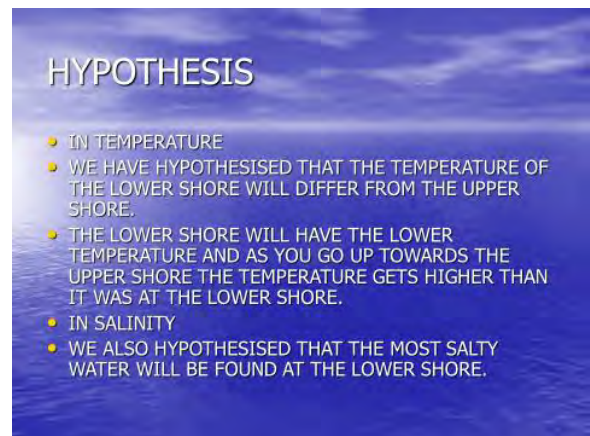
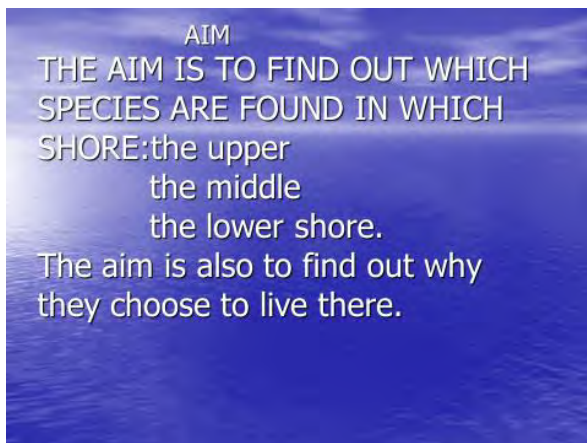
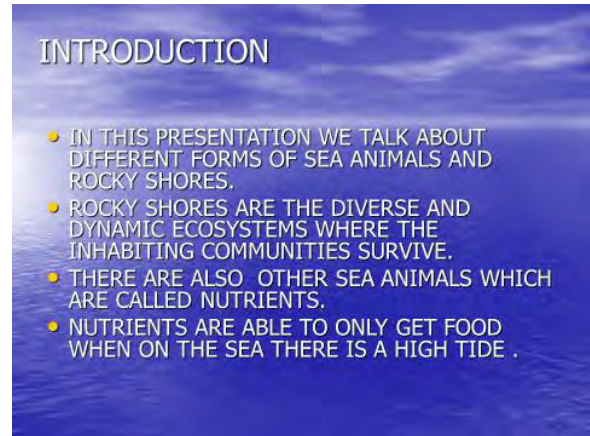
CONCLUSION

- ❖ WE HAVE IDENTIFIED THAT MORE SPECIES OCCUR IN THE DRY AREAS BECAUSE THEY ARE MORE COMFORTABLE THERE
- ❖ WHEN THE SPECIES ARE IN THE SEA SOME SURVIVE, SOME DIE
- ❖ AND ALSO THAT FEW SPECIES WERE FOUND IN THE AREAS CLOSE TO THE SEA

THE END

- ❖ WE THANK YOU FOR LISTENING TO OUR PRESENTATION AND WE REALLY APPRECIATE THE LOVELY SOULS WHO MADE THIS SCIENCE CAMP POSSIBLE
- ❖ NOT FORGETTING OUR PEERS THAT WE ADORE SO MUCH

Group 4



APPARATUS

- THERMOMETER
- MEASURING TAPE-100M
- REFRACTOMETER
- CLIP BOARD
- DATA SHIT
- 2X QUADRADS

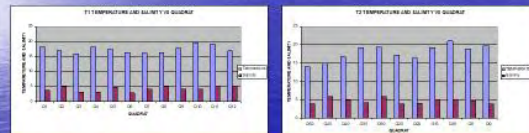
VARIABLES

- INDEPENDENT
 - WAVE ACTION
 - SITES
- DEPENDENT
 - TEMPERATURE
 - SALINITY
 - THE PLANTS AND ANIMALS
- CONTROLLED
 - DISTANCE AT THE STUDY SITE

