

**THE INFLUENCE OF THE INTEGRATION OF LOCAL KNOWLEDGE
DURING CHEMISTRY HANDS-ON PRACTICAL ACTIVITIES ON
GRADE 8/9 LEARNERS' ATTITUDE TOWARDS SCIENCE**

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DECLARATION OF ORIGINALITY

I, Akhona Ngqinambi, declare that this thesis is my own original work that is submitted at Rhodes University and has not been submitted at any other university. All ideas and citations used in this study derived from other people are acknowledged and indicated in the list of references.

Signature: 

Date: 09 December 2019

ABSTRACT

With every passing year, there is a decrease in the number of learners pursuing science degrees after completion of grade 12. One of the main reasons for this is the negative attitude that high school learners have towards science learning and science as an entity. The Natural Sciences curriculum suggests the use of local knowledge to introduce the usefulness and the relatability of science to learners. This study is an intervention that seeks to ascertain the influence that local knowledge has on the attitudes of grade 8/9 learners when integrated into their chemistry hands-on practical activities.

The study was informed by Vygotsky's social constructivist theory and Wenger's community of practice theory. Grade 8/9 learners from four high school science clubs did three local knowledge integrated experiments based on acids and bases. The learners completed pre- and post- surveys and were interviewed about their experiences. Volunteers at the science clubs were also interviewed. Excel was used to deductively analyse quantitative data. On the other hand, an inductive-deductive thematic approach was used to analyse the qualitative data.

The findings of the study showed a divergence of qualitative and quantitative methods. The quantitative data showed that there was a slight decrease (but not statistically significant) in the attitude of the learners after engaging in chemistry hands-on practical activities into which local knowledge had been integrated. On the other hand, the qualitative data showed that there was a positive shift in the learners' attitudes after they had been engaged in the chemistry hands-on practical activities. Additionally, the findings of the study revealed that the integration of local knowledge promotes conceptual understanding and improves the performance of the learners.

This study thus recommends that local knowledge should be integrated into the grade 8 and 9 learners' curriculum to enrich and promote contextualized science for learners. Additionally, the integration of local knowledge would promote conceptual understanding and spark interest and motivation in learners to pursue science-related careers.

Keywords: Natural Sciences, acids and bases, hands-on practical activities, local knowledge, attitudes, social constructivism, community of practice.

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LIST OF ABBREVIATIONS AND/OR ACRONYMS

| | |
|-------|---|
| ASPs | After School Programmes |
| CoP | Community of Practice |
| KMSC | Khanya Maths and Science Club |
| NESTA | National Endowment for Science, Technology and the Arts |
| NISE | National Informal STEM Education |
| QUAL | Qualitative |
| QUANT | Quantitative |
| SCORE | Science Community Representing Education |
| STEMI | Science Technology Engineering Mathematics and Innovation |
| TIMSS | Trends in Mathematics and Science Study |
| TOSRA | Test of Science Related Attitudes |

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- Principal of school B
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CHAPTER ONE: SITUATING THE STUDY

1.1 INTRODUCTION

The aim of the study was to explore the influence of the integration of local knowledge on Grade 8 and 9 learners' attitudes towards science. This chapter introduces the study and gives a pathway for the thesis. It provides the background of the study, the problem the study tried to address and the reason why this is important to do. It then goes on to highlight the goal of the study, the research questions used as guidelines to achieve the goal and the data-gathering techniques used. The theoretical and conceptual frameworks that inform the study are introduced, with definitions of a series of concepts that are used throughout the study. Finally, an outline of the thesis is provided, followed by a chapter summary.

1.2 BACKGROUND OF THE STUDY

With the direction the world is taking, particularly with the unfolding of the fourth industrial revolution, there is a great need for people with Science, Technology, Engineering, Mathematics and Innovation (STEMI¹) skills, to be able to drive and sustain the development. This suggests that it is critical that learners are trained to investigate, criticize and analyse the world around them, and therefore find ways to improve the environment in which we live. In light of this caveat, science deals with attempts by human beings to understand the world around them and set up systems that mimic natural processes. Science is therefore significant in ensuring that our minds are opened to discover new knowledge that helps to develop our current world as well as enhance our way of life.

However, with every passing year, there is a decline in the number of learners choosing science subjects in high school and pursuing science careers after school. A study done in India showed that there is a declining trend in the number of learners that take up science subjects at secondary school and university (Garg & Gupta, 2003). The results from a study done by Mack and Wilson (2015) in Australia, showed that half of learners that leave high school, leave without any science subjects. Additionally, only a small percentage of the half that take science subjects meet the requirements for entry into an undergraduate science degree.

¹ STEMI – Any subject that falls into Science, Technology, Engineering, Mathematics and Innovation disciplines.

In South Africa, a report on the Trends in Mathematics and Science Study (TIMSS) shows that over a 10-year period of the study, there has been a steady decrease in science achievement at grade 12. At the same time, the study showed that the percentage of learners who enrolled for science undergraduate careers in the 2005 – 2015 period was stagnant (29.5% in 2005 - 29.7% in 2015). This suggests that there is a need for the improvement of science education sector in the country (Reddy, Visser, Winnaar, Arends, Juan, Prinsloo & Isdale, 2017).

Performance in high school science subjects, such as Physical Sciences and Life Sciences is a big factor in the declining number of learners enrolling for science. However, one other significant factor, which also influences the way learners perform in these subjects is, the negative attitude that learners have towards science (Juan, Reddy, Zuze & Hannan, 2016). This constitutes the perceived difficulty of science, perception that science is not relatable, lack of enjoyment of science activities, and lack of interest in science learning and science careers. Pringle and Henderleiter (1999) describe attitudes towards science as the perception of the usefulness or the applicability of science based on one's opinions/beliefs and experiences.

Learners' attitudes towards science are influenced and developed, based on the associations they have with science, because of their experiences with science activities. Thus, to make sure that learners perform well in science and are interested in pursuing science careers, it is important to develop programs that will help learners build positive associations with science. These programs should promote positive associations such as motivation, enjoyment and helping the learners see the relevance and applicability of science to everyday life. In response to the declining attitude of learners towards science, and therefore a decline in the achievement in science-related subjects, a wide range of interventions have been developed to influence positive learner attitudes towards science.

One of the most common programs developed and used, is science clubs (Hartley, 2014). Science clubs are intervention programmes that promote interactive, fun, informative, challenging and informal ways of teaching and learning science. Stake and Mares (2005) describe science clubs as intervention programmes that provide learners with informal spaces to engage in science activities and with support that promotes a positive attitude towards science and will ultimately lead to the understanding of scientific concepts.

It is not the science clubs *per se*, but rather the activities at the science clubs that play a significant role in bringing excitement, enjoyment and motivation to do science. At science

clubs, learners can engage in, for example, practical hands-on activities which can stimulate interest and excitement (Abrahams & Millar, 2008).

Practical hands-on activities promote conceptual understanding and a positive interest by giving the learners a feel of what the world of a scientist actually looks like. However, some authors claim that the attitude developed at secondary school drives the learners to perform well in science-related subjects, but that motivation decreases as they progress through levels (Haste 2004; Osborne, Simon & Collins, 2003). This is because, although they would be enjoying science lessons and activities, they might still find it difficult to relate to science and might struggle to see how science fits into their lives, or how useful science is.

Something needs to be done to ensure that the learners' positive attitude is not only towards practical work, but towards science generally and that the positive attitude continues after school as well. It is important to use content that instils a lifelong positive attitude in learners, one that makes them realise the problems in the community and gets them interested in using science to find ways to solve these problems. To introduce the relevance of science and the applicability of science to everyday life, the practical activities can have local knowledge (knowledge that is already common and relatable to the learners) integrated into them.

Essentially, the integration of local knowledge into the curriculum might enhance the learners' interest towards science by allowing the learners to analyse the work and make connections between the concepts (Kibirige & Van Rooyen, 2006; Ogunniyi & Ogawa, 2008). Furthermore, this promotes more classroom interactions because of the conversations the learners have with others in their community (Klein, 2011) and the general strong link of local knowledge to everyday life (Kibirige & Van Rooyen, 2006; Ogunniyi & Ogawa, 2008).

Some teachers speak about the lack of resources for experiments and the lack of support and guidance on how to conduct these experiments (Asheela, 2017). It is thus important that we find solutions to the problems that teachers encounter when teaching science, without waiting on the government to build laboratories and offer resources for experiments. Hands-on practical activities that have local knowledge integrated into them and make use of easily accessible materials to do the experiments, is one way of addressing the needs of under-resourced classrooms (Asheela, 2017).

1.3 MOTIVATION TO DO THIS STUDY

I am one who has always been bothered by the state of the youth of today, how much they have let their surroundings and personal experiences define the people they become and how much they have given up on life which can be seen in the number of children found in the streets and those consumed by all kinds of socio-economic issues. It wasn't until I had people who cared enough to help in the development of my life, that I realized that children need people who care enough to stand up and help them. It is because of this that I decided to do my part in helping the youth realize and live up to their full potential.

While still trying to figure out how I could possibly do this, I stumbled upon the service-learning course as one of my Chemistry Honours modules. In the course, we were expected to do a presentation lecture on the gases in the atmosphere and do hands-on demonstrations of experiments explaining various topics in science. Through the course, I got to see and understand the state of basic education in South Africa. I noticed how some learners, particularly in the townships and the rural areas, do not have basic resources such as textbooks and even teachers. Some learners do not perform well and drop out of school, not because of a lack of potential, but mainly because of lack of support. I noticed how most learners are running away from the sciences because they felt it was too difficult. I felt, because I had been in a similar position to theirs, and had then done science up to honours level, I could go back and show them that it was not that difficult. That it could be done.

I then went on to look at things that I would have liked to see changed when I was still in school and thought about ways to improve those areas. One of the main issues I had with science was that it was so abstract. It was so theoretical that I failed to see how it could possibly connect to my life and what I would have to do if I chose to pursue a career in the sciences. This is why I chose to study towards a master's degree in Chemistry Education, looking at using experiments to influence the attitudes of learners towards science.

In 2018, at the start of my master's journey, I did the research design course with the Rhodes Education Department. In this course, I heard and learnt about the use of local knowledge to aid in teaching and learning of science. This reminded me a bit about my childhood, and some of the activities I used to do. When I did these, I did not know that there could be science in them, and really, if I had known, my whole perception about science being abstract would have changed. One of the things I enjoyed while growing up was making bread with my grandmother. After preparing the dough, my grandmother taught me that putting it in direct

sunlight would make it rise faster, and it did. It is only now that I know the factors that affect the rate of a reaction that I understand why that actually worked. If someone had told me I can use the experience I have at home to understand the science I struggled with at school, things would have been very different for me. If someone had shown me that some of the things I did at home were actually scientific, I would have seen how science connects to my life and things could have been easier. I then decided to include local knowledge as part of my research project.

It is against this background that I decided to do a study on how the use of local knowledge which has been integrated into hands-on chemistry experiments can influence learners' attitudes towards science.

1.4 PROBLEM STATEMENT

With every passing year, fewer learners choose to pursue science careers, after completion of Grade 12. It has been suggested that the negative attitudes that learners have towards science (Juan et al, 2016) might be one of the reasons behind this decline. Juan et al (2016) posit that the way that learners feel about science, their perception of its usefulness and its relevance, play a big role in the associations they build with the subject and whether or not they choose to do it beyond their current engagement. It is then important that science is taught in a way that helps learners build positive associations with science and create motivation to pursue it further than just high school.

1.5 RATIONALE AND SIGNIFICANCE OF THE STUDY

This study was an intervention study that focused on exploring the attitudes of grade 8 and 9 learners towards science when local knowledge is integrated into chemistry hands-on practical activities.

The study has the potential to help us understand the role of local knowledge on the attitudes that learners have towards science. It might give an idea of the perception that learners at grade 8 and 9 have towards science and an understanding of what could be done to influence a positive attitude towards science in learners. Additionally, the intervention in this study might aid in developing a positive attitude in participants, while assisting them with the conceptual understanding of their schoolwork. Furthermore, this study will help me develop and grow as a researcher in science education.

1.6 RESEARCH GOAL AND QUESTIONS

This section outlines the goal that this research was trying to achieve, and the research questions asked, in an attempt to achieve the goal.

1.6.1 Research goal

The aim of the study was to ascertain the Grade 8 and 9 learners' attitudes towards science when local knowledge has been integrated into their hands-on chemistry practical activities.

1.6.2 Research questions

The following research questions were used as a guideline to realize the aim of the study:

1. What is the attitude that Grade 8/9 learners have towards science prior to the intervention on chemistry hands-on practical activities that integrate local knowledge?
2. How do Grade 8/9 learners' attitudes towards science shift/evolve as a result of doing chemistry hands-on practical activities that integrate local knowledge?
3. How does the intervention of chemistry hands-on practical activities that integrate local knowledge influence the attitudes that Grade 8/9 learners have towards science?
4. From the volunteers' perspectives, what factors affect Grade 8/9 learners' attitudes towards science?

1.7 DATA GATHERING TECHNIQUES

The data for the study was collected using these gathering techniques:

1. Document analysis;
2. Questionnaires;
3. Observations; and
4. Semi-structured interviews.

1.8 CONCEPTUAL FRAMEWORKS

Conceptual framework refers to the researcher's understanding of the connections between the main concepts of the study and gives an outline of how the concepts work together to respond to the research question (Regoniel, 2015).

The main concepts of the study are conceptions and dispositions. Dispositions are used interchangeably with attitudes. Conceptions in the context of this study refer to the learners' preconceived notions of science and dispositions or attitudes refer to learners' actions towards science guided by their personal traits and beliefs (Facione, 2000).

1.9 THEORETICAL FRAMEWORKS

Abend (2008) describes theoretical frameworks as principles that serve as the basis for the understanding of a certain problem. Theoretical frameworks form an important part of a study because they give a clear understanding of the functioning of a system and how it can be developed to work more effectively (Swanson & Chermack, 2013).

This study is informed by Vygotsky's (1978) theory of social constructivism and Wenger's (1998) Community of Practise (CoP) theory, which both state learning as a function of social context. Vygotsky (1978) suggested that knowledge is constructed based on one's understanding of how culture, language, history and context influence society, and that learning is a product of social activities. To Wenger (1998), a community of practice is a group of people constructing knowledge through social interaction and practice.

1.10 DEFINITION OF KEY CONCEPTS

The following key concepts are used in this study:

1. Attitudes: a collection of feelings, beliefs that govern a person's behaviour towards specific things (Vaughan & Hogg, 2005).
2. Dispositions: a person's actions based on their belief or personal traits (Facione, 2000).
3. Local knowledge: information and habits that are specific to a culture and are established and passed down through generations (Kibirige & Van Rooyen, 2006).

4. Practical activities: hands-on demonstrations of theory learnt, using real material and objects (Millar, 2004).
5. Science clubs: science-oriented organizations, designed to provide opportunities for learners to explore science, while promoting skills and interest in science (Dabney, Tai, Almarode, Miller-Friedmann, Sonnert, Sadler & Hazari, 2012).
6. Community of practice (CoP): a group of people with a mutual concern that expand their knowledge through regular interactions with each other (Wenger, 1998).
7. Social constructivism: a process of human development where knowledge is constructed based on people's social context and the interactions they have with other people (McKinley, 2015).

1.11 THESIS OUTLINE

This thesis is comprised of six chapters namely: introduction, literature review, theory of acids and bases, methodology, discussion of data and the conclusion.

Chapter one: This is the introductory chapter of the thesis. This chapter gives the context of the study, outlines the problem that the study aims to solve and gives an account of the significance of the study. The chapter also gives an outline of the goal of the study and the questions asked to achieve this goal. It introduces the conceptual and theoretical frameworks employed in carrying out the study, the data gathering techniques and an explanation of the key concepts used throughout the thesis.

Chapter two: In this chapter, the literature relevant to the study is reviewed. The chapter looks at what the Grade 8 and 9 Natural Sciences curriculum requires in terms of the teaching of acids and bases. Science clubs, chemistry practical hands-on activities and local knowledge are discussed as they relate to the study. The concepts of conceptions and dispositions are discussed followed by a discussion of social constructivism and community of practice, which are the theories that inform the study.

Chapter three: This chapter outlines the science background of the study. The concept of acids and bases and their related concepts are discussed. These concepts are the strength of acids and

bases; the pH scale; indicators and acid-base reactions. Additionally, the chemistry of the experiments done by the learners is discussed to close the chapter.

Chapter four highlights the research design and methodology followed in the study. This includes the research methods and paradigm used in the study, the research site and sampling of participants and the data-gathering techniques used. The chapter is concluded with the discussion of the analysis used, the validity of the study and the ethics considered in carrying out the study.

Chapter five: This is where the data gathered from the study are analysed and discussed. In this chapter, the data are presented and discussed as answers to the research questions outlined in section 1.5 of the introduction chapter. This chapter answers the main question of whether or not learners' attitudes can be influenced by the integration of local knowledge on their chemistry practical activities.

Chapter six: In this chapter, the thesis is concluded by giving a summary of all the findings of the study and the recommendations and limitations experienced throughout the period of the study.

1.12 CHAPTER SUMMARY

This chapter gives the background of the study and the reason why a study of this nature has to be done. In the next chapter, the literature relevant to the study will be reviewed.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, I discuss afterschool science enrichment programmes, hands-on practical activities, local knowledge and the literature as they all relate to dispositions toward science. I give the conceptual framework which highlights conceptions and dispositions, giving different arguments and studies with relevance to this study. Lastly, I look at Vygotsky's theory of social constructivism and how it can be used in conjunction with Wenger's community of practice theory to answer the question of using local knowledge to influence the attitudes learners have towards science learning, and science as an entity.

There are many systems and programmes designed to promote conceptual understanding and help learners develop a positive attitude towards science. One of those programmes is after school programmes.

2.2 AFTER SCHOOL PROGRAMMES

The term 'after school programmes' is often used interchangeably with 'school-age-care', 'out-of-school time' and 'expanded learning opportunities' (National Research Council, 2000). After school programmes consist of a series of safe and supervised programmes that run outside of school hours (Little, Wimer & Weiss, 2007). They are designed to actively and effectively support learning and development (Little et al, 2007) in the social, personal and academic aspects of learners' lives (Vygotsky, 1978).

The three goals of these programmes are: to improve self-image and confidence, improve engagement in learning and to improve academic performance (Little et al., 2007; Vygotsky, 1978). Essentially, after school programmes are spaces with activities that cater to the social, personal and academic development of children in different communities. The activities include tutoring, mentoring, homework help, arts, technology, civic engagement and involvement, activities that promote and support healthy social/emotional development and academic enrichment (Little et al., 2007).

The activities of a specific programme depend on the goal the programme is trying to achieve with the learners. One of the most common after school programmes are 'after school science enrichment programmes' which are also known as science clubs.

Science clubs can be defined as science-oriented organizations designed to provide opportunities for learners to explore science while promoting skills and interest in science (Dabney et al., 2012). In essence, science clubs are intervention programmes that promote interactive, fun, informative, challenging and informal ways of teaching and learning science. In most science clubs, learners are divided into groups with tutors facilitating the science activities (Freeman, Eddy, McDonough, Smith, Okoroafor, Jordt, & Wenderoth, 2014). In other science clubs, the whole group is engaged in the same activity and facilitated by one tutor (Freeman et al., 2014).

In addition to assisting learners with conceptual understanding, science clubs also promote enjoyment of science by providing learners with exciting experiences created outside of the normal classroom setting. Beyond this, science clubs also bring the relatability of science to learners, which in turn changes their perspective of science as an entity. This is supported by Agunbiade, Ngozo, Jahawar and Sewry (2017), who claim that science clubs seek to spark excitement in learners and ultimately foster a positive attitude towards science.

Although efficient in influencing positive attitudes in learners, the activities that take place in the science club are important in the development of attitudes. One dominant activity in science clubs is hands-on practical activities.

2.3 PRACTICAL ACTIVITIES

Practical work in science is described as the demonstration of the theory learnt in class, using real materials and objects (Millar, 2004). Science theory tends to be abstract as it speaks to the world and the systems that govern it. Practical work can illustrate the feasibility of science, creating a wholesome learning experience of a learner's scientific journey. According to the Science Community Representing Education (SCORE) (2009), practical activities train learners to think critically and creatively about the world around them, find ways to develop the world and therefore enhance human life.

Scientific theory gives learners information about how the world functions and behaves, whereas practical activities engage learners, helping them to develop significant scientific skills, understand the process of scientific investigation and develop an overall understanding of scientific concepts (Woodley, 2009).

Practical activities are used in teaching science to assist learners with the building of science understanding and equipping them with skills relevant for them to pursue science as a career. In a study done by the National Endowment for Science, Technology and the Arts (2005), when asked about their view on practical activities in teaching, teachers said learners' engagement in practical work improves student performance and attainment (Festile, 2017). In agreement, Abrahams and Millar (2008) claim that practical work bridges the gap between the understanding of ideas and observation. When learners engage in practical work, they are motivated, and they value learning and take responsibility for their own learning (Dillon, 2008). Furthermore, practical work gives learners a scientific skillset, which is in great demand right now, with the world moving into the fourth industrial revolution.

Hodson (1990) claims that practical activities also stimulate the interest and enjoyment of the subject and helps learners develop positive scientific attitudes. To support this claim, Abrahams and Millar (2008) found that practical work does promote enjoyment of science and therefore creates excitement to engage in science activities, which generally influences a positive attitude towards science as an entity and towards science-related subjects. It has been proven that some learners prefer practical work to other methods of science teaching (Cerini, Murray & Reiss, 2003). One reason for this could be that practical activities generally have a lighter workload or less to read compared with theory. Additionally, learners are generally energetic beings, so they always want to be engaged in something rather than reading and listening. It is easier to remember something that you have touched and seen, compared to something you were told about or that you read about.

Although practical activities are praised by some researchers/authors, there are some other authors that criticize the use of practicals to teach science. Abrahams and Millar (2008), did a study that evaluated the effectiveness of practical activities in teaching science. The findings of the study showed that, depending on how the experiment is set up by the teachers, the understanding of the basic concepts could be lost during the experiment. This suggests that the design of the practical activities should allow for the explanation of the main ideas/concepts, as opposed to expecting the ideas to emerge from the activity. Ideally, when the main concepts have been explained, the learners go through the activity with background knowledge that helps them understand the activity, and how it relates to the theory they have learnt in class.

Practical activities are supposed to help learners build conceptual understanding of science, which also depends on how the activities have been designed. Some experiments are only for

learners to enjoy without understanding the concepts. Bertsch, Kapelari and Unterbruner (2014) found that practical activities do not help learners in their conceptual understanding, instead, they help them cram facts as standalones, without any links between the concepts. According to Hodson (1990), for effective learning of science, experiments should rather be enquiry based, giving the learners opportunities to do investigations, rather than the ‘cookbook’ step by step experiments which are designed to work each time.

The experiment design used in the study is the expository method, which speaks to explaining the important concepts to learners, or rather reminding them about the concepts they learnt in class, in relation to acids and bases. This is followed by an outline of the experiment and a procedure on how to conduct the experiment. As the experiment goes, the explained concepts would emerge and the volunteers would facilitate a discussion around those concepts in their groups, to make sure that the learners understand how this experiment relates to their schoolwork. This approach is very different from the enquiry-based approach which gives learners questions and requires them to design their own experiments and evaluate them. In both methods, in the case of this study, the learners are not aware of the outcome of the experiments, but they go through the procedure to answer a certain given question. The difference between the two is that, the learners have the procedure and an explanation of the main concepts beforehand in the expository approach and there is no explanation and no procedure in the inquiry based approach. The reason why the expository approach was used is that, the time given in the science club was not enough to give the learners space to think about the design and procedures of experiments. Furthermore, the experiments were intended to help the learners bring into life the theory that they learnt in class, which is something they were able to see also in the expository approach.

One of the goals of introducing practical activities and helping learners to develop a positive attitude towards science is to encourage the learners to pursue science-related careers upon finishing school. However, a study conducted by Abrahams (2009) showed that although practical activities can influence a positive attitude towards science, there are some limitations. The motivation acquired by the learners does not always translate into learners taking up science-related careers. This study is in support of other authors who claim that although there is a positive attitude towards science at secondary school, that attitude drives the learners to perform well in science-related subjects at that level, but motivation declines as they progress through grades (Haste, 2004; Osborne, Simon & Collins, 2003).

Practical work can motivate learners, but something more needs to be done to ensure that the attitude is not only towards the practical work but also towards all aspects of science and that it endures after school as well. One other issue is the lack of resources to carry out the experiments in schools (Asheela, 2017). This calls for the development of practical activities that can be done with easily accessible materials and equipment. An example of such is the integration of local knowledge.

2.4 LOCAL KNOWLEDGE

Various people have tried to define local knowledge according to their understanding or based on their experiences. However, because of the breadth of the concept, it has been difficult to reach a consensus on what the definition of local knowledge is. There is a wide range of constructs associated with local knowledge. These constructs include everyday science, community knowledge, cultural heritage, ethnoscience, indigenous science, folklore expressions, and rural people's knowledge (Snively & Corsiglia, 2001). All these ideas stem from the setting or location under study. One can, therefore, link facts related to these social constructs to establish their practical definition of 'local knowledge' with reference to their area and setting of the study.

Different definitions of local knowledge share similarities and facets of local knowledge.

- It has been defined as knowledge that has been built up and passed on, either orally or by action, and is specific to an area (Odhanbo & Kamp, 1990; Warren, 1996).
- Semali and Kincheloe (1999) emphasize the understanding that local people in an area have of themselves in relation to their environment and the use of that knowledge to their benefit.
- According to Hoppers (2001), local knowledge is knowledge based on the culture and history of a specific people, which also encompasses their civilization.
- Ajibade (2003) defines it as institutionalized information that takes heed of local factors and is developed to address local problems.
- Kibirige and Van Rooyen (2006) consider local knowledge as information and habits that are specific to a culture and are established and passed down to future generations.

From the descriptions above, one can deduce that a practical definition of local knowledge has to include: an ecological setting/geographical area; inherited information; specific culture, and

a specific function/application such as solving a problem (or enhancing human life). It seems, therefore, that local knowledge is about the social, economic, scientific and technological identity of the people (Mavuru & Ramnarain, 2017). Beyond this, local knowledge seeks to inform various aspects such as, socio-economic, engineering, health, politics, agriculture, sports and education and plays a significant role in the growth of all these fields of enquiry (Ajibade, 2003). An example would be the use of vinegar and bicarbonate of soda to get rid of water rings on furniture and the use of lemon juice to remove armpit stains on clothes. Other fields of relevance include agriculture, science, education and science education.

Local knowledge is considered to be different from scientific knowledge, although both are information that helps us understand the world around us. This difference lies in how each of these is constructed. Local knowledge is usually passed down, orally, from one generation to the other, or observed through daily and past experiences (Kibirige & Van Rooyen, 2006). Another difference is that scientific knowledge is used, and universally understood, and local knowledge is specific to a culture or geographical area, hence the term ‘local.’ On the other hand, scientific knowledge is factual information proven through scientific processes.

For information to be considered as scientific knowledge, it must satisfy four requirements:

- Independent and rigorous testing;
- Peer review and publication;
- Measurement of actual potential rate of error; and
- Degree of acceptance within the scientific community (Fabricius, Scholes & Cundill, 2006).

The ‘westernized’ scientific knowledge, known to be ‘universal’ knowledge, is a fairly recent concept. This suggests that science has its origins across a wide range of cultures and parts of the world. So, if we are to teach science to future generations, it is imperative that, in addition to scientific knowledge, local knowledge should be integrated into the curriculum.

Several authors and researchers in science education are in favour of integration of local knowledge, for a number of reasons. To Kibirige and Van Rooyen (2006), the integration of local knowledge makes the teaching and learning of science easier because learners build on the knowledge that they already have. Learners are more interactive in the classroom because of the conversations they have with their elders (Klein, 2011; Sedlacek & Sedova, 2017). So,

learners feel more confident to participate in class activities and discussions, because they have an idea of what the concept is about based on the knowledge they already have.

Mavuru and Ramnarain (2017) who also advocate for this integration speak about the link that local knowledge creates between science and society. They claim that local knowledge gives the social context to science, which helps learners relate to and see the value of science in their lives. These authors support Ogunniyi and Ogawa (2008) who say that, as learners see the general strong link of science to everyday life, learners become analytical and begin to make connections between the concepts, which, in turn, promotes conceptual understanding. Additionally, Kibirige and Van Rooyen (2006) and Ogunniyi and Ogawa (2008), claim that the integration of local knowledge into the curriculum enhances the learners' interest towards sciences. It seems that, when learners are able to see the usefulness of science in their lives, they want to do more.

However, integrating local knowledge into the curriculum can have its disadvantages. As stated earlier, local knowledge is based mostly on what people think, feel and use in their different locations (Vhurumuku & Mokeleche, 2009). That means local knowledge does not meet the criteria to be accepted as scientific knowledge because it lacks truth and adequate justification (Vhurumuku & Mokeleche, 2009). So, local knowledge lacks facts and, in most cases, fails to meet the standard to be accepted as science. Beyond this, 'local' speaks to a specific area or culture which sometimes makes it difficult for local knowledge to be exchanged across different cultures and areas (Kibirige & Van Rooyen, 2006).

One form of local knowledge that is shared across various communities is what is known as kitchen chemistry. According to the National Informal STEM Education Network (2005), kitchen chemistry refers to the chemistry of the everyday activities performed in households such as cooking and cleaning. Kitchen chemistry can help learners to recognize that the activities explain chemistry concepts and that the items used, possess chemical properties. Kitchen chemistry hands-on practical activities require easily accessible materials and equipment that most learners have at home. The local knowledge employed in the study is kitchen chemistry, since this is common across a wide range of communities. All the experiments make use of household items, or easily accessible materials to explain the concept of acids and bases.

2.5 CONCEPTUAL FRAMEWORK

The conceptual framework gives the researcher's understanding of the connections between the main concepts of the study. It outlines how the previous researchers' perspectives collectively shape the answering of the research question at hand (Regoniel, 2015). The conceptual framework for this study is conceptions and dispositions of learners towards science in general and the learning of science in particular.

2.5.1 Conceptions

Learning generally occurs in three domains: cognitive, affective and psychomotor (Koballa, 2007). The cognitive domain can be described as the domain which relates to knowledge and understanding of concepts; the affective domain relates to emotions, traits and the conscience; and the psychomotor domain refers to the skills and abilities developed in relation to the subject (Krathwol, Bloom & Masia, 1964). Conceptions and dispositions belong to the affective domain (which also includes attitudes and perceptions) as they relate to values and beliefs that inform a behaviour towards a specific subject (Koballa, 2007).

Conceptions towards science are generally defined as a person's preconceived notions, pertaining to science, which in turn influences how that person acts, behaves or performs in science-related subjects. Oaks (1994) posits that learners' conceptions influence the learners' perceptions towards science, their approach in learning and ultimately their quality of learning. Put differently, conceptions are formed from how learners perceive science as an entity. Atallah, Bryant and Dada (2010), in their description with regards to mathematics, mention that conceptions are the views that learners have towards a specific subject and their beliefs concerning the requirements and learning outcomes of the specific subject.

It is recognized that conceptions are related to dispositions.

2.5.2 Dispositions and Attitudes

The first use of the term disposition in literature was by Dewey, in his description of "readiness to act" as either a disposition or habit (Nelson, 2015). Following this, several researchers (Cummins & Asempampa, 2013; Nelson, 2015; Villegas, 2007) adopted the term. Consequently, there is no one specific definition of disposition as different researchers relate the concept to other constructs such as attitudes and habits. Dispositions are described

according to three categories, based on the researcher or author's point of view: (1) beliefs and attitudes; (2) permanent personality traits and (3) inferred from observable actions.

Quite a number of researchers believe that dispositions are related to beliefs and attitudes. For example, Burant, Chubbuck and Whipp (2007) describe dispositions as values, that are guided by beliefs and attitudes, which influence action. Similarly, Villegas (2007, p. 273) defined dispositions as "tendencies for particular individuals to act in a particular manner, under particular circumstances based on their belief". In agreement, Carroll (2005) and Cummins and Asempampa (2013) describe dispositions as attitudes or rather attitudinal tendencies. One of the main arguments that these researchers make, is that the dispositions are not permanent in the particular individual but can be learned and developed at any given time, based on educational experiences and interactions with the world and other people (Carroll, 2005; Cummins & Asempampa, 2013).

Other researchers believe, however, that dispositions speak to an individual's fixed or unchanging personality traits. An example of this is a definition given by Damon (2005) which speaks to how a certain individual acts as a result of his or her character or personality. Similarly, Facione (2000) describes dispositions as personality traits that govern how we behave or act towards a certain subject or object. This suggests that a person's inherent characteristics or nature informs their general actions towards certain situations. The main argument raised by these researchers is that dispositions are permanent and inborn or stable characteristics and can never be changed (Wasicsko, 2002). In the same light, some researchers also suggest that dispositions are actually stable human qualities (Nelson, 2015).

The third category of dispositions is based on the actions of individuals (Bondy, Beck, Curcio & Schroeder, 2017). The researchers in this category describe dispositions as behaviour that is recognizable and can become predictable over time (Welch, 2010). Similarly, according to Alsup and Miller (2014), dispositions are the demonstrations of people's values and judgements about a particular subject based on specific cultures and contexts. Not all actions are physical, so, in this regard, Nelson (2015) argues that some actions can be a mental process or habit, which is not necessarily observable to others. In my view, this argument is inclined towards the notion that dispositions are based on observable behaviours which can be developed or changed over time, as opposed to the temperament and inborn perspective of dispositions suggesting that they can never be changed.

For the purpose of this study, dispositions are described using category 1 and category 3. They are seen as personality traits or beliefs that determine how a person might behave in specific situations. This suggests, therefore, that dispositions towards science speak to how a person acts towards science as a result of their beliefs or attitudes. Additionally, dispositions can be changed or developed based on different experiences.

Attitudes and dispositions possess a number of similarities and as a result, some authors (Ajzen, 2001; Facione, 2000) have chosen to use these terms interchangeably to describe people's behaviours as informed by their preferences. Similarly, to Agunbiade's (2015) study in South Africa, in this study, 'attitudes' will be used to refer to dispositions from now onwards.

According to Eagly and Chaiken (1993, p. 1), an attitude is "a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour". To support this, Vaughan and Hogg (2005) claim that attitudes refer to a collection of feelings or beliefs that govern a person's behaviour towards specific things. Several authors describe attitudes as relating to either positive or negative feelings that determine a person's actions, response or behaviour towards an event, activity or specific situation (Ajzen, 2001; Koballa, 2007).

Koballa (2007) and Lakshmi and Rao (2003) describe attitudes towards science as the positive or negative feelings that a person has towards science. The feelings govern or dictate that person's behaviour towards science, and everything related to it. Ajzen (2001) argues that attitudes do not only speak to the affective domain (involving feelings) in relation to the subject at hand, but they also speak to the cognitive domain (involving the understanding) of the subject. Essentially, attitudes towards science refer to the feelings (either positive or negative) towards science and the understanding of science and science-related subjects. These attitudes are informed partly by the person's knowledge of science, which in turn determines how that person acts or behaves in science-related subjects or events.

Attitudes towards science are regarded as a significant aspect of science education. Science is described as the attempt by human beings to fully understand the physical and natural world around them, through observations, experiments and the setting up of systems that mimic natural processes (Millar, 2004). Science is therefore significant in ensuring people are receptive to discovering new knowledge which could develop our current world as well as

enhance our way of life. Attitudes towards science could influence how receptive people are to discovering new knowledge.

To Pringle and Henderleiter (1999), attitudes towards science refer to the perceptions of the usefulness or the applicability of science-based on one's opinions or beliefs. Some other researchers argue that attitudes towards science do not refer to feelings alone as the main construct, but also speak to perceptions, interest and motivation related to science (Koballa & Glyn, 2007; Osborne et al., 2003).

Perceptions towards science refer to the lenses that one uses to view science and its applications to real-life situations (Atallah et al., 2010). This is related to whether one can see the link between science as an entity and the scientific tools used to solve real-life problems (Atallah et al., 2010). This is also concerned with what learners think about their science lessons, the language used in science, and the intricacy of science generally. According to a few authors (Atallah et al., 2010; Kaya & Ebenezer, 2007), when the perceptions of learners towards their lessons and towards science are positive, their attitude towards the subject is generally positive and their performance improves.

Motivation and an interest in a subject could influence attitudes towards science. Motivation can be defined as an inspiration or stimulation which results in one acting or behaving a certain way towards something (Lai, 2011). Motivation and interest are usually sparked by a specific event, activity or person. Motivation for learning science can be described as a positive push to engage in science-related subjects or activities (Maharaj-Sharma, 2012). Various factors influence motivation, which in turn enhances the attitude and interest in science and science-related subjects (Hofstein & Mamlok-Naaman, 2011; Osborne & Collins, 2000).

Interest in science has been described as the feeling of wanting to know how the world around us works and the tendency of learners to engage in science or to withdraw from it (Ormerod & Duckworth, 1975). Research has proven that interest in science promotes a positive attitude towards science and science-related subjects and that a positive attitude promotes a positive performance (Krapp & Prenzel, 2011). This suggests that there is a need to develop systems or science teaching and learning methods that will interest learners and therefore influence a positive attitude towards science.