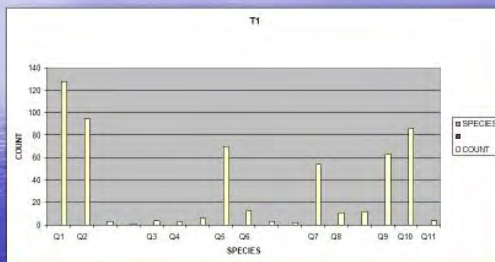
METHOD

- STEP ONE ;SET UP THE APPARATUS
- STEP TWO:WE MAKE A STRIAGHT LINE USING A TAPE MEASURE
- STEP THREE:WE PUT A QUADRAT AT 5 METER
- STEP FOUR:WE LOOK INSIDE THE QUADRAT TO FIND WHICH SPECIES ARE THERE,THEN WE COUNT,CHECK THE TEMPERATURE AND HOW MUCH SALT IS IN THE WATER.

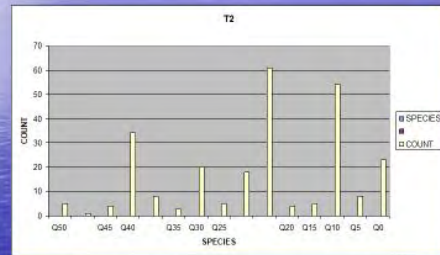
RESULTS



SPECIES AND COUNTS RESULTS



T2 RESULTS



DISCUSSION

- IN OUR RESULTS ,WE SAW THATMOST OF THE ANIMAL SPECIES WERE FOUND IN THE LESS EXTREME AREAS.
- DIFFERENT ADAPTATIONS WERE OBSERVED IN THE DIFFERENT SITES DUE TO ENVIRONMENTS.
- WE MADE A DISCOVERY THAT THE GRANULAR LIMPET AND LONG-SPINED LIMPET WERE NOT TO BE FOUND ELSEWHERE


CONCLUSION

- FROM OUR PRACTICAL WE HAVE OBSERVED THAT IN THE UPPER SHORE THERE ARE A LOT OF PERIWINKLES ON THE ROCKS.
- ALSO FROM OUR RECORDINGS OF SALINITY AND TEMPERATURE IN T1 WE HAVE OBSERVED THAT THE TEMP AND SALINITY ARE ALMOST ON THE SAME LEVEL ,THE DIFFERENCE IS NOT THAT GREAT,THE TEMPERATURE IS NOT MORE THAN 20 DEGREES
- IN T2 ,THE TEMP IS MORE THAN 20 DEGREES BUT LESS THAN 25 DEGREES,THE SAME THING ON DIFFERENCE .
- IN SPECIES AND COUNT,THE NUMBER OF SPECIES AND TYPE OF SPECIES DEPEND ON WHETHER THE AREA IS ROCKY OR WATERLY,THE HIGHEST NO OF SPECIES FOUND IN ONE PLACE WAS 128 AND THE SPECIE WAS AFRICAN PERIWINKLE.

Appendix 17: Learner science fair project



Grade 11.

 Secondary School

Project Category: Environmental Studies

Science Expo project

Abstract

Fish assemblages associated with vegetated, rocky and sandy habitat in two estuaries (Kariega and Bushman) located in the Eastern Cape region were studied. Fish were collected using the seine net. YSI- multi parameter probe was used to measure physico-chemical parameters in the water column.

A higher species diversity and abundance was observed over the vegetated habitat. Cape stumpnose was the most abundant species caught in the vegetated areas in the Bushman's Estuary. The total catch was dominated by juveniles in both estuaries.

Temperature was more or less the same in all habitats in both estuaries and the highest temperatures were recorded in the vegetated and sandy habitats. Salinity ranged from 35 from sandy (closer the estuarine mouth) to 36 in the vegetated habitat which is about 1 km from the mouth. In both estuaries, turbidity was high in sandy habitats and low in vegetated areas (decreased with an increase with distance from the mouth).

The results show that, vegetated habitats are important habitats within estuaries. Therefore, these habitats need to be protected/ conserved.

Do fish have a habitat preference in an estuary?

Introduction

An estuary is a unique habitat which is a meeting place for rivers or streams containing fresh water and an ocean containing salt water. Within estuaries, there are many habitat types that function as nursery areas by providing growth and protection against predators and hence contain high densities of early juvenile (baby fish) fishes. These include seagrass, saltmarshes and non-vegetated mudflat areas.