Many studies on attitudes towards science were influenced by Bloom's theory of school learning, which states that 25% of learners' performance is a result of the learners' attitude

towards the subject, the school environment and their beliefs (Papanastasiou & Zembylas, 2004).

Studies have further shown that the attitudes students have towards science is of great significance in their performance/achievement in science (Osborne et al., 2003; Welch, 2010), and a positive attitude towards science influences an interest in science-related careers (Knezek, Christensen, Tyler-Wood & Periathiruvadi, 2013; Welch, 2010). In their studies, Simpson and Oliver (1990) and Lee and Burkam (1996) found that attitudes towards science and science achievement were directly proportional to each other. The reason for this is that a positive attitude towards science sparks interest and cultivates motivation to actively engage with the science (Welch, 2010).

2.6 THEORETICAL FRAMEWORKS

A theoretical framework refers to the set of structured principles that illustrate the understanding of a specific phenomenon (Abend, 2008). It is used to generate an understanding of how a certain system works, and, therefore, how it can be improved to work more effectively (Swanson & Chermack, 2013). For this study, the theoretical frameworks used will be Vygotsky's (1978) social constructivist theory and Wenger's (1998) Community of Practice (CoP). I now discuss these in detail below.

2.6.1 Social Constructivism

Piaget (1953) described learning as an individual process and knowledge construction as a process of assimilation and accommodation done only by the individual based on their environment. Lev Vygotsky, to counter the claim made by his colleague, developed the theory of social constructivism.

Vygotsky claimed that, it was impossible to separate learning from its social context and that learning is a product of social interactions (Kalina & Powell, 2009). In his seminal work, Vygotsky (1978, p.57) stated that "every function in the child's cultural development appears twice: first, on the social level and, later on, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological)". To Vygotsky, this applies equally to voluntary attention, to logical memory, and to the formation of concepts. That is, all these functions originate as actual relationships between individuals.

In consequence, Vygotsky's (1978) theory of social constructivism has been described as the principle of human development where knowledge is constructed based on one's social context and the interactions he/she has with other people (McKinley, 2015). This suggests that knowledge is constructed based on one's understanding of how culture, language, history and context influences society (Derry, 1999; McMahon, 1997) and that meaning is a product of social activities (Kukla, 2000). According to Kim (2001), social constructivism assumes that all learning is a process of knowledge creation based on prior knowledge.

Other authors go further to say that learners use their everyday experiences, conversations and their understanding of the environment around them to generate an understanding of concepts and therefore create knowledge for themselves (Gredler, 1997; Prawat & Floden, 1994). Additionally, learners learn by actively engaging in tasks (Sedlacek & Sedova, 2017) that help them to build a link between experience and knowledge (Tobin & McRobbie, 1997) and by constructing knowledge through doing rather than reading and listening to theory (Shunk, 2000).

In any model of instruction, the application of the theory of social constructivism is based on three assumptions: *reality*, *knowledge* and *learning* (Kim, 2001). Social constructivism assumes that reality exists as a result of human activity and that its development is informed by social interactions (Kukla, 2000; Vygotsky, 1978). According to Ernest (1999) and Lemke (2001), knowledge is also created both *culturally* and *socially* through human activity. The activity is in the form of interactions with the participants and the environment around them. Social constructivists view learning as a process dependent on social context.

Social constructivists apply four different perspectives to the learning process, namely, the cognitive tools perspective, idea-based social constructivism, pragmatic or emergent approach and transactional or situated cognitive perspectives. All these perspectives are based on the two factors: the learning context and the social context brought by the learners to the learning environment (Gredler, 1997).

The cognitive tools perspective refers to the use of experimental methods and cognitive tools that are specific to the learners' domain of interest in order to address and solve problems (Gredler, 1997). As learners interact with the tools and with each other, a level of understanding or meaning is developed, and their knowledge of the discipline is deepened. Ideas-based social constructivism describes how knowledge is constructed on a step by step

basis (Gredler, 1997; Prawat, 1995). Ideas-based social constructivists prioritise discipline-specific key concepts and believe that an understanding of these will give learners a broad idea or understanding of the discipline and the learning processes peculiar to the specific discipline (Gredler, 1997). The pragmatic or emergent approach is about the use of social constructivism as a theory informing a learning process. The theorists advocating for this perspective (Gredler, 1997) argue that learning in the classroom setting is a product of both the individual learner's view and the view of the classmates. Lastly, the transactional or situated cognitive perspective is based on the relationships that people have with each other and their environment (Gredler, 1997).

For the purpose of this study, the cognitive tools perspective be applied. This is because, in this study, the learners do experiments and answer a set of questions based on the experiment. This is done to test their understanding of the science behind the experiments. The learners do the experiments in groups of three or four, with the help of a facilitator. The experiments and the set of questions following the experiments are intended to help the learners construct their own meaning of the concept of acid and bases. This learning experience happens in a science club, which is considered as a community of practice.

2.6.2 Community of Practice

According to Wenger (2006), a community of practice (CoP) is informed by a group of people with a mutual concern that expand their knowledge through regular interactions with each other. In other words, a community of practice is a collective of people who form a learning community in an effort to expand their knowledge and understanding of a subject. A CoP can either develop naturally because of shared interests or a CoP is formed, as members realize their shared interest and make an effort to learn more and grow in the knowledge of their domain (Lave & Wenger, 1991). Li, Grimshaw, Nielsen, Judd, Coyte and Graham (2009) describe a CoP as an informal network of people that creates opportunities for knowledge exchange and learning. The knowledge exchange is based on a specific domain. The domain of a CoP describes an identity shared within the community and defined by a common area of interest (Wenger, 2006).

However, a group of people who just share interests does not necessarily make up a CoP (Wenger, 2006). Instead, it should involve a learning process, guided by participation and practice (Lave & Wenger, 1991). Central to a community is *learning* and it should be

characterized by four elements: *identity, community, practice and meaning* (Wenger, 2006). All four these elements work together to ensure that the learners are able to construct knowledge for themselves with regards to the particular discipline, as shown by the diagram below.



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

The ‘meaning’ element of CoP describes ‘learning as experience’. This element speaks to an experience that is shared between the members of the science club, as they interact with the volunteers and with each other. That experience helps their learning process.

The second element is practice (learning as doing). A CoP develops a certain way of doing things and addressing problems, which happens over time and through sustained interactions (Wenger, 2006). This ‘way of doing things’, is known as the practice of the community, or a shared repertoire (Wenger, 1998). A repertoire refers to a formulation of stories, tools, experiences and methods that are used regularly. Any interaction in a CoP results in a sharing of the repertoires relevant to the domain which could lead to the establishment of a common practice that is specific to that community (Wenger, 2006; Wenger, 1998). In this study, the practice aspect of the CoP will be the chemistry hands-on practical activities, which will help the learners in understanding the about acids and bases.

As the third element, a community (learning as belonging) refers to a group of people that live in one place and share beliefs and interests. The community aspect of a CoP deals with the

interactions between the members of the community where information regarding the domain of interest is shared among the members (Wenger, 2006). A community is constituted through relationships formed when members with each other during their activities. The community members share experiences and learn from each other through mutual engagement where all the members of the CoP share their individual views on the domain of interest (Wenger, 1998). The learners and volunteers in the science club form the community in this study, and they all share a common domain, that is science.

The last element of CoP is identity (learning as becoming). The members' identity is informed by their interactions with each other and the content of their specific domain (Gresalfi, 2009). In a CoP, people who are identified as members of the CoP, are required to commit to certain goals. These goals inform competence in their functioning within the community (Wenger, 2006). All the interactions and activities that occur in a CoP result in the members creating some knowledge about their domain of interest. Knowledge develops the mind and changes how people view or perceive everything around them. So, knowledge changes people's identity. In the study, the learners' experience in the science clubs should help them begin to identify as scientists and encourage them to pursue careers in the sciences.

The theory of CoP is applied in a wide range of disciplines, such as businesses, organizations, the government, projects and education in an attempt to influence knowledge construction (Wenger, 2006). For the purpose of this study, the theory of CoP will be applied in education.

CoP has also been used in the formulation of after school science enrichment programmes (Ngcoza, Sewry, Chikunda & Kahenge, 2016). These, programmes, informally known as science clubs, can be seen as CoPs because they possess the four elements of a CoP. Science is the domain of interest. The learners are the community and they have a shared practice which could be practical work, group discussions and tutoring of science subjects based on work done in class, or a combination of all three. Furthermore, the learners engage with their facilitators, tutors and peers and this helps the learners enhance their understanding of science.

A CoP does not only help learners understand science, it also helps to develop the attitudes that learners have towards science (Honig & MacDonald, 2005). This happens through the interactions that the learners have with each other and as they engage in science enrichment programmes which illustrate how relatable science is to everyday life. To support this, Jimenez-Silva and Olson (2012) state that interactions within a community of practice, in the form of

sharing and participating activities, lead to an enhancement in the members' understanding about the domain, who they are and about what they know in relation to the domain. This then influences the attitude they have towards the domain as an entity (Jimenez-Silva & Olson, 2012).

2.7 CHAPTER SUMMARY

For this study, science clubs are the communities of practice. Central to the clubs is knowledge construction by the learners. The theory of social constructivism introduces the social aspect of learning, which is, that learning is based on one's social context and the interactions that they have with other people. The social aspect of this study is group experiments that have local knowledge (learner's prior knowledge) integrated to them. All these activities formulate the practice of the communities. The practices are used to ensure that learners are able to learn and understand the science behind acids and bases.

This chapter reviewed the literature relevant to this study, namely, dispositions and conceptions, and how they can be developed to improve the teaching and learning of science. How after school science enrichment programmes, practical activities and local knowledge work together to influence the attitudes that learners have towards science, were discussed. Vygotsky's (1978) theory of social constructivism and the Wenger's (1998) community of practice theory are explored as they relate to learning in a social context.

CHAPTER THREE: ACIDS AND BASES

3.1 INTRODUCTION

In this chapter, I discuss the concept of acids and bases. Three main theories of acids and bases are thus explored: The Arrhenius theory, the Brønsted-Lowry theory and the Lewis theory. I then describe the strengths of different acids and bases, followed by the discussion of how the acidity of substances can be determined using pH scale and indicators. The chapter is concluded by discussing the chemistry of the experiments done in the study, red cabbage as an indicator, turmeric as an indicator and the heat involved in acid-base reactions.

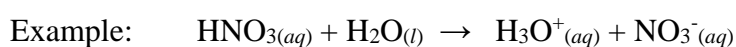
3.2 ACIDS AND BASES

Based on their properties, many substances can be classified as acidic, basic or neutral. Three theories have been developed to explain the concept of acids and bases: the Arrhenius theory, the Brønsted-Lowry theory and the Lewis theory of acids and bases.

3.2.1 The Arrhenius theory of acids and bases

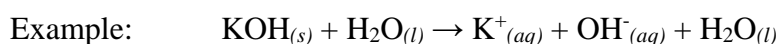
The Arrhenius theory was introduced by a Swedish chemist Svante Arrhenius in 1884 (Ebbing & Gammon, 2013). He proposed that substances could be classified as either acids or bases, based on the kind of ion they produced in an aqueous solution. The theory states that, in an aqueous solution, a substance that produces a hydrogen ion (H^+) is an acid and the substance that produces a hydroxide ion (OH^-) is a base (Ebbing & Gammon, 2013).

With Arrhenius acids, the release of the hydrogen ion results in the formation of hydronium ions (H_3O^+) in aqueous solution (Ebbing & Gammon, 2013). This is because, in solution, the acid dissociates to form a hydrogen ion and a counter-ion. The hydrogen ion cannot exist as a free ion in water because it is attracted to the lone pair of electrons on the oxygen atom in the water molecules, and the reaction forms the hydronium ion (Ebbing & Gammon, 2013). This is illustrated in the reaction below:



In the example above, HNO_3 is the Arrhenius acid. In solution, the acid dissociates to form the nitrate (NO_3^-) anion (the counter-ion) and the hydrogen cation, which then reacts with water to form the hydronium ion (H_3O^+).

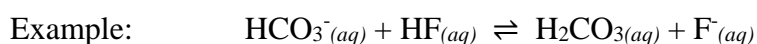
Arrhenius bases, in aqueous solution, dissociate into a hydroxide ion and the positive counter-ion of the base. Thus, Arrhenius bases result in solutions with a high concentration of hydroxide ions. The example below illustrates this reaction. In the example, potassium hydroxide (KOH) is the Arrhenius base, and thus releases the hydroxide ion, which in turn increases the concentration of hydroxide ions in the solution.



The Arrhenius theory of acids and bases was limited to explaining acids and bases in aqueous solutions as it only looked at the concentration of the solvated ions (Clark, 2002). This suggests that, according to this theory, some substances that dissolve in organic solvents, or reactions that are not in solution, cannot be regarded as acids/bases. This limitation led to the development of the Brønsted-Lowry theory (Clark, 2002).

3.2.2 The Brønsted-Lowry theory of acids and bases

The Brønsted-Lowry theory of acids and bases was developed in 1923 by Johannes Nicolaus Brønsted and Thomas Martin Lowry (Ebbing & Gammon, 2013). These chemists found a way to classify substances as acids or bases, irrespective of solvent (Ebbing & Gammon, 2013). They proposed that substances which either donate or accept hydrogen ions in any solution can be classified as either acids or bases. The Brønsted-Lowry theory states that substances that donate hydrogen ions (H^+) in solution are acidic, and substances that accept hydrogen ions are basic. (Ebbing & Gammon, 2013). That is, in a reaction, a Brønsted-Lowry acid donates a hydrogen ion (or also termed a proton) to the Brønsted-Lowry base.



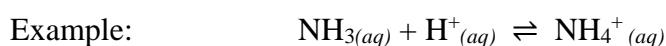
In the example above, HF is the Brønsted-Lowry acid, donating a hydrogen ion. On the other hand, HCO_3^- is a Brønsted-Lowry base, accepting the hydrogen ion from the hydrofluoric acid. The substances in this reaction form conjugate acid-base pairs. From the example, F^- is the conjugate base of HF , its conjugate acid, and H_2CO_3 is the conjugate acid, with HCO_3^- its conjugate base.

Some substances can act as both an acid and a base in solution (Clark, 2002). These substances are known as amphoteric substances (Ebbing & Gammon, 2013), an example of which is water



3.2.3 The Lewis theory of acids and bases

The Lewis theory of acids and bases was developed by Gilbert N Lewis, in 1923 (Ebbing & Gammon, 2013). He proposed a way of defining acids and bases without referring to the presence of hydrogen or hydroxide ions, but by looking at the ability of a substance to accept or to donate electron pairs. This theory states that a substance that donates an electron pair is basic and a substance that accepts electron pairs is acidic (Clark, 2002). An electron pair donor is a Lewis base and an electron pair acceptor is a Lewis acid.

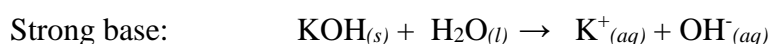
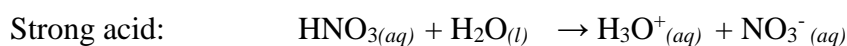


In the example above, the hydrogen ion is electron deficient, and the nitrogen atom of the ammonia (NH_3) molecule has a lone pair of electrons, which makes it electron rich. The hydrogen ion (Lewis acid) accepts an electron pair from ammonia (Lewis base), which results in the formation of a bond between the nitrogen of the ammonia and the hydrogen ion and results in the formation of the ammonium ion (NH_4^+) as a product.

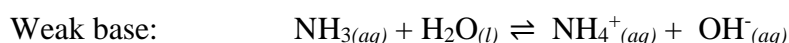
3.3 ACID-BASE STRENGTH

Different acids and bases act differently in solution. This behaviour is governed by what is termed as their strength. Acid-base strength is a measure of the extent to which a substance ionizes in solution (Campion, Gillis & Oxtoboy, 2011).

Strong acids/bases dissociate almost completely, when in solution (Campion et al, 2011). An example of a strong acid is nitric acid, which completely dissociates to form the hydrogen cation and the nitrate anion. An example of a strong base is KOH, which completely dissociates to form the potassium cation (K^+) and the hydroxide (OH^-) anion.

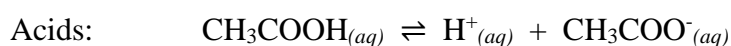


Substances that do not dissociate completely in solution are considered as weak acids or bases (Ebbing & Gammon, 2013). Hydrofluoric acid is the only hydrogen halide that is a weak acid (all the other hydrogen halides are strong acids). All other weak acids are organic acids, an example of which is acetic acid, CH_3COOH (Campion et al., 2011). Most weak bases do not dissociate to give the hydroxide ion (they do not act as Brønsted-Lowry bases), instead, the hydroxide ion forms when the base reacts with the water (Campion et al., 2011). An example of this is ammonia.

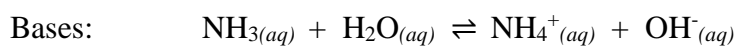


Acid and base strength can also be described as a measure of the ability of an acid/base to conduct electricity (Campion et al., 2011). This is a result of the amount of hydrogen ions (in acids) and hydroxide ions (in bases), present in solution. In acids and bases, there must be enough hydrogen ions or hydroxide ions, in solution, for the substance to conduct electricity (Campion et al., 2011). Additionally, the ability of a solution to conduct electricity is influenced by the concentration of the acid/base in solution (Campion et al., 2011). Strong acids/bases conduct electricity better than weak acids/bases of the same concentration. A concentrated acid/base solution will conduct electricity better than a dilute acid/base solution.

The strength of weak acids and bases can be determined from their ionization constants K_a and K_b , respectively (Campion et al., 2011). These are used to give the mathematical expression of the acid/base percentage dissociation in solution.



$$K_a = \frac{[\text{H}^+][\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]}$$



$$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]}$$

A large value of K_a denotes a stronger acid than one with a low K_a value. Similarly, a high K_b denotes a stronger base, than one with a lower K_b . (Campion et al., 2011).

3.4 ACIDITY AND BASICITY: pH SCALES AND INDICATORS

The acidity and basicity of substances refers to the function of whether a substance is acidic or basic. The expression of this is the pH of the substance. The pH scale is based on the concentration of H⁺ ions in solution and gives an indication of the acidity/basicity of any substance. The scale has a pH range of 1-14, and solutions are classified as acidic, basic or neutral based on this scale:

- pH less than 7 – acidic (contains a high concentration of hydrogen ions);
- pH at 7 – neutral (contains low concentrations of both the hydrogen and the hydroxide ions); and
- pH more than 7 – basic (contains a low concentration of hydrogen ions).

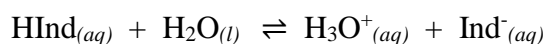
Mathematically, the negative logarithm of the concentration of the hydrogen ions gives the pH of a substance.

$$\text{pH} = -\log [\text{H}^+]$$

Acidity or basicity of a solution can be determined using pH indicators. Indicators are organic compounds, usually weak acids and bases that change colour in response to different pH levels (Ebbing & Gammon, 2013). This is made possible by the sensitivity of these substances to any changes in the concentration of the hydrogen ions in solution (Helmenstine, 2019). There is a wide range of indicators available, some occurring naturally and some synthesized organic compounds (Helmenstine, 2019). Indicators are found in the liquid or solid states, as powders or paper strips. Some examples of indicators are:

- Phenolphthalein, a liquid [colourless in acidic solution – colourless in neutral solution – pink in basic solution];
- Universal indicator, a liquid [red in acidic solution – green in neutral solution – purple in basic solution];
- Red cabbage/onion juice [pink in acidic solution – purple in neutral solution – green in basic solution]; and
- Litmus paper strips [pink in acidic solution and blue in basic solution].

Indicators are themselves weak acids and bases but they (HInd and Ind) have different colours in an acidic or basic solution (Helmenstine, 2019). This is illustrated by the following equations:



The reaction is an equilibrium reaction following Le Chatelier's Principle. In an acidic solution, there will be a higher concentration of the hydronium ion (H_3O^+). The equilibrium will lie to the left and the colour of HInd will be observed. In a basic solution, with a lower concentration of the hydronium ion, equilibrium will lie to the right and the colour of the conjugate base (Ind^-) will be observed (Helmenstine, 2019).

3.5 THE CHEMISTRY EXPERIMENTS CONDUCTED IN THIS STUDY

In this study, the intervention consisted of three hands-on experiments using household substances to explain the concept of acids and bases. The experiments were: the use of red cabbage juice to determine the acidity of household substances, using turmeric to determine the acidity of carbon dioxide and the energy change in acid-base reactions. The experiments all make use of household items that the learners in the science clubs use at home, or are familiar with, and hence are referred to as local knowledge. The following section explains the chemistry of the experiments.

3.5.1 Acidity of household substances: Using red cabbage as an indicator

The aim of the experiment was to determine the acidity of different household substances. Red cabbage juice was added to small amounts of the substances, resulting in mixtures that were one of two colours (red/pink or green/yellow). The experiment makes use of red cabbage, household substances, plastic spoons and plastic cups, which are all materials familiar to the learners.

Red cabbage contains a pH sensitive pigment called anthocyanin (Rein, 2005). Anthocyanins are water-soluble and unstable pigments that occur in nature (Rein, 2005). Their susceptibility to degradation is at its maximum when they are in their liquid form rather than the solid form (Brouillard, Iacobucci & Sweeny, 1982). They occur in different colours ranging from red to yellow and are the pigments that give some plants, fruits and flowers their colours, including red cabbage (Rein, 2005). These pigments show different chemical properties at different temperatures, pH levels, concentrations, exposure to light levels *etcetera* (Rein, 2005).

Anthocyanins are flavonoids that fall under the family of polyphenols (with a C₆C₃C₆ skeletal structure). They contain a number of hydroxy and methoxy groups accompanied by glycols. The main parts of their chemical structure are a positive charge on the oxygen situated on the second carbon ring of the chroman ring (Fig 3.1). This positive charge, forming the flavylum cation, gives anthocyanins the ability to absorb light at about 500 nm and therefore reflect red colour. The other significant part of the structure is the sugar group also attached to the chroman ring. This group increases the solubility of anthocyanins in water.

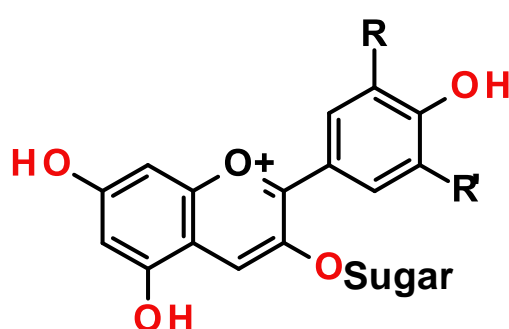


Figure 3.1: The basic structure of anthocyanins

Anthocyanins are categorised based on the number of glycosyl units they contain. They can be either: monoglycosides, diglycosides and triglycoside, characterized by the number of monosaccharides, attached to the 3-hydroxyl group of the structure (Brouillard et al., 1982). The pigment present in red cabbage falls under the monoglycosides. There are 6 different known anthocyanins, which are characterized by different (R and R') substituents on the main structure (Khoo, Azlan, Tang & Lim, 2017). The different anthocyanins are:

- Cyanidin [R – OH, R' – H]
- Delphinidin [R – OH, R' - OH]
- Malvidin [R - OCH₃, R' - OCH₃]
- Pelargonidin [R – H, R' – H]
- Peonidin [R – H, R' - OCH₃]
- Petunidin [R – OH, R' - OCH₃] (Khoo *et al*, 2017)

Red cabbage contains cyanidin. Anthocyanins are most stable in acidic medium, and an increase in pH results in the degradation of the pigment (Ibrahim, Muhhamed & Salleh, 2011).

This process results in the pigment absorbing colours at different pH levels. Anthocyanins are red in acidic environments, violet in neutral environments and blue/green in basic environments. This is made possible by the ionic structure of these pigments (Rein, 2005). This ionic structure allows for the transformation of anthocyanins to form different structures at different pH levels, which interact with light differently and therefore reflect different colours.

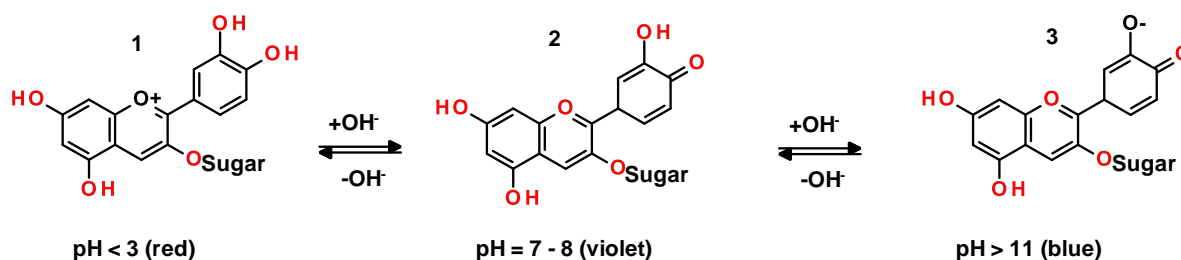


Figure 3.2: A scheme showing the alteration of anthocyanins at different pH levels

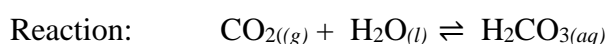
The flavylium cation structure (**1** – in Figure 3.2), is present at a very low pH (Rein, 2015). At this point, the substance appears red in colour (Rein, 2015). As the pH increases, the amount of the flavylium cation species decreases and the intensity of the red colour also decreases. A sharp increase in pH (to about 7) means more hydroxide ions in solution, which results in the removal of a proton from one of the attached hydroxyl groups (Rein, 2015). The removed proton results in a shift in the conjugation system and the formation of derivative showing a violet colour, at about 380 – 450 nm (**2** – in Figure 3.2) (Rein, 2015). A further increase in pH results in a further reaction as another hydroxyl group loses its proton, to the point where the pigment is blue, which is at about 495 – 570 nm (**3** – in Figure 3.2) (Rein, 2015).

3.5.2 Acidity of carbon dioxide: Turmeric

The aim of the experiment was to ascertain the acidity of carbon dioxide in solution, which is used as a reactant in the reaction. Three bottles with water in each were labelled: acid, base and experimental respectively. A spatula tip of turmeric was put in each of the three bottles.

- Upon turmeric addition, all mixtures were yellow/orange with some undissolved particles of turmeric floating on the surface of the water;
- Vinegar was added to the bottle, labelled ‘acid’. The resulting mixture turned yellow, with some particles still floating on the surface of the water;

- In the bottle, labelled ‘base’, household ammonia was added, resulting in a red clear mixture with all the particles of the turmeric dissolved; and
- Carbon dioxide was blown into the bottle labelled ‘experimental’, resulting in the formation of a yellow mixture, which meant that carbon dioxide is acidic. The learners used plastic bottles, turmeric, household items and their breaths to test for carbon dioxide. All these are materials the learners encounter and use almost everyday in their lives.



Turmeric was, in this case, the indicator. Turmeric is a spice mainly used in Asia, for a wide range of applications such as medicinal and colouring. It is also used as an indicator because of its ability to change colour at different pH levels. Turmeric is yellow in acidic medium, red-brown in basic medium and yellow/orange in neutral medium. This is made possible by the presence of a compound in the spice, called curcumin (Marin, Briceno & George, 2016).

Curcumin is a yellowish naturally occurring pigment that is almost insoluble in water and soluble in organic compounds (Wang, Pan, Cheng, Lin, Ho, Hsieh & Lin, 1997). The chemical structure of curcumin is in three parts:

- two electron rich aromatic rings that have o-methoxy phenolic groups attached to each,
- a π conjugated 7 carbon chain, consisting of 2 α, β – unsaturated carbonyl groups joined head to head that connect the two rings (Wang et al., 1997).

This π conjugated diketone is hydrophobic and is the reason for the insolubility of curcumin available as a powder, in its neutral form. Curcumin can be found in two different forms at equilibrium: keto form and enol form that are a result of tautomerism (see Figure 3.3) (Marin et al., 2016). The enol is the most stable form, in both solid and liquid phases, and it can easily lose its hydrogen to form the enolate.

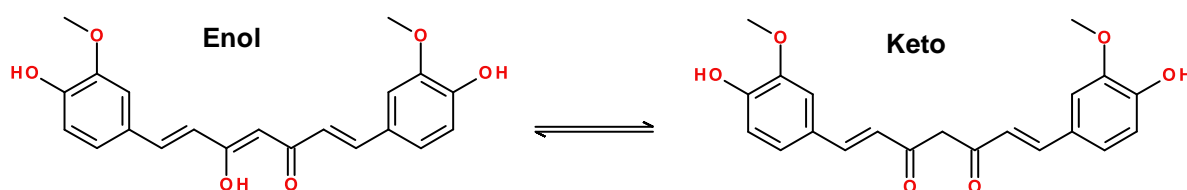


Figure 3.3: A scheme showing the enol – keto tautomers of the curcumin pigment.

Curcumin (enol form) contains three reactive functional groups: the diketone moiety and the 2 phenolic groups (Marin et al., 2016). It is a Brønsted acid that is able to release and donate three protons from the three reactive functional groups. This pigment naturally occurs in its neutral state (pH around 7) (Marin et al., 2016). The acidic state (pH < 7) is, however, the most stable state of curcumin, because of the conjugated diene structure (Marin et al., 2016). Curcumin is unstable at its neutral and basic states. The alteration occurs as a result of the hydrolysis of the diketo moiety of the structure (Dovigo, Carmello, de Souza Costa, Vergani, Brunetti, Bagnato & Pavarina, 2013).

When the pH of the system increases, curcumin loses a proton, and degrades to the point where all the protons (of the reactive functional groups) have been removed (Figure 3.4), at the highest pH, around 10, (Dovigo et al., 2013). There is still a debate concerning which of the hydroxyl groups (phenolic/enolic) is the most acidic (Dovigo et al., 2013). At pH 1-7, the pigment is highly conjugated and therefore absorbs light at longer wavelengths. It absorbs red light (around 700 nm) and reflects yellow light (around 560 nm), which is what we observe. At higher pH levels, 7.5 – 11, the deprotonation of the pigment disrupts this conjugation structure and shortens the wavelength of absorption. At this stage, as the pigment is continuously deprotonated, it absorbs yellow light and reflects the red, which is what we observe (Dovigo et al., 2013). At this state, curcumin has been deprotonated to form other molecules that are more soluble in water (Figure 3.4).

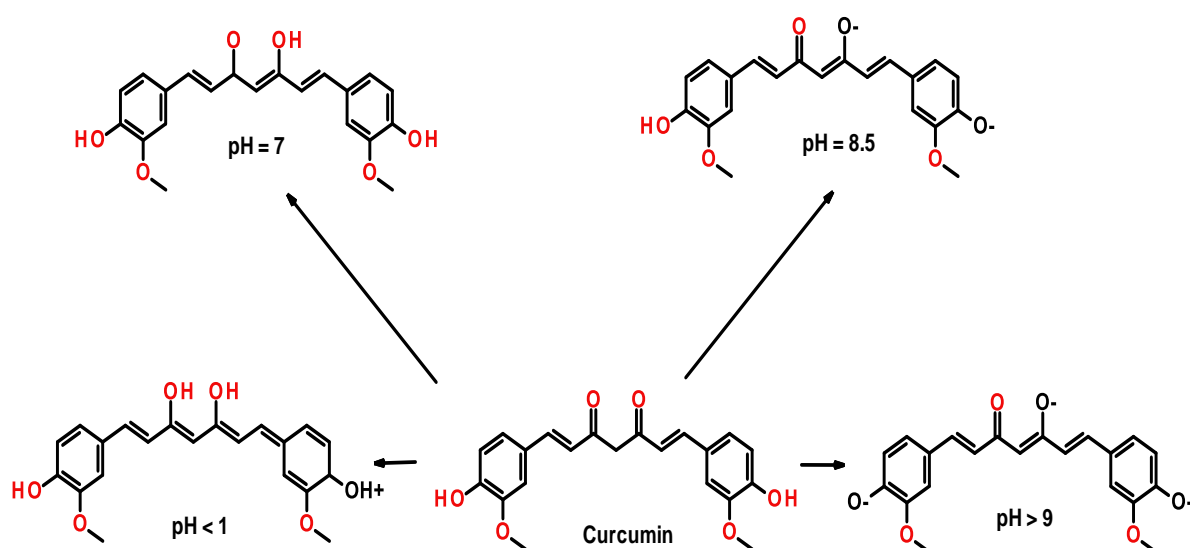
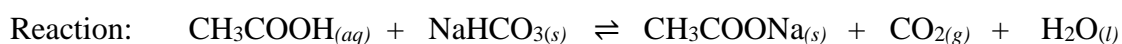


Figure 3.4: A scheme showing the alteration of derivatives of curcumin at different pH levels

3.5.3 Energy transfer in acid-base reactions

To get an indication of the energy involved in an acid-base reaction, the temperature was measured before and after mixing vinegar and bicarbonate of soda. The temperature dropped and carbon dioxide was released. This is an example of a neutralization reaction between an acid and a base forming a salt, water and carbon dioxide. Steel wool, vinegar, bleach, plastic cups, bicarbonate of soda were all materials used in the experiment. All these materials fall under kitchen chemistry which as explained in section 2.4, and can be understood as local knowledge.

This is a two-step reaction. Vinegar is an acid (acetic acid), and when reacted with a base (sodium bicarbonate), vinegar donates a proton to the sodium bicarbonate which breaks up the base into sodium ions and carbonic acid. The conjugate base of vinegar (acetate ions) reacts with the sodium ions to form a salt (sodium acetate). The conjugate acid of the base (carbonic acid) decomposes into water and carbon dioxide. The carbon dioxide is released through effervescence. The overall reaction is shown below:



Reactions can either be endothermic (absorb heat from the surrounding) or exothermic (release heat to the surrounding). This energy transfer is based on the breaking of existing bonds and the formation of new bonds to form the products. Energy is required to break bonds and released when bonds are formed. When looking at endothermic and exothermic reactions, we consider the heat energy of the system, which is known as enthalpy (H). The difference between energy required and energy released is change in enthalpy (ΔH).

The enthalpy of endothermic reactions is greater than zero ($\Delta H > 0$), and the enthalpy of exothermic reactions is less than zero ($\Delta H < 0$) as illustrated in Figure 3.5:

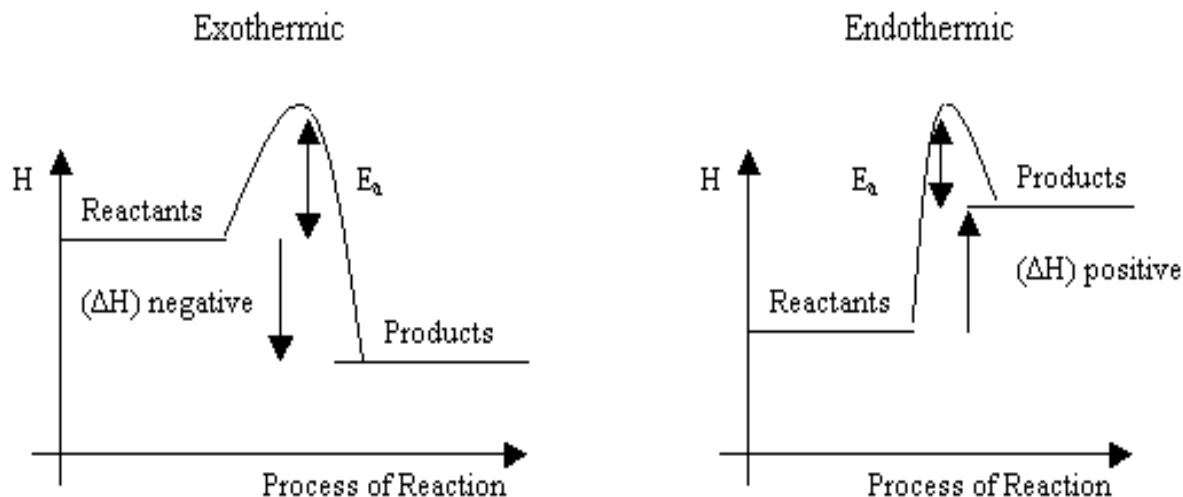


Figure 3.5: *The energy diagrams of exothermic and endothermic reactions (IB Chemistry, 2014)*

The reaction of vinegar and bicarbonate of soda requires more energy to break the bonds than that which is released in forming the bonds of water, carbon dioxide and sodium acetate. This suggests that, in order for the reaction to occur, some energy is absorbed from the surroundings, which results in a drop in the temperature of the solution. This proves that it is an endothermic reaction, and the change in enthalpy for this reaction is greater than zero ($\Delta H > 0$).

The second experiment was the reaction of steel wool in solutions of vinegar and bleach, respectively. The temperature of the steel wool was measured before and after it was put in vinegar and in bleach, by wrapping it around a thermometer, and there was an increase in the temperature in both the vinegar and in bleach. The steel wool formed rust in both cases. In vinegar, there was more rust, but the rust was formed after the steel wool had been taken out of the vinegar. In bleach, the rust started forming when the steel wool was still in the bleach. This is an example of the reaction of acids/bases with metals. The reaction between an acid and a metal base is a redox reaction where the metal is oxidised to form a metal oxide and hydrogen gas. In this reaction, the acid oxidises the base, and vice versa to form the hydrogen gas and the salt.