Fish species utilizing estuaries include marine fishes which enter estuaries during their juvenile or larval phase and when they reach maturity they return to the sea; then, estuarine species are estuarine-residents which complete their life cycle within estuaries.

This study was conducted in the two estuaries which include Bushman's and Kariega estuaries. These estuaries are situated in the south east coast of South Africa and they are permanently open estuaries which opens into the Indian ocean. Due to low freshwater input into these two systems, salinity tends to be high in the upper reaches i.e. reversed salinity gradient and these estuaries can become hypersaline during very dry conditions (Whitfield, 1998).

In Italy a similar investigation to mine was conducted where they found more species in the vegetated area compared to the rocky and the sandy area (Guidetti, 2000)

Aim of the project:

To investigate the diversity and abundance of fishes in the vegetated, rocky and sandy areas of Bushman's & Kariega estuaries.

To understand environmental variables related to fish assemblages in different habitats of both estuaries

Hypothesis

There will be more species in areas closer to the sea that is sandy area.

Study area



Materials and Methods

Fish were collected in September 2019 in the lower reaches of the Bushman's and Kariega estuaries. The microhabitats such as sandy, rocky and vegetated were randomly selected.

The following equipment was used:

- small seine net with a 3 mm mesh size
- YSI multi-parameter probe borrowed from SAEON was used to measure environmental variables including temperature, salinity and turbidity were recorded in each habitat.
- A 10 litre bucket to keep fish sampled in water.
- Measuring tape and a ruler.
- Coastal fisheries ID book Heemstra and Heemstra (2004).

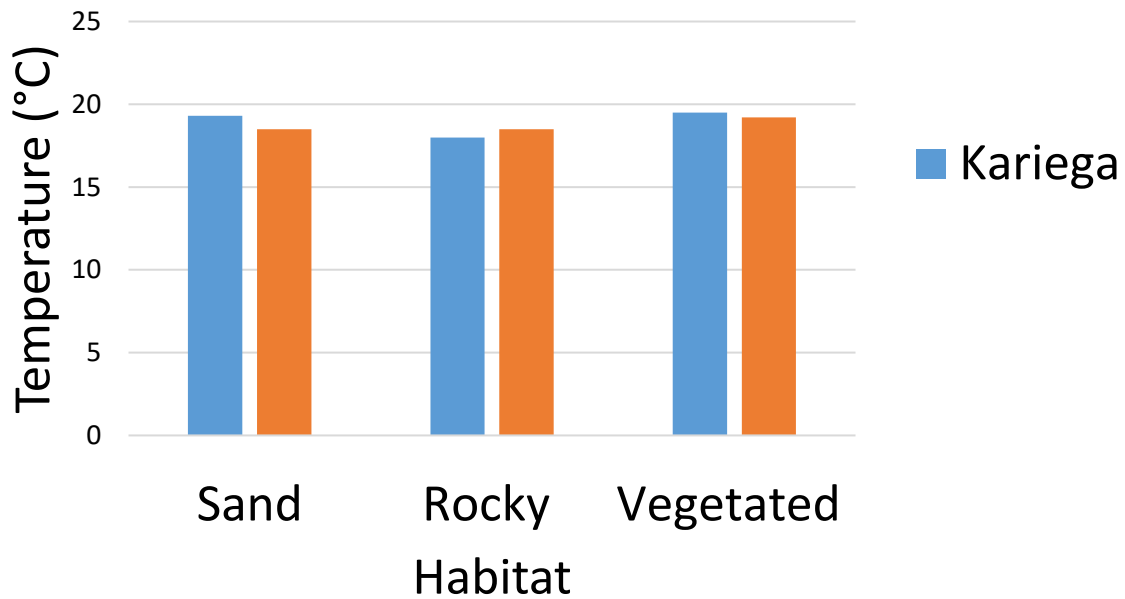
All the specimens were measured in the field and released back into the water

Excel was used for all the data analysis.