Vinegar is acidic, and steel wool is a metal complex. The hydrogens released from the vinegar attract electrons removing the coating of the steel wool and therefore exposes the iron in the steel wool (Australian School Science Information Support for Teachers and Technicians, 2016). When the steel wool is taken out of the vinegar, the iron metal is exposed to oxygen

(Australian School Science Information Support for Teachers and Technicians, 2016; Papiewski, 2019). The oxidation of the iron in the steel wool causes the steel wool to form rust (Fe_2O_3). Bleach contains an oxidising agent called sodium hypochlorite (NaClO), which oxidises the iron of the steel wool causing rust formation (Papiewski, 2019). The rust formation in bleach is faster than the rust formation in vinegar (Papiewski, 2019).

The reaction of vinegar or bleach and steel wool results in reactions between oxygen and the iron of the steel wool. Heat is released to the surroundings and therefore the reaction is exothermic ($\Delta H < 0$).

3.6 CHAPTER SUMMARY

In this chapter, I discussed the concept of acids and bases, acid-base strength and pH indicators. I end the chapter by discussing the chemistry of the experiments in this study.

CHAPTER FOUR: RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

In this chapter, I discuss the overall research design and methodology of the study, which includes the methods followed in an attempt to answer the main question of how learners' attitudes towards science shift or evolve as a result of their participation in hands-on chemistry practical activities into which local knowledge has been integrated. I discuss research paradigms and research method approaches, with the specific mention of the pragmatic paradigm and the mixed-method approach as they relate to this study. I then discuss the site of the study and the sampling of participants, followed by the research process/procedure followed in conducting the study as well the data collection techniques used in each stage of the process. I end the chapter by detailing the approach to analysis, the validity and trustworthiness and the ethics considered in the study.

4.2 RESEARCH PARADIGM

A research paradigm is a set of standards that guide how the study will be conducted. Kuhn (1962) defines a research paradigm as the mutual beliefs between scientists concerning how problems can be understood and solved. Put differently, a research paradigm describes assumptions that researchers have about how things relate to their field of research work which, in turn, influences how the research will be conducted. Essentially, research paradigms inform the research method that a study should adopt.

There are four well-known types of research paradigms:

- the positivist paradigm which is grounded on the scientific method of investigation and is concerned with quantitative research;
- the constructivist paradigm which is grounded on the data generated by the research and is concerned with qualitative research;
- the transformative paradigm which is based on addressing the political, social and economic issues faced by people; and

- the pragmatic paradigm which uses a more practical and pluralistic approach to research, combining quantitative and qualitative methods to form one approach, that is, the mixed-methods approach (Kivunja & Kuyini, 2017).

My study follows the pragmatic paradigm. The pragmatic paradigm emerged to end the debate between the incompatible truth (positivism) and reality (constructivism) paradigms. Theorists such as Tashakkorie and Teddlie (2009) argue that it is difficult to understand and solve the problems in the world using either the positivism or the constructivism paradigms. The pragmatic paradigm approach to research combines the quantitative and qualitative methods to understand the behaviour, the attitude or the belief informing the behaviour and the consequences of the behaviour. The quantitative method gives the attitude and, the qualitative method would give an extensive understanding of the beliefs behind the behaviour.

In this study, the quantitative data measure the attitude that the learners have towards science, and the qualitative gives a clear understanding of the belief and the views the learners have, which influences their attitudes and behaviour. The pragmatic paradigm is therefore linked to the mixed-methods approach to conducting research.

4.3 RESEARCH METHODS

Research methods refer to the approaches that researchers use in conducting their research. This usually depends on the nature of research and the type of data required to draw arguments. There are three types of research methods: qualitative which looks at non-numerical representations; quantitative which looks at numerical representations and the mixed-methods approach which uses both. The mixed-methods approach is the research method used in this study.

According to Tashakkori and Creswell (2007), the mixed-methods approach refers to the research approach where data is gathered and analyzed, and conclusions are drawn using both the qualitative and the quantitative research methods. To support this, Christensen, Johnson and Turner (2015) describe a mixed-methods approach as one where the elements of the qualitative and quantitative methods are combined and used together in one study. A mixed-methods approach is used to “gain a better understanding (comprehension) of results, discover new perspectives, or develop new measurement tools” (Tashakkori & Teddlie, 1998, p. 43).

The mixed-methods approach has been used in a wide range of fields such as psychology, health sciences, business and education.

A mixed-methods approach enables researchers to use various sources of data collection which, in turn, give different perspectives to address the complexity of research problems (Malina, Nørreklit & Selto, 2011). The use of different methods provides an opportunity to address different problems using the same study by means of triangulation² (Tashakkori & Teddlie, 2009). One method can be used to confirm the results provided by another method. Beyond this, a mixed-methods approach affords the researcher an opportunity to strengthen their research by using the beneficial aspects of both the qualitative and the quantitative research methods while limiting the weaker aspects of the two methods (Creswell & Plano Clark, 2011).

Different researchers arrange their mixed-methods in various designs depending on their research questions. The design most often used in mixed-methods research, is the QUAN-QUAL design. In this design, quantitative and qualitative data are collected and analyzed in a parallel process or in a sequential process. The parallel process has two independent phases of data collection and analysis (the quantitative and the qualitative phases), leading to two conclusions that are integrated to form meta-inferences concerning the study (Creswell & Plano Clark, 2011).

Tashakkori and Teddlie (2009) describe the sequential process of data collection as characterized by having one research method (either quantitative or qualitative) used to inform the other research method. In this, the quantitative method is used to collect and analyze data and the qualitative research method is used in the same manner to give a more extensive understanding of the subject/object or issue in question. Inferences made are therefore based on the data provided by both research methods. Generally, the sequence of data collection and analysis is quantitative followed by qualitative, where the qualitative gives a deeper understanding of the quantitative data (Hanson, Piano, Petska, & Creswell, 2005).

In this study, the mixed-methods approach is used, following the parallel process of data collection and analysis.

² Triangulation refers to the use of different sources of data to answer the same research question and validate data.

4.4 RESEARCH GOAL AND QUESTIONS

The research goal and questions provide the aim of the study and the direction that the study will take in trying to achieve that aim. In the next section, the goal and the research questions asked in this study are discussed.

4.4.1 Research goal

The aim of the study was to ascertain the Grade 8/9 learners' attitudes towards science when local knowledge has been integrated into their hands-on chemistry practical activities.

4.4.2 Research questions

The following research questions were used as a guideline to realize the aim of the study:

1. What is the attitude that Grade 8/9 learners have towards science prior to the intervention on chemistry hands-on practical activities that integrate local knowledge?
2. How do Grade 8/9 learners' attitudes towards science shift/evolve as a result of doing chemistry hands-on practical activities that integrate local knowledge?
3. How does the intervention of chemistry hands-on practical activities that integrate local knowledge influence the attitudes that Grade 8/9 learners have towards science?
4. From the volunteers' perspectives, what factors affect Grade 8/9 learners' attitudes towards science?

4.5 RESEARCH SITE AND SAMPLING

The study was conducted in four different science clubs in Grahamstown, Eastern Cape. Three of the science clubs are at three high schools in Grahamstown and the fourth is the Khanya Maths and Science Club.

4.5.1 Research site

The High School Science Clubs (Clubs A, B and C)

The High School science clubs are at three public, poorly-resourced high schools, in Joza location, in Grahamstown now called Makhanda, in the Eastern Cape Province of South Africa. These clubs are a part of the initiatives of the Rhodes University Community Engagement³ Engaged Student Programme and the schools fall under the Vice Chancellor's schools' initiative. The clubs were established in 2017 and run one afternoon a week at each of the schools. The main objective of the clubs is to improve the learners' understanding of science-related concepts and to assist the learners with the Eskom Expo for Young Scientists⁴ Initiative. Membership of the clubs is open to any Grade 8 – 12 learners at the schools, as long as the learners are doing science-related subjects.

The clubs run for 1 hour 30 minutes every week. That time is divided into two 45 minutes slots. The first 45 minutes is for the enrichment programme, which is a series of experiments and discussion sessions that are based on the grade 9 Natural Sciences curriculum. This is a compulsory programme for grade 8 and 9 members of the science clubs. The second 45 minutes is for assisting the learners with their Eskom Expo projects. This is done by working with the learners through the different stages of scientific investigation (based on their various projects). The clubs are coordinated by the Natural Sciences teachers at the different schools. The facilitators of the programmes are Rhodes University science students (both undergraduate and postgraduate).

Khanya Maths and Science Club (KMSC)

The Khanya Maths and Science Club was established in 2000 and is currently coordinated by a Rhodes University Chemistry academic. The club is located at the Albany Museum, in Grahamstown, in the Eastern Cape Province of South Africa and meets on Saturday mornings. The purpose of the Club is to enhance the grade 8 and 9 learners' understanding of Maths and Science. This is done through workshops and lessons given by volunteer scientists and students from departments within the science faculty at Rhodes University. The activities include tutorials on maths and science with a focus on their curriculum-related questions. The participants come from a wide range of both private and public schools in Grahamstown, with the greatest number coming from under-resourced schools. Invitations and encouragement to

³ Community engagement – a group of people working together to encourage development/advancement in a community.

⁴ Eskom Expo for Young Scientists – a science competition developed by Eskom, where learners from different schools identify problems in the environment around them and use science investigation techniques to find solutions to those problems.

join the club is sent out to all schools in Grahamstown at the beginning of the year. Any interested learners may sign up without academic prerequisites.

4.5.2 Sampling

The participants in this study were grade 8 and grade 9 learners that were members of the clubs. In total, 20 learners completed both the pre- and post-surveys. Of the 20 learner participants, 8 learners were selected for the semi-structured interviews conducted at the end of the intervention programme. These learners were selected because they had done both the pre- and post-surveys and had attended all the sessions. Some of the 8 learners had shown enthusiasm during the experiments and some were just impassive. These 8 learners represented both grades 8 and 9 and were from different science clubs. Five were from Khanya Maths and Science Club, and three were from school B. Of the learners from Khanya Maths and Science Club, one attended School A, one school B, one school C and the other two attended a school that does not have a science club. There were no learners interviewed at school A and school C science clubs. This is because, the school C science club had a lot of cancellations because of their school programmes and at the time of the interviews, the 4 learners at school A had stopped going to the science club.

Three Rhodes University science students volunteering at the clubs also participated in the study. Two of the volunteers volunteered at the KMSC and one at school B.

4.6 RESEARCH PROCESS

The research process describes the route of the study, from how the goal is identified to the completion of the project. All the steps followed in the answering of the research questions. The process of the study was document analysis, development of experiments and the intervention and data collection. The process is discussed in the next section.

4.6.1 Document analysis

The start of the research was the analysis of the Department of Education Curriculum Assessments Policy Statements (CAPS) document (2012), for grade 7-9 Natural Sciences. The document was analyzed to understand what the main concepts of Natural Sciences were and how these concepts should be taught. Moreover, the analysis was done to get a perspective on the use of local knowledge in the teaching of Natural Sciences. It was discovered that teachers

were encouraged to use local knowledge in teaching. However, methods on how to include local knowledge in teaching acids and bases were not given.

4.6.2 Development of experiments and worksheets

I am most knowledgeable about the chemistry section of the grade 8 and 9 curriculum because I majored in chemistry. For this reason, the Matter and Materials section of the curriculum, and, specifically, the concept of acids and bases was chosen for the intervention. Acids/bases was chosen because it has been reported as one of the most confusing topics to learners (Damanhuri, Treagust, Won & Chandrasegaran, 2016) and there is some local knowledge on acids and bases readily available to help learners. To address acids and bases in grade 9, three experiments were done (Carvalho, Mendonça & Piedade, 2002; Siyavula Education, 2015; Steve Sprangler Science, 2019). These experiments were modified to be based on local knowledge and to fit with the grade 8 and grade 9 curriculum.

The experiments conducted with the learners at the science clubs were (Appendix C) the acidity of household substances (Steve Sprangler Science, 2019), the acid-base reactions of carbon dioxide (Carvalho et al., 2002) and acid-base energy transfer reactions (Siyavula Education, 2015). In the first experiment, the concepts of acids/bases and natural pH indicators were introduced. These concepts were linked to the knowledge that learners already have about the substances they use at home. The second experiment was used to illustrate the acidic properties of carbon dioxide, production of carbon dioxide and to introduce acid-base reactions using carbon dioxide as a reactant and as a product. The third experiment showed the reactions of acids and bases with steel wool, and incorporated energy transfer reactions to help the learners draw the link between the chemistry concepts they were learning, and ultimately construct knowledge of chemistry as an entity, as opposed to learning the concepts as standalone items.

Three worksheets based on the experiments were developed to test the learners' understanding of the main concepts and their ability to find the connections between these said concepts (Appendix C).

4.6.3 Intervention and data collection

The intervention was done during the second term when the learners were studying matter and materials (which includes acids and bases) at school. There were four clubs altogether (school A, B, C and Khanya Maths and Science Club (KMSC)) and I was a volunteer at all the clubs,

working with other students from Rhodes University. I was, however, the only volunteer at school A.

During my first meeting at each of the clubs, I explained the research process and the ethics to the learners and asked whether any of the learners were willing to participate. The willing learners were given parent consent forms to return at the next club meeting. 14 consent forms were returned from school A, four from school B, three from school C and 13 from KMSC. The learners signed assent forms and Fraser's (1981) Test of Science Related Attitudes (TOSRA) questionnaire as a pre-survey was given to the learners to complete. The volunteers at the clubs helped to explain the TOSRA to the learners and answered questions that the learners had.

After this, all the learners at the clubs, including the learners who were not part of the study, worked in groups, doing the experiments. I briefed the learners and the volunteers (who were students studying science-related courses at Rhodes University) on what was entailed in the first experiment. The briefing explained to the learners the main concepts of the experiments and then outlined the experiment they were to do. The volunteers helped facilitate the different groups while the learners worked on the experiments. With the other two experiments, different volunteers at the clubs did the briefing before the experiment while I continued with the facilitating. This gave me an opportunity to observe without taking part in the experiments. I was the only volunteer at school A and that meant I had to do everything myself. Worksheets with questions relating to the experiments were completed during each experiment and discussed by everyone at the end of each experiment. I made observations in the different science clubs during the experiment sessions. In my observations, the learners were engaged with the experiments and showed some excitement when colours changed.

After all three experiments and the worksheets had been completed, the learners were again given the TOSRA questionnaire as a post-survey. This was done, to measure the possible change in attitude before and after the intervention. In the end, 15 learners from school A did the post-survey, 3 from school B, 6 from KMSC and none from school C. The learners at school C had stopped going to the club. Of all these learners, 20 learners returned consent from the parent/guardian, had signed assent forms, had done the experiments and had completed both the pre- and post-survey. Eleven of these learners were from school A, three from school B and six from KMSC. Analysis of both the pre- and post-intervention survey was done to evaluate the change in the attitude of the learners. Data from the 20 participants were used in the study.

Eight learners were interviewed (Appendix E) to get a more in-depth understanding of the change in their attitudes and to check whether that change could have been influenced by the use of local knowledge integrated into practical activities. The eight learners had done all the experiments, represented both grades 8 and 9 and were from different clubs.

Table 4.1: The description of the learners interviewed.

| LEARNER | GENDER | GRADE | CLUB/SCHOOL |
|----------------|---------------|--------------|--------------------|
| Learner 1 | Male | 8 | B |
| Learner 2 | Female | 8 | B |
| Learner 3 | Male | 8 | B |
| Learner 4 | Male | 8 | KMSC |
| Learner 5 | Male | 9 | KMSC |
| Learner 6 | Female | 9 | KMSC |
| Learner 7 | Female | 9 | KMSC |
| Learner 8 | Female | 9 | KMSC |

The interviews were conducted in the third term after the learners had returned from their winter holidays. The reason for this is that the club sessions were delayed because the schools cancelled the clubs for some weeks, some learners were absent from the clubs for various reasons such as transport and weather conditions. There was also a break because of examinations and the winter vacation for both the learners and the volunteers.

By the time the interviews were conducted, the learners were doing other experiments and focused on topics other than acids and bases, and some were not as sure about their second

term experiences. This meant that the learners' responses would be based on their intervention experiences, and also their experiences at the time of the interviews. The interviews with the learners ranged from 8 minutes to 18 minutes, based on how the learners answered the questions and how much probing was done. All these interviews were tape-recorded and I transcribed the recordings.

During the course of the experiments, the volunteers were interviewed. The volunteers were from the Khanya Maths and Science Club and the club at school B.

4.7 DATA GATHERING TECHNIQUES

The data gathering techniques are the tools used to generate data that seeks to answer the research questions of the study. The data gathering techniques used in this study are a TOSRA questionnaire (Fraser 1981), semi-structured interviews. In the next section, I discuss these techniques referring to how they relate to this study.

4.7.1 Test of Science Related Attitude questionnaire (TOSRA)

A common quantitative data collection technique is a survey or questionnaire. A questionnaire has been described as a document designed with the purpose of seeking specific information from respondents (Sansoni, 2011). The questionnaire used in this study is the Test of Science Related Attitude (TOSRA) (see Appendix D).

TOSRA is a questionnaire developed by Fraser (1981), which is used to measure learners' attitudes towards science. It uses a science-related attitude scale, with 7 scales: social implications of science, normality of scientists, attitude towards science enquiry, adoption of scientific attitudes, enjoyment of science lessons, leisure interest in science and career interest in science (Fraser, 1981). The questionnaire consists of a set of questions that evaluate the 7 scales of attitude and therefore giving an ultimate understanding of the said attitude towards science learning and towards science as an entity. The standard questionnaire can be modified to fit a specific study. The questionnaire used in this in study is a version modified and used in a study by Agunbiade et al. (2015).

4.7.2 Semi-structured interviews

Interviews are an example of qualitative data collection techniques. An interview is a formal question and answer session between two or more people where one is an interviewer and the

other(s) are the interviewees. This is conducted to get one person's or a group's view on something. To support this, Diccico-Bloom and Crabtree (2006) describe an interview as a verbal conversation guided by a series of questions devised to get a deeper understanding of one's opinions on a subject, an object or an issue. According to Cohen, Manion and Morrison (2011), the subject/object/issue should be of mutual interest.

Interviews can be either with individuals or focus groups. In-depth individual interviews are described as an interaction between two people and the focus groups are described as a conversation or discussion between an interviewer and a group of participants. Individual interviews provide a deeper understanding of the feeling towards something and a focus group interview provide ideas on a broad range of experiences (Dicicco-Bloom & Crabtree, 2006).

There are two types of interviews: structured and semi-structured interviews. The type of interviews used in this study is semi-structured interviews. Diccico-Bloom and Crabtree (2006) describe semi-structured interviews as a conversation between two parties characterized by a series of pre-set open-ended questions about a topic. The pre-set questions are based on an interview guide that has questions that aim to answer the main question of the study. The open-ended questions allow the interviewer to ask follow-up questions that emerge from the conversation.

In this study, the individual semi-structured interview was used (Appendix E). The interview questions for the learners were developed to answer the main question of the study, that is: What is the influence of local knowledge integrated practical activities on the learners' attitudes towards science? The interview questions for the volunteers were designed to answer the question of what factors influence the attitude that science learners have towards science, and the teachers' questions were developed to answer the question of whether or not there was a difference between the learners that attended the science club and did the experiments and those who did not (Appendix E).

4.8 APPROACH TO DATA ANALYSIS

Both qualitative and quantitative research methods were applied in gathering data for the study. The next section describes how the data used in this study was analyzed.

4.8.1 Approach to quantitative data analysis

The quantitative data was analyzed using Microsoft Excel. Frequency and tally tables were used to organize the data into categories of three sub-scales of attitudes as outlined by Fraser (1981): perception, enjoyment of science activities and interest in science. The data were plotted in bar graphs to illustrate the differences between the attitude of the learners before and after the intervention. A paired sample *t-test* was also done to check the statistical significance of the change in the learners' attitudes towards science.

4.8.2 Approach to qualitative data analysis

An inductive-deductive approach was used to analyze the data. The interviews were transcribed and collated. The transcribed interviews were coded to find underlying themes. This was done by reading through the transcripts and highlighting words and phrases, in different colours, for each question. The codes were grouped according to similarities, across the different questions to formulate themes.

4.9 VALIDITY, TRUSTWORTHINESS AND RELIABILITY

Validity refers to the accuracy and the credibility of a report, given as a representation of a phenomenon (Schwandt, 1997). The validity of data follows the entire research method, from sampling to the handling of the data, from collection to interpretation. Validity can be achieved in various ways.

One of the ways in which data were validated was through data triangulation. Triangulation speaks to the collective use of different sources of data in a study (Bogdan & Biklen, 2007). This validates the data by giving the link or the connection between the different data sources. In this study, a mixed-methods approach was used for the collection of data. Data were collected using the TOSRA questionnaire (survey) and semi-structured interviews with the learners and the volunteers.

4.10 ETHICAL CONSIDERATIONS

Ethics refer to the use of morals and principle in research. This is done to ensure that the research does not pose harm to anyone, is necessary and of high quality. The study was approved for ethical clearance by the Rhodes University Ethics Committee (Appendix A). Permission to conduct the study was requested from, and granted by, the District Director of

the Eastern Cape Department of Education, the principals of the different schools and the coordinator of Khanya Maths and Science Club (Appendix A).

The learners at all the clubs are younger than 18 years old and considered minors. For this reason, consent was requested from the learners' parents/ guardians, and the learners' assent to be participants in the study, was also requested (Appendix B). Only the data from those learners who assented and whose parents consented were used in the study. The volunteers gave consent to their participation in the study and the Rhodes University Registrar gave permission for the volunteers (Appendix A), who are registered students at Rhodes University, to participate. The teacher also gave consent for her participation (Appendix B).

Participation in the study was voluntary and all participants were allowed to withdraw from the study at any time, without any repercussions. Furthermore, the participants' decision to withdraw from the study did not affect any learners' membership at the clubs and the learners would still be able to do all the intervention experiments even if they were not a part of the study. All the participants were made aware of this information before the start of the study and were also made aware of all the details of the study and the different roles they would be playing.

4.11 CHAPTER SUMMARY

In this chapter, I gave a detailed explanation of the mixed-methods approach and the pragmatic paradigm as they inform the study. A discussion of the research methodology developed to achieve the aim, in the form of the research site, participant sampling, research process, data collection techniques and approach to analysis. Furthermore, validity and ethics are discussed to give an account of the accuracy and credibility of the study.

CHAPTER FIVE: DATA PRESENTATION, ANALYSIS AND DISCUSSION

5.1 INTRODUCTION

The main aim of the study was to investigate if learners' attitudes could be influenced by the integration of local knowledge with curriculum-based experiments. The experiments formed part of the activities at the different science clubs which the learners attended. The study was based on literature evidence that practical activities and science clubs do have a positive influence on the learners' attitudes towards science. The results and discussion chapter contain the presentation, the analysis and the discussion of the results. In the study, we collected both qualitative and quantitative data. The quantitative data are from the pre- and post- surveys using the TOSRA questionnaire (Fraser, 1981) and the qualitative data are from semi-structured interviews with the learners and the volunteers at the science clubs and an educator. In this chapter, all these results are discussed to answer the four research questions:

1. What is the attitude that Grade 8/9 learners have towards science prior to the intervention on chemistry hands-on practical activities that integrate local knowledge?
2. How do Grade 8/9 learners' attitudes towards science shift/evolve as a result of doing chemistry hands-on practical activities that integrate local knowledge?
3. How does the intervention of chemistry hands-on practical activities that integrate local knowledge influence the attitudes that Grade 8/9 learners have towards science?
4. From the volunteers' perspectives, what factors affect Grade 8/9 learners' attitudes towards science?

5.2 QUANTITATIVE DATA

Twenty participants completed the TOSRA survey (Appendix D) before and after they had done all three practical activities. The survey questions were divided into three different subscales: perception of science, interest in science and enjoyment of science, which together speak to attitude towards science (Agunbiade et al., 2015). The analysis was done using

tally/frequency tables, percentage frequency tables and the paired sample *t*-test. The results of the analysis are presented in bar graphs of frequency of learners per statement, bar graphs showing the percentage frequency of learners according to the three different sub-scales: perception, interest and enjoyment and a graph showing the overall attitude of the learners and *t*-test statistics. The graphs illustrate the differences between the learners' attitudes before and after the intervention.

The graphs derived from the surveys attempt to answer question (1) and question (2):

1. What is the attitude that Grade 8/9 learners have towards science prior to the intervention on chemistry hands-on practical activities that integrate local knowledge?
2. How do Grade 8/9 learners' attitudes towards science shift/evolve as a result of doing chemistry hands-on practical activities that integrate local knowledge?

5.2.1 Presentation and Analysis of the Quantitative Data

Figures 5.1-5.9 illustrate the differences in frequency between the responses the learners gave to the questionnaire statements in the pre- and post-surveys. 9 out of the 35 statements were selected and presented in this chapter. The rest are in Appendix F.

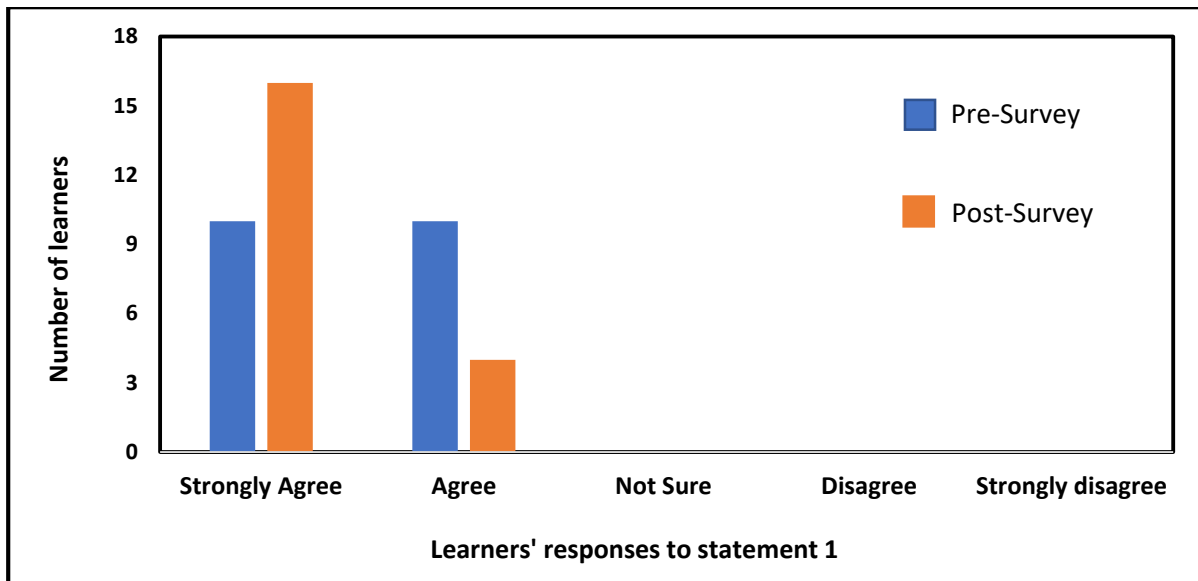


Figure 5.1: *The learners' responses to statement 1: 'Science can help make the world a better place,' before and after the intervention*

Before the intervention, 50% of the learners thought “science can help make the world a better place” and the other 50% disagreed (Figure 5.1). This means that all 20 learners had a positive attitude with regards to statement one, before intervention. After the intervention, more learners (80%) strongly agreed that science can help make the world a better place.

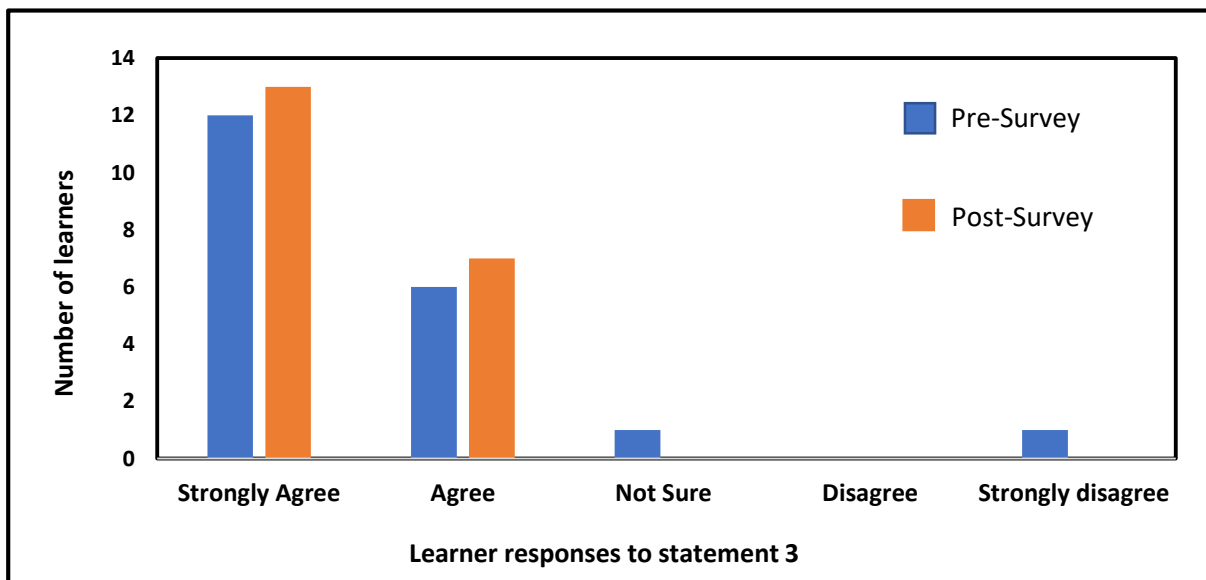


Figure 5.2: *The learners' responses to statement 3: 'I would rather find out why something happens by doing an experiment than by being told how it works,' before and after the intervention*

For the statement “I would rather find out why something happens by doing an experiment than by being told how it works,” 18 learners had a positive attitude, 1 learner was undecided, and 1 learner had a negative attitude, before the intervention (Figure 5.2). After the intervention, all learners said that they would rather find out why something happens by doing an experiment than by being told how it works.

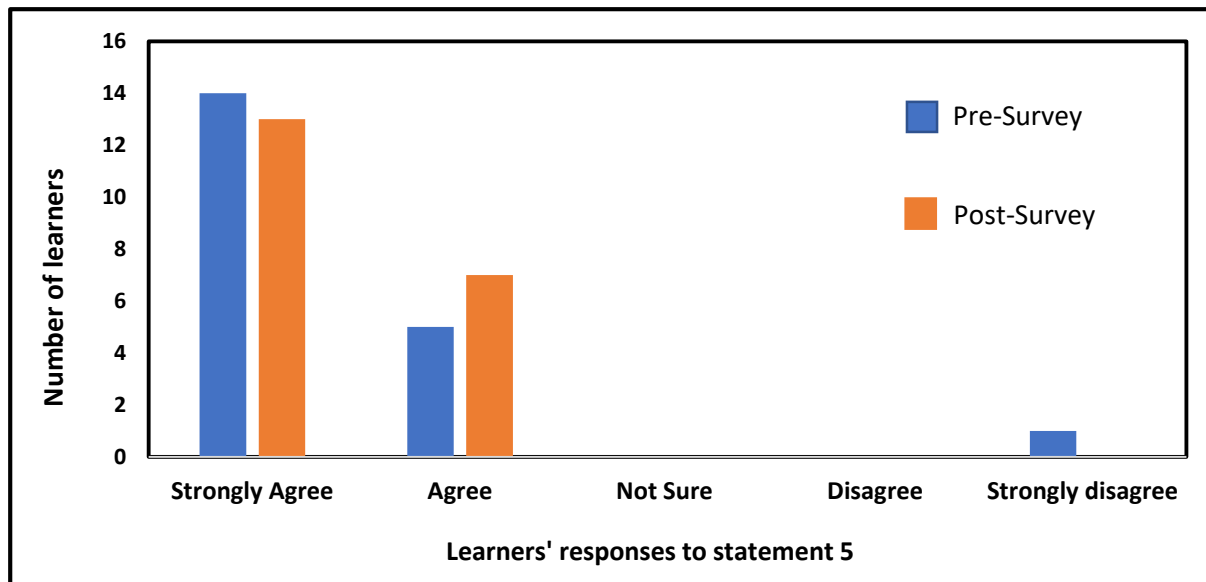


Figure 5.3: The learners' responses to statement 5: 'Science lessons are fun,' before and after the intervention

For the statement “science lessons are fun,” 14 learners strongly agreed 5 learners agreed, and 1 learner disagreed before the intervention, (Figure 5.3). This means that, out of the 20 learners, 19 learners had a positive attitude, and 1 learner had a negative attitude with regards to statement five, before the intervention. After the intervention more said that they enjoyed science activities.

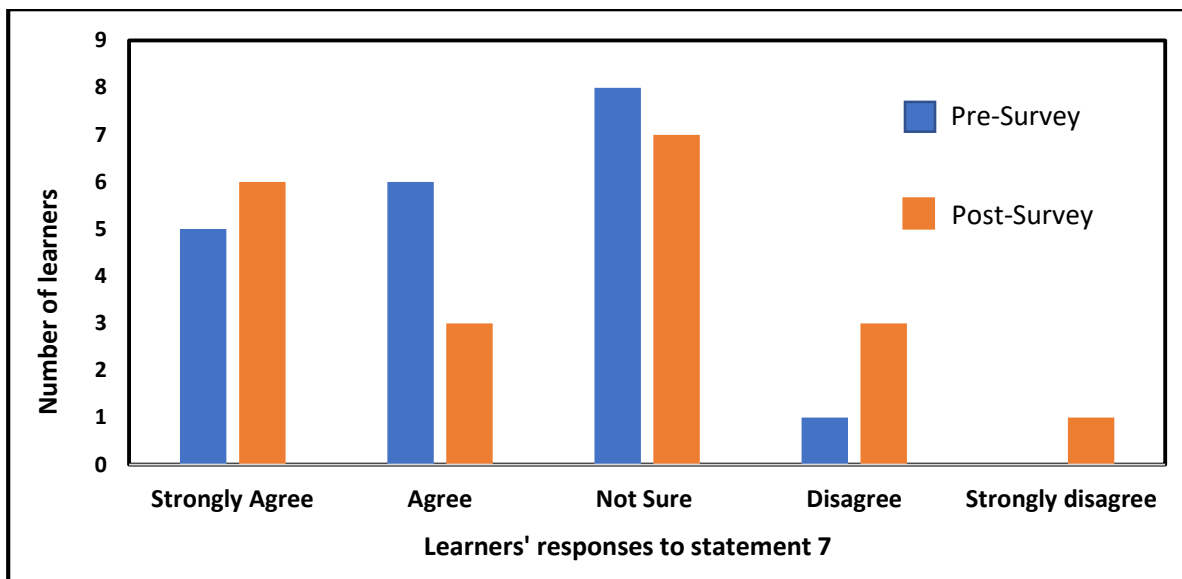


Figure 5.4: *The learners' responses to statement 7: 'I would like a job as a scientist,' before and after the intervention*

Before the intervention, 11 learners had a positive attitude with regards to the statement “I would like a job as a scientist,” 8 learners were undecided, and 1 learner had negative attitude (Figure 5.4). After the intervention, fewer learners (9) had a positive attitude with regards to the statement, compared to before the intervention.

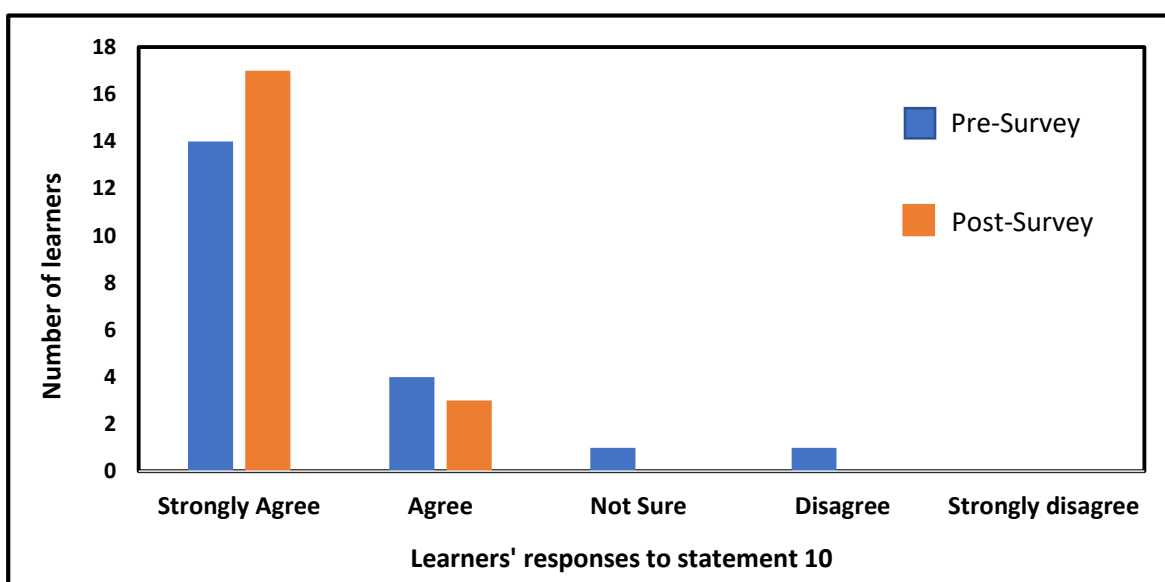


Figure 5.5: *The learners' responses to statement 10: 'Doing experiments helps me learn as much as finding out information from the teachers,' before and after the intervention*

For the statement “Doing experiments helps me learn as much as finding out information from the teachers,” 18 learners had a positive attitude, one learner was undecided, and one learner had a negative attitude with regards to statement 10 (Figure 5.5). After the intervention, there was a good shift towards a positive attitude for this statement.