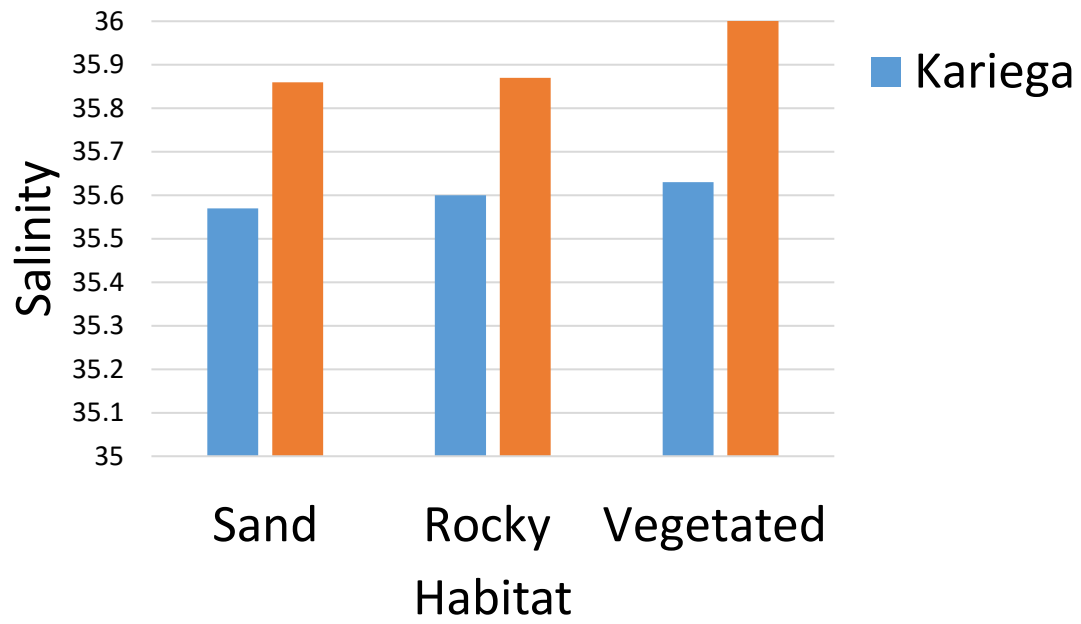
Dependent variables: Number of species

Independent variables: Environmental variables

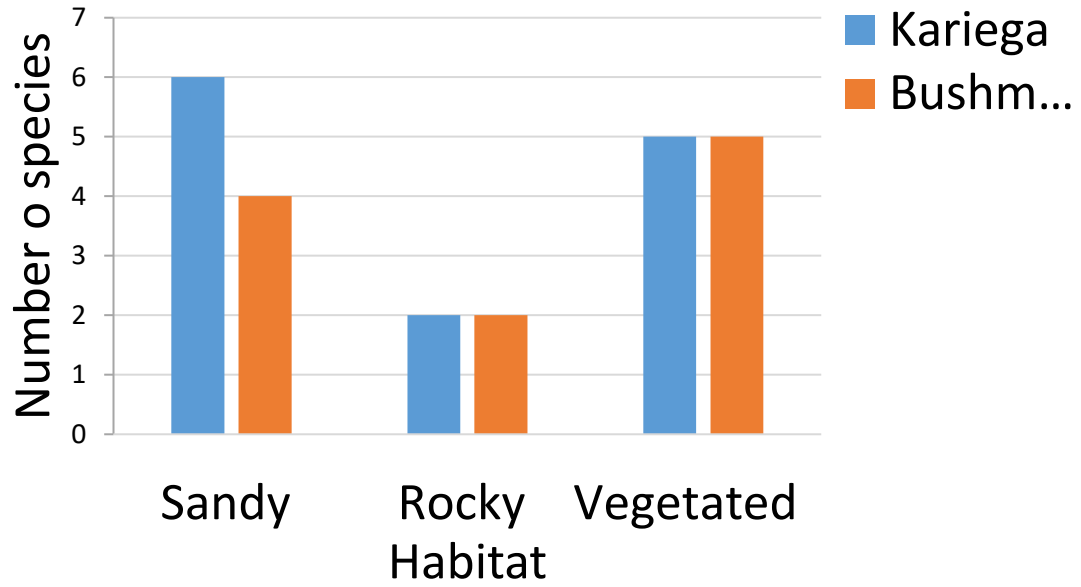
Temperature vs habitat type



Salinity vs habitat type



Number of species vs habitat type



Number of fishes vs habitat type

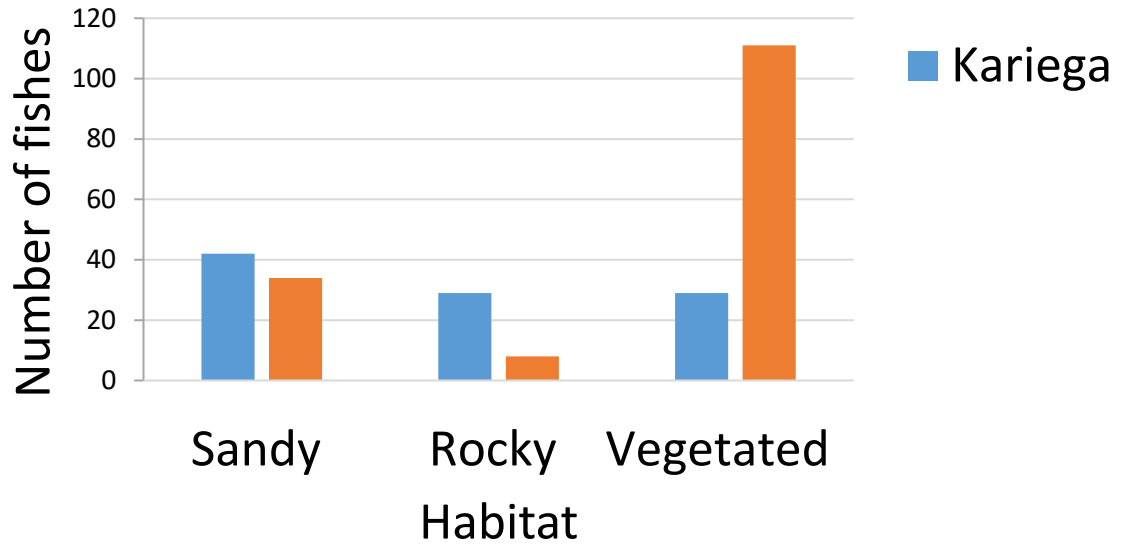
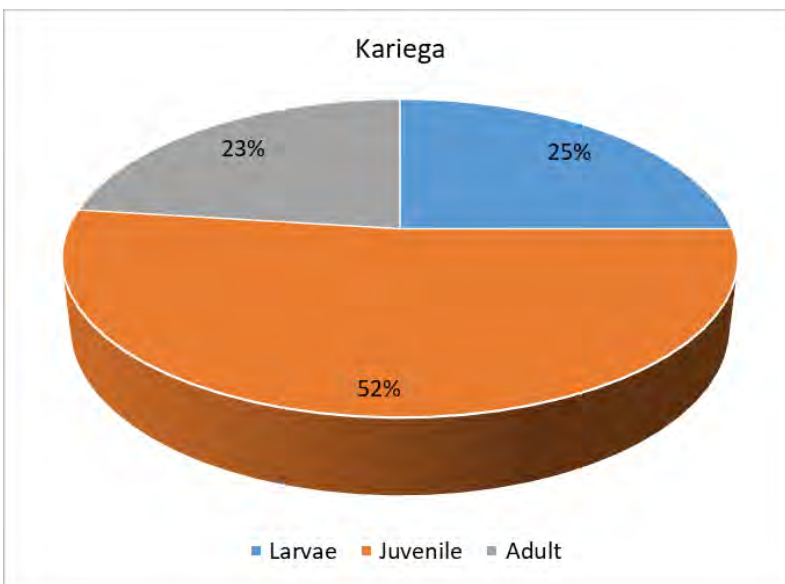
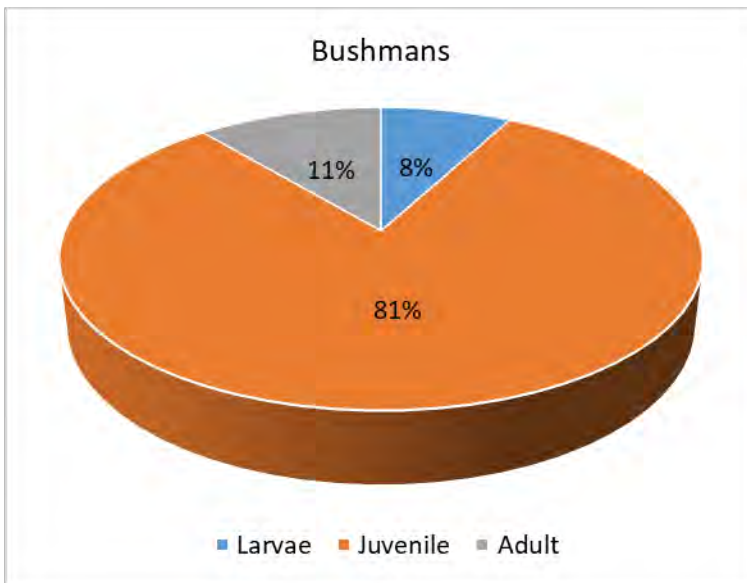


Table showing fish stages caught, estuarine association and the habitat preferred in Bushman's and Kariega estuaries.