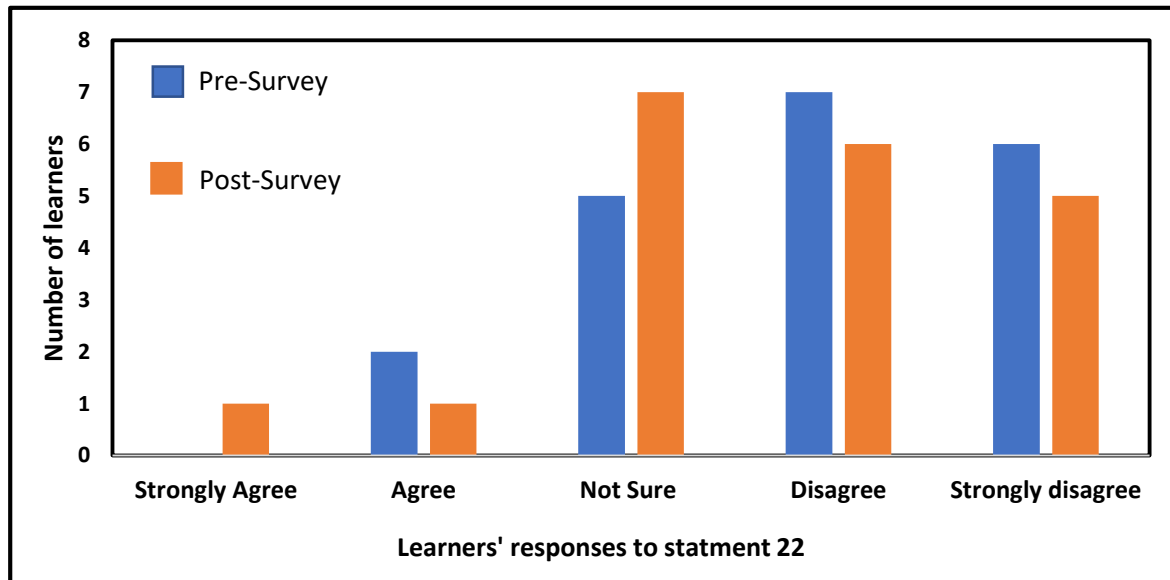


Figure 5.6: The learners' responses to statement 22: 'scientific discoveries are doing more harm than good,' before and after the intervention

Statement 22 (“scientific discoveries are doing more harm than good,”) was stated in a way that if a person agrees with the statement, she/he has a negative attitude towards science. Before the intervention, 13 learners had a positive attitude, 5 learners were undecided, and 2 learners had a negative attitude with regards to statement 22 (Figure 5.6). After the intervention, 11 learners had a positive attitude, 7 were undecided and 2 learners had a negative attitude with regards to statement 22. Results for statement 22 showed an increase in the number of learners who were not sure about whether or not science was posing harm.

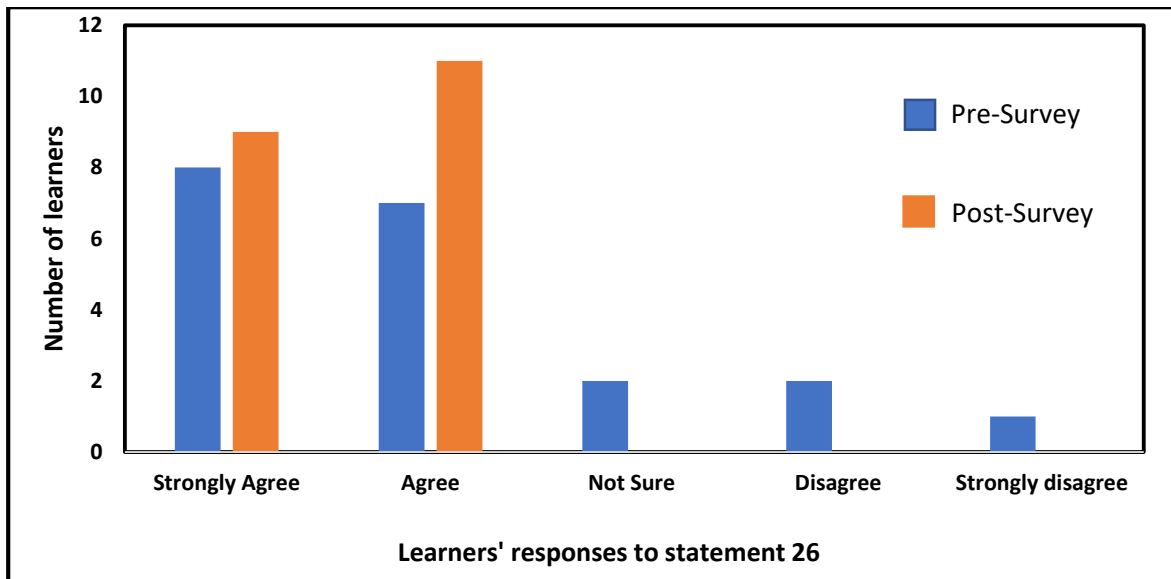


Figure 5.7: The learners' responses to statement 26: 'science lessons are useful for learning about everyday life,' before and after the intervention

Statement 26 (“science lessons are useful for learning about everyday life,”) is explicit about asking the learners’ attitudes towards science and its application to life and for learning about everyday life. Before the intervention, 15 learners had a positive attitude, 2 learners were undecided, and 3 learners had a negative attitude with regards to statement 25, before the intervention (Figure 5.7). After the intervention more learners had a positive attitude with regards to the statement, compared to before the intervention.

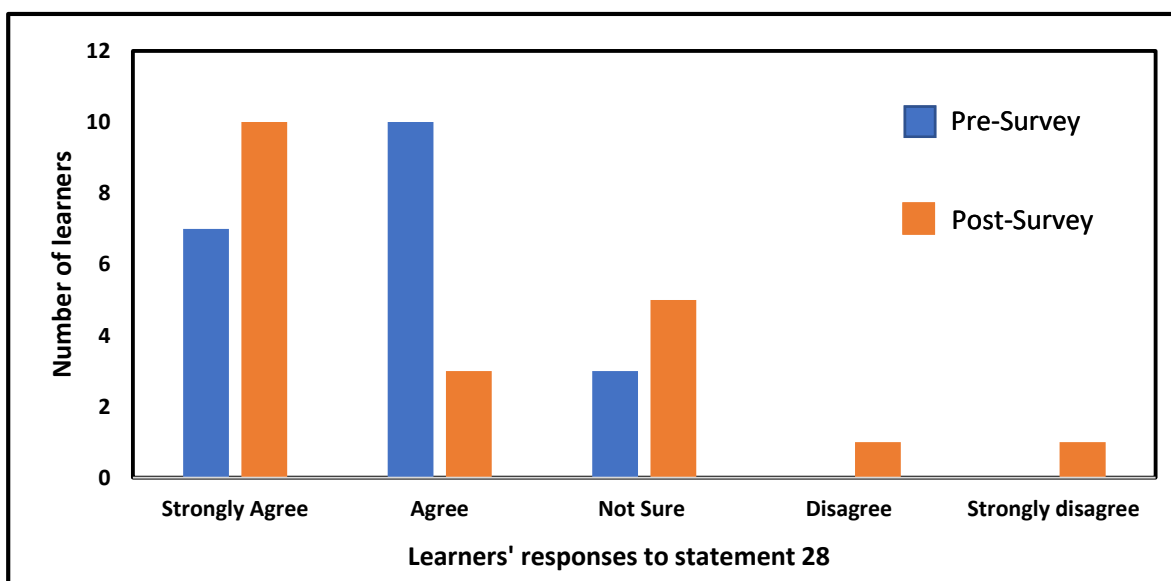


Figure 5.8: The learners' responses to statement 28: 'Working in a science laboratory would be interesting,' before and after the intervention

Before the intervention, 17 learners had a positive attitude with regards to statement 28 “Working in a science lab would be interesting,” and 3 learners were undecided (Figure 5.8). After the intervention, 13 learners had a positive attitude, 5 were undecided and 2 learners had a negative attitude with regards to the statement. After the intervention, fewer learners felt like working in a science laboratory would be interesting, compared to before the intervention.

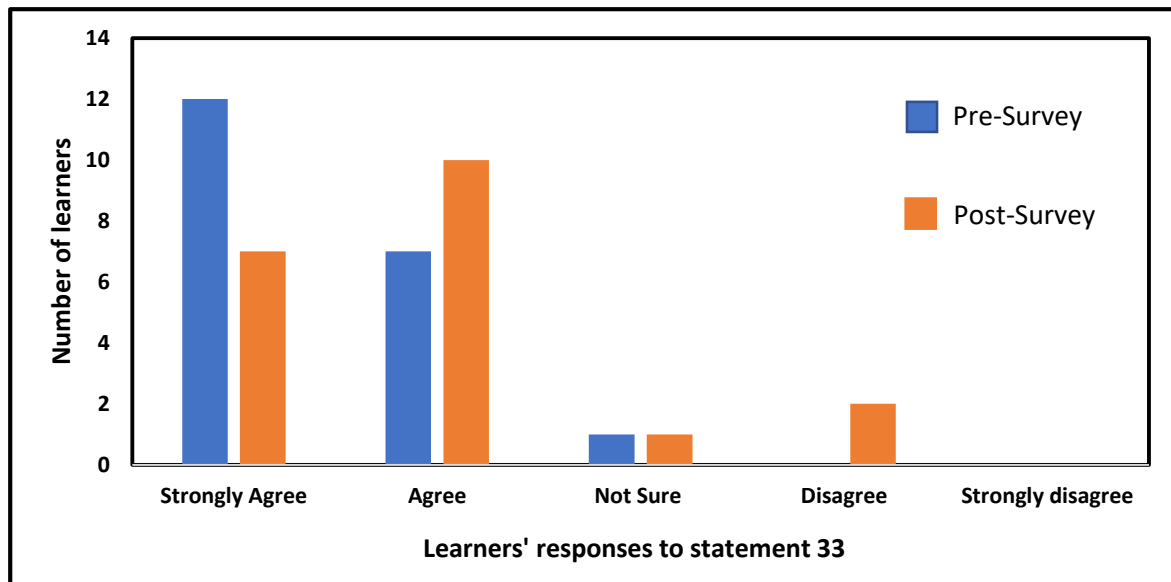


Figure 5.9: The learners' responses to statement 33: ‘science is one of the most interesting school subjects,’ before and after the intervention

Before the intervention, 19 learners had a positive attitude with regards to the statement “science is one of the most interesting school subjects,” and 1 learner was undecided (Figure 5.9). After the intervention, fewer learners felt that science was one of the most interesting school subjects, compared to before the intervention.

Figures 5.10 - 5.12 illustrate the differences in the percentage frequency of the learners’ responses to each sub-scale: perception, interest and enjoyment, in the pre- and the post-surveys. Statements 12, 22, 27, 30 and 35 were phrased in the negative and scoring for the learners’ responses was ‘5’ for strongly disagree to ‘1’ for strongly agree. The ‘strongly agree,’ ‘agree,’ ‘not sure,’ ‘disagree,’ and ‘strongly disagree,’ are measures that give the level of agreement to the statements that relate to perception, enjoyment and interest in science.

Table 5.1: The statements of the TOSRA questionnaire per sub-scale

| | |
|------------|---|
| Perception | 1, 2, 9, 15, 16, 22, 23, 25, 26, 30, 35 |
| Interest | 4,6, 7, 8, 11, 14, 17, 20, 21, 24, 28, 29, 32, 33, 34 |
| Enjoyment | 3, 5, 10, 12, 13, 18, 19, 27, 31 |

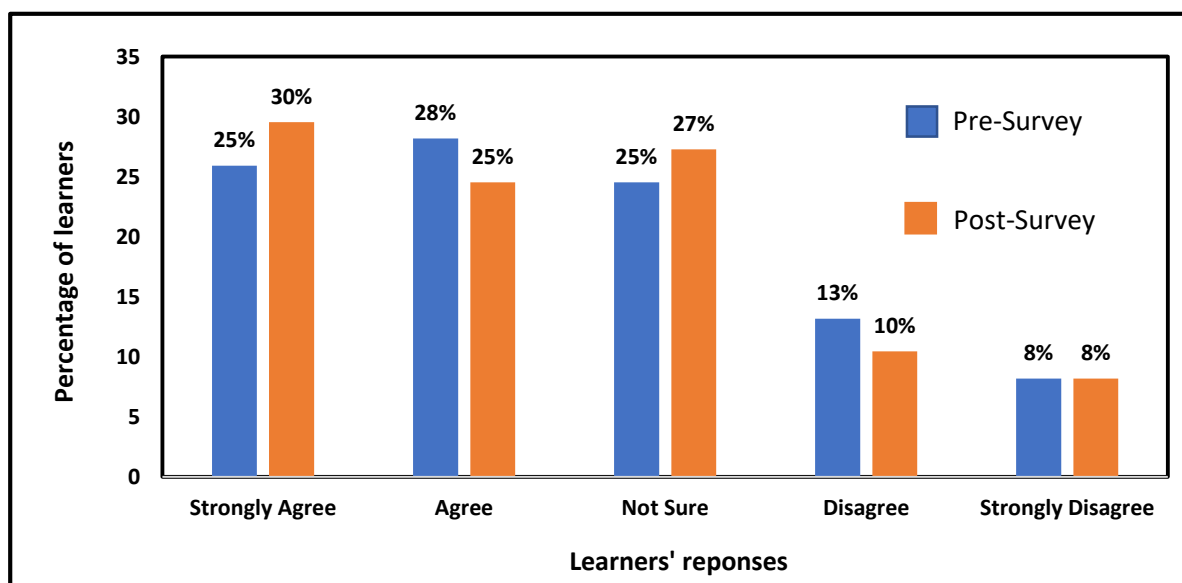


Figure 5.10: Measures that give the level of agreement to the statements that relate to the perceptions of learners towards science before and after the intervention programme

Perceptions towards science speak to the lenses that one uses to view science and its applications to real-life situations (Atallah et al., 2010). Figure 5.10 shows that most of the learners, 54%, already had a fairly positive perception of science before the intervention. This means that most of the learners at the clubs saw a correlation between science and real-life before they engaged in the intervention programme. A quarter of the learners were not really sure about science and a smaller percentage of the learners (21%) had a negative perception of science, at the start of the programme. The reason for this could be that these learners had not been exposed to an environment or activities that illustrated the link between science as an entity and its tools being used to solve real-life problems.

At the end of the intervention programme, the post-survey results showed that there was a small positive change in the perception that the learners had towards science. As illustrated in Figure 5.10, there was a 1% increase in the percentage of learners, who could relate science to their

everyday lives. There was a 2% increase in the percentage of learners who were not sure about science and a 3% decrease on the learners that had a negative perception. This means that 2% of the learners that initially had a negative attitude, were now considering the fact that, there could be a link between science as an entity and its use thereof in real-life situations, and 1% were totally convinced.

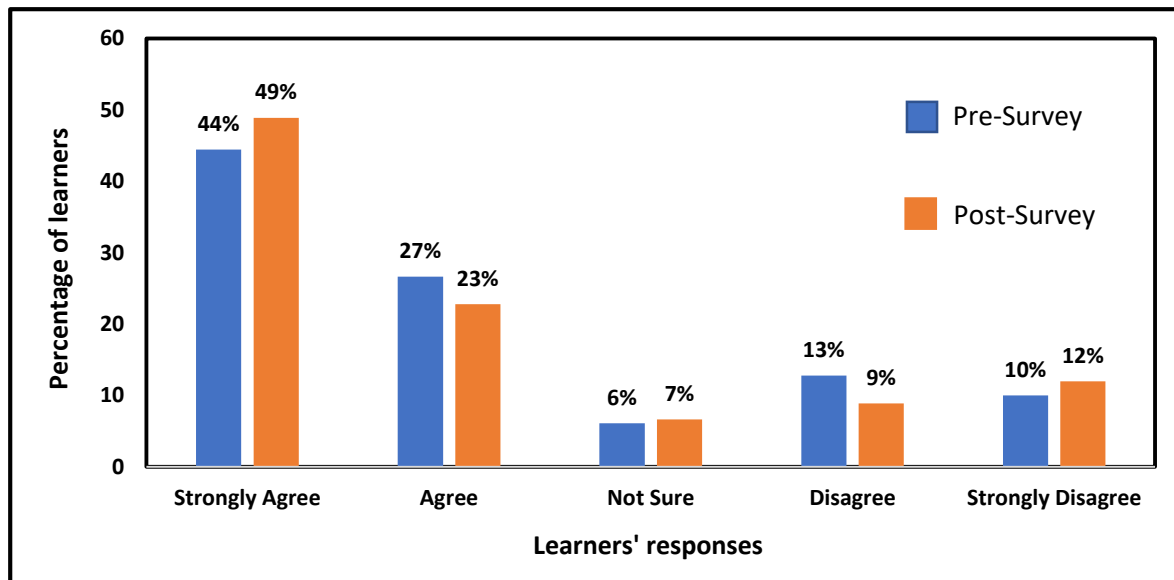


Figure 5.11: Measures that give the level of agreement to the statements that relate to the enjoyment of science activities of the learners before and after the intervention programme

Enjoyment of science speaks to the experience of pleasure and fulfilment in science activities, which translate to a positive attitude about science as an entity (Grabau & Ma, 2017). Figure 5.11 shows that 71% of the learners at the clubs already enjoyed science activities before the intervention programme started. This could be because the activities/teaching methods that their teachers used at their schools were stimulating and interesting. A small percentage of the learners (6%) were not sure about enjoying science activities and almost a quarter of the learners (23%) did not enjoy any science activities. This usually happens when the activities are not interactive or experimental but based on just reading the textbook.

The analysis of the post-survey results shows a small change in the enjoyment of science sub-scale when compared to the pre-survey results. As shown in Figure 5.11, most learners still enjoyed science activities, with an increase of 1% on the positive. There was a 2% increase with learners that were not sure about whether or not they found science activities fun and exciting and a 2% decline in the number of learners that did not enjoy science activities at all.

This means that, at the end of the intervention programme, 2% of the learners moved from not enjoying science to having mixed feelings about it and finding it exciting, respectively.