<i>Fish names</i>	Bushman's			Kariega			<i>Estuarine association</i>	<i>Preferred habitat</i>
	<i>Larvae</i>	<i>Juvenile</i>	<i>Adult</i>	<i>Larvae</i>	<i>Juvenile</i>	<i>Adult</i>		
Blacktail	14 - 19	20 - 22		10 - 16	18 - 25		Marine	Rock
Cape Gurnard					35		Marine	Sandy
Cape silverside					45	47 - 55	Estuarine	Rock
Cape sole		24 - 55	60 - 72		17 - 36	49 - 49	Estuarine	Sandy
Cape stumpnose	15 - 19	20 - 60					Marine	Vegetated
Garrick					17 - 18		Marine	Vegetated
Klipfish		22 - 56	72 - 96		20 - 45	50 - 100	Estuarine	Vegetated
Longsnout Pipefish					80 - 135		Estuarine	Vegetated
Mullet		30 - 50		13			Marine	Sandy
Olive grunter		41 - 41					Marine	Vegetated
Prison Goby		48 - 49	59 - 100				Estuarine	Vegetated
Sand goby		25 - 49	50 - 60		20 - 45	47 - 53	Estuarine	Sandy

Pie chart showing percentage contribution of different fish stages (Larvae, juveniles and adults)



Discussion

Environmental factors

Temperature was more or less the same in all habitats in both estuaries and was ranging from 18 to 19.5 °C. The highest temperatures were recorded in the vegetated and sandy habitats. Salinity ranged from 35 from sandy (closer the estuarine mouth) to 36 in the vegetated habitat which is about 1 km from the mouth.

Fish species diversity and abundance

A total of 253 individual and 12 species were caught from the Bushman's and Kariega estuaries. Nine species were collected from both estuaries and about 153 and 100 individuals were caught in the Bushman's and Kariega estuaries respectively.

Fish stages

The total catch was dominated by juveniles in both estuaries. In the Bushman's Estuary, cape stumpnose (juveniles) was the most abundant fish and it was only caught in the vegetated habitat. In the Kariega estuary, black tail (larvae) was the most dominant fish and it was collected in all three habitats but mostly recorded in the rocky areas.

Limitations:

This project was only done in two estuaries in the Eastern Cape in one day. It is therefore difficult to generalize the results.

Sampling method was biased as only one seine net drop was done per site.

Conclusion:

The hypothesis was rejected. In both estuaries vegetated habitats had higher number of species and individuals with rocky habitats having the least numbers. In both estuaries vegetated areas were further away from the sea.

Given the importance of the vegetated areas in estuaries in the life cycles of numerous fish species particularly the important commercial and recreational line fisheries, it is therefore important for us to examine their nursery role for the coastal fishes for management and conservation purposes and to understand the potential effects of climate change.

Future research:

Future research can look at two or three replicas per site in the same estuaries or other estuaries in other coastal provinces like Cape Town and or Durban and compare with these two estuaries in the Eastern Cape.

Also one as well as seasonal changes in these habitats.

Bibliography:

1. Heemstra, P. and Heemstra, E. 2004. Coastal fishes of Southern Africa. National Inquiry Service Centre (NISC), 488pp.
2. Whitfield, A.K. 1998. Biology and ecology of fishes in southern African estuaries. Ichthyological Monographs of the *J.L.B. Smith Institute of Ichthyology*, No 2, 223pp.
3. <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0175186>
4. https://www.jstor.org/stable/1352784?seq=1#metadata_info_tab_contents

Acknowledgements:

Mrs Hambaze from SAEON, Science Engagement officer

Ms Nodo from SAIAB, PhD fellow

Mr Malick from SAEON, Oceanographic technician