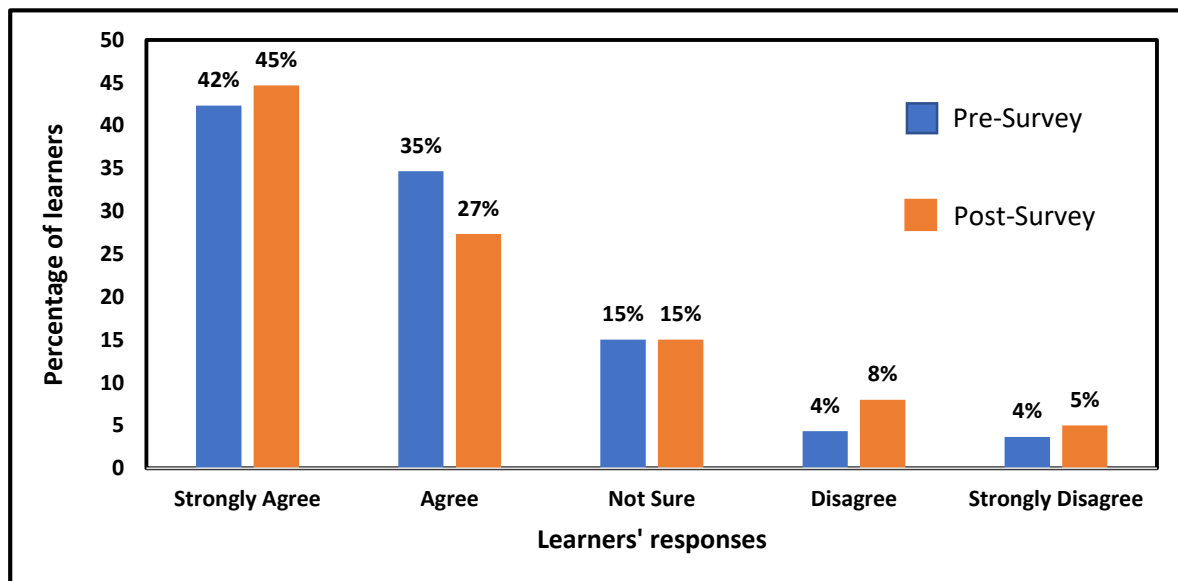


Figure 5.12: Measures that give the level of agreement to the statements that relate to the interest in science of the learners before and after the intervention programme

Interest in science is a measure of wanting to know more about science, which translates to the tendency to engage in science activities (Ormerod & Duckworth, 1975). 77% of the learners at the club (Figure 5.12) were interested in science before the intervention programme started. This means that most learners that joined the club were learners that were already interested and curious about science as an entity and science learning. However, 15% of the learners were not sure about their feeling towards science and 8% of the learners were not interested in science or science activities at all, possibly because they had not yet been exposed to science activities outside the classroom/school programme yet.

At the end of the intervention programme, the analysis of the post-survey results showed a slight change in the interest of the learners in science when compared to the pre-test results. The results as shown in Figure 5.12 indicate that the percentage of learners interested in science decreased from 77% to 72%. This means that, after the programme, some of the learners lost their interest in science and science activities. There was no change in the percentage of learners who were unsure about their feeling with regards to science and science activities. There was an increase in the percentage of learners who were not interested in science, which means that, after the programme, some of the learners had lost interest in science

Figure 5.13 below illustrates the change in overall attitude towards science between the pre- and the post-surveys. Similarly to Agunbiade’s (2015) study, the learners’ responses were split into three different categories: low attitude, average attitude and high attitude, based on their pre- and post-survey scores. This shows the changes in the overall attitude before and after the intervention. The survey responses were scored using the Likert scale: strongly agree = 5, agree = 4, not sure = 3, disagree = 2 and strongly disagree = 1 for the positive statements. The negative statements were scored in descending order from strongly disagree = 5. The minimum score of the TOSRA is 35 and the maximum is 175. The scores of the learners ranged between 115 and 172. The categories were scored as follows:

- the category for low attitude: 115-134;
- the average attitude category: 135-153; and
- the high attitude category 154-172.

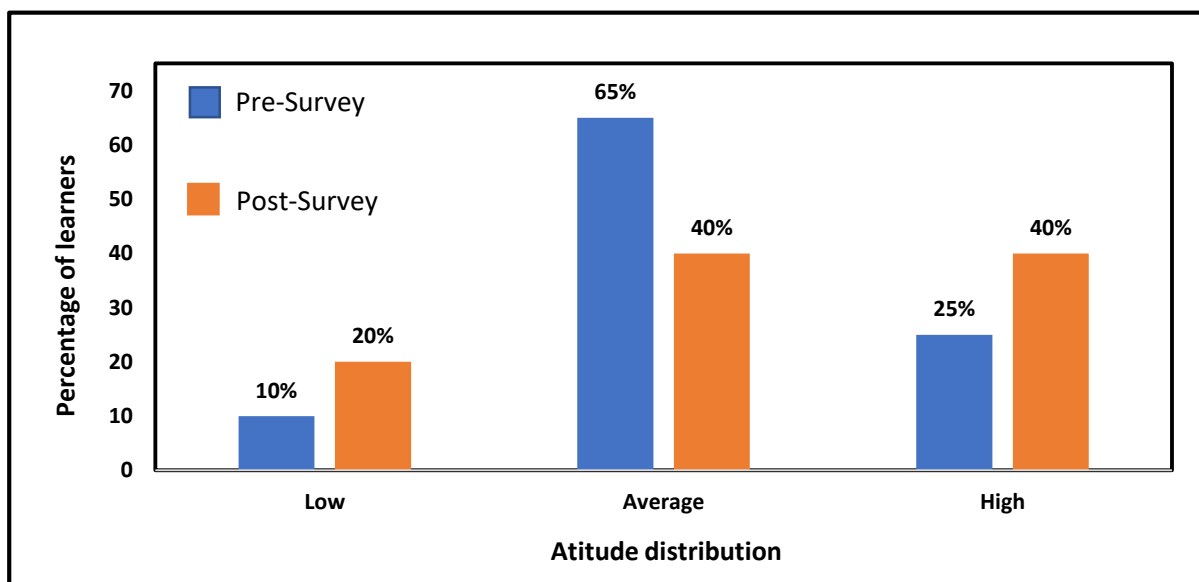


Figure 5.13: The distribution of the learners’ overall attitude before and after the intervention programme

Before the intervention, 10% of the learners were in the low attitude range, 65% were in the average and 25% were in the high attitude range. After the intervention, 20% of the learners were in the low attitude range, 40% were in the average and 40% in the high attitude. There was a decrease in the overall attitude of the learners after the intervention.

Table 5.2: The *p*-values of the attitudes of the learners

| Paired samples <i>t</i>-test Results | | | | |
|---|-------------------|-----------------|------------------|-------------------------|
| <i>n</i>=20 | Perception | Interest | Enjoyment | Overall Attitude |
| Pre-test mean | 3.97 | 4.25 | 4.38 | 4.20 |
| Post-test mean | 4.01 | 4.20 | 4.44 | 4.21 |
| Difference | 0.04 | - 0.05 | 0.06 | 0.01 |
| <i>p</i>-value | 0.297 | 0.179 | 0.0933 | 0.399 |

The paired sample *t*-test (one-tailed) was done on the pre- and post-test surveys of the 20 participants, for the perception, enjoyment, interest and the overall attitude data. The results of this analysis are recorded in Table 5.2. The table shows an increase in the mean perception of science, the mean enjoyment of science activities and the overall attitude to science, but a decrease in the mean interest in science. From the *p*-values, it can be seen that none of these changes are statistically significant.

5.3 QUALITATIVE DATA

The learners and volunteers were interviewed, and the interviews tape-recorded. The learners spoke on their experiences, both at the club and at their different schools. The volunteers spoke on the experiences they had at school and their observations at the science clubs.

All the learners' and volunteers' interviews were transcribed and collated. An inductive-deductive approach was used to analyse the data. All data were coded and grouped into sub-themes and then sub-themes with similarities were grouped into themes.

5.3.1 Interviews with learners

Eight learners were interviewed, and the table below shows themes identified from the learner interviews together with the relevant supporting literature. These themes are relevant to research question 3:

How does the intervention of chemistry hands-on practical activities that integrate local knowledge influence the attitudes that Grade 8/9 learners have towards science?

Table 5.3: *The themes that emerged from the learners' interviews together with relevant literature*

| THEMES | LITERATURE |
|---|---|
| Theme 1: Confidence in Natural sciences | |
| <ul style="list-style-type: none"> • Get better marks • Remembering school work • Understanding school work | Kibirige and Hodi (2013); Kibirige & Van Rooyen (2006); Ogunniyi & Ogawa (2008); Osborne et al. (2003); |
| Theme 2: Learning with understanding | |
| <ul style="list-style-type: none"> • Building up knowledge • Connecting concepts to everyday life • Understanding the world around us | Kibiridge & Van Rooyen (2006); Mavuru & Ramnarain (2017); Sedlacek & Sedova (2017); Simasiku, Ngcoza & Mandikonza (2017). |
| Theme 3: Development of the attitude sub-constructs | |
| <ul style="list-style-type: none"> • Enjoying science activities • Interest to pursue science careers • Positive perception of science | Hofstein & Mamlok-Naaman (2011); Kibiridge & Van Rooyen (2006); Krapp & Prenzel (2011); Ogunniyi & Ogawa (2008); |

Each of these themes is discussed below.

Theme 1: Confidence in Natural Sciences

The learners who came to the science clubs indicated that they needed help with Natural Sciences at school. After the intervention, most of the learners expressed that they had received the help they needed with their studies. As a result, they were now able to understand some important aspects of their work, which they had found hard to understand before. Additionally, because they attended the club they were to understand their schoolwork better as they got clarity on things that they did not understand in class. For instance, when they did experiments, they got better marks for Natural Sciences. The following quotes are examples of what the learners had to say about the help that they got from the club:

“...Uhm, I, the chemicals first, I can remember the chemicals and, in the table, I... iElements, I can remember them from 1-20.” (L7)

“Indincedisa kwizinto, mhlambi endingazivayo eclassini ndiziunderstande kwiscience club.” (L3) Translation: It helps me with things I don't understand in class. I get to understand them in the science club.

“It helps me, let's just start there, it helped me a lot, especially last term, I mean my marks improved drastically, in maths I got a level 7 and in science, I also got a level 7.” (L8)

These excerpts are in agreement with Kibirige and Hodi (2013) whose study found that doing experiments helps learners see and understand the concept they are studying better. Furthermore, Kibirige and Van Rooyen (2006) posit that the integration of local knowledge makes the teaching and learning of science easier because learners build on the knowledge that they already have. This is to say that, engaging in practical activities that have local knowledge integrated into them, helps the learners make connections and build a deeper conceptual understanding of science.

The learners felt that their involvement in the practical activities played a role in their understanding better in class, and therefore performing better in Natural Sciences. When the learners understand more, their performance improves, and they gain confidence and the motivation to do more, so they can do even better. For example, one of the learners said:

“At the beginning of the year, I didn’t do so well in Natural Sciences, I got level 4. My teacher told me to join the club, I did and I began to understand my work better, worked more and studied more. I got level 6 and I am now aiming for level 7. (L1)

Generally, a positive attitude towards science promotes working harder and therefore an improvement in performance (Osborne et al., 2003). According to these results, the opposite of that is also possible. When learners perform well in science subjects, motivation to do more is developed. Motivation to do more science is one of the sub-constructs of positive science attitudes (Osborne et al., 2003). This means that, as depicted by the findings of the study, an improvement in performance promotes a positive attitude towards science.

Theme 2: Learning with understanding

The experiments that the learners did, were designed to help them see that science is relatable to their lives and can be applied in real-life situations. Most of the learners felt that they learnt a lot from the experiments. The knowledge they created for themselves was based on the work they did at school, but not only that, they also got to learn new things about the substances they use at home in relation to science. Additionally, the learners expressed that they could now relate the work that they did at school to their everyday lives, and they could apply that knowledge in activities they did at home.

“Ngoba mna khange ndiyazi uba xa uAdd(a) ivenegar kwisteeel wool, like ukubone xa usebenzisa isteel wool kwimbiza ne usbeka pha, sizajika sibengathi siba goldish. Then, khange ndiyazi uba xa ugalela ivinegar kwisteeel wool sizawjika. Ongakhange uqale ushlabbe embizeni.” Translation: I didn’t know vinegar and bleach can result in steel wool rusting, I thought that only happened after you’ve used it to wash pots. (L5)

“Actually, iyawavula amehlo, mhmh... And for mna, I’ve learnt a lot kwiscience, for an example, namhlanje...” Translation: Actually, it opens your eyes and I have learnt a lot in science, for example, what we did today. (L6)

“Iye yandiinceda kakulu kuba ndizazi iAcids neBases, because ekuqaleni bendingayazi, then we had to use ifood elements from endlini, so its easy to separate, to have iacids on the side and to test nebases on the other side.” Translation: They helped a lot because I know acids and bases because at the beginning I didn’t know them, then we

used food elements from home, so it's easy to separate acids and bases and to test them.
(L7)

These excerpts show that the learners were able to relate some of the things they learnt at the club when doing experiments using readily accessible materials, with the activities they do at home, and also increase some knowledge they have about the science. Hofstein and Mamlok-Naaman (2011) assert that when learners are able to see the relationship between their everyday lives and science, they are most likely to develop a positive attitude towards science. Thus, these learners have begun to see science as relevant and useful and that is an indication of a positive attitude towards science.

Theme 3: Development of the attitude sub-constructs

There were three sub-constructs of attitudes that the study was looking at enjoyment of science activities, interest in science and perception of science as an entity. After the intervention, the learners gave positive accounts in relation to these three sub-constructs. A number of learners said that they enjoyed the experiments integrated with local knowledge. The following excerpts are examples of how learners felt about the experiments:

"...To me science is fun ..." (L1)

"Hayi, bendizienjoy(a)." Translation: I enjoyed them... (L4)

"...and I also got shocked and excited when I saw colours change in the experiment..."
(L7)

From these excerpts, it could be inferred that the learners enjoyed the experiments that they did with easily accessible materials. Fraser (1981) introduced enjoyment of science activities as one of the subscales of attitudes towards science. When learners enjoyed science activities, their attitudes towards learning science and science as an entity would be positive. The learners at the science clubs had a positive attitude, which is supported by how much they enjoyed the experiments that incorporated local knowledge.

These learners did not only speak about enjoying the science activities in this study. They also spoke about perception. Perception of science is one of the sub-scales Fraser (1981) used to describe attitudes. A positive view of science speaks to a positive attitude towards science.

Learners who see how important science is in society, and how they are a part of it, are more likely to want to do science in their lives.

When asked about how they see science, the learners showed a positive perception of science. Perception of science has to do with how learners see science in relation to the world around them (Atallah et al, 2010). The following excerpts represent what the learners thought about science after the intervention:

“...its great to learn new things and have a better understanding of what happens around us...Oh, iyakwazi udibana because, izinto ezenzeka eee...around us ziyiscience and iresearch ihelp(a) us uba siUnderstand(e) the world around us so iscience iyasinceda kwiresearch.” Translation: It is relatable to real life because, it is about what happens around us and research helps us to understand the world around us. (L1)

“I see it as a new way to explore things.” (L4)

“Science isn’t just life science or physical science but also social science... It’s great, it’s nice, it’s transforming...” (L8)

These excerpts illustrate that the learners were able to view science in a positive light. They see it as a way to learn more about the world around us, to learn new things. This suggests that doing experiments with everyday materials helps learners see the usefulness of science, and how science relates to their everyday life and to the world as a whole.

Most of the learners joined the club because they were already interested in science and a career in the sciences, in future, but some expressed that after the intervention, they would consider a career in the sciences. Below are examples of what one of the learners had to say about a career in science, after the intervention:

“I could consider it...” (L5)

“I see it a subject that I love and would do even in future among other subjects.” (L4)

“Yes, I would like to be a scientist yeah. Yah, ndiyafuna uba yiscientist.” Translation: Yes, I would like to be a scientist yeah. Yah, I really want to be a scientist. (L1)

The aim of this study was to influence a positive attitude in the learners, so they would want to pursue science in high school and science careers after completion of grade 12. The third sub-

construct of attitude is interest (Fraser, 1981). An interest in a career in science is an indication of a positive attitude towards science (Krapp & Prenzel, 2011). Some felt, after the intervention, that they could consider a career in the sciences, even though initially they did not consider science-based careers. Most of the learners in the clubs had an interest in medicine and astronomy, which are careers in the sciences. Based on this interest in science careers, we can say a positive attitude has been developed in the learners.

5.3.2 Additional findings

The theories that informed the study were Vygotsky's (1978) theory of social constructivism and Wenger's (1998) theory of community of practice. Central to both these theories is learning and knowledge construction attached to social interactions. In the interviews, most of the learners expressed that, the activities in the club helped them to understand their schoolwork and in learning new things in science and the world around them. This means that, at the end of the intervention programme, the core of the two theories employed, in the study, learning, was achieved. The following excerpts are examples of what some of the learners said about learning and understanding at the club:

"Yes. I understand better at school when I come here. I don't really understand the formulas, but when we get here and do things like that, I begin to see them and understand." (L5)

"At the science club for an example, we learnt about things that we hadn't done in class yet, so the volunteers taught us. So, by the time we learnt about them in class, I now knew everything I needed to know about them." (L1)

These excerpts illustrate that learners understood better and learnt new things from their engagement in the science clubs. Understanding and learning influences attitude. Increased understanding motivates learners to do more. Motivation is a sub-construct of attitude (Osborne et al., 2003). This means that, when learners are motivated to do more, they have a positive attitude towards science.

The assumption at the beginning of the study was that the learners would find the practical activities integrated with local knowledge relatable and interesting and, therefore, develop a positive attitude towards science as an entity. Indeed, from the interviews, the learners could relate to the practical activities, however, they did not find the activities interesting. Additionally, the learners agreed that the practical activities helped them with their understanding of their schoolwork and therefore their performance in Natural Sciences.,

However, learners expressed the opinion that despite doing science using everyday materials, they would still like to go to the laboratory and do the conventional experiments using the materials and equipment with which they are not familiar. For example, this is what some of the learners said when asked, which experiments they preferred between using easily accessible materials and using chemicals in a laboratory:

“Into zaselab to learn new things nento zasemakhaya to understand uba kwenzeka ntoni but into zaselab ukwazi uzazi izinto ezintsha like iexperiments zawudibanise le nale kuzokwenzeka ntoni kwireactions.” Translation: I prefer lab stuff to learn new things, but with things that I know also for understanding but I prefer lab stuff to learn new things and do new experiments, like knowing the products of some reactions. (L1)

“Hayi, zoyi2. Because apha senza ezi zipha kum ekhaya, ndyayazi uba if ndyamix(a) into ethile nethile, ingenza into enje and iyandenza uba ndibe aware uba into ezithile azidibani.” Translation: Both. Because here, we are working with things that I have at home, so I am aware of what would happen if I mixed some things together. (L4)

“Ndiyabawela, ziyandinceza ezi ndiziqhelileyo, ndiske ndibawele nam ukuya elab, then ndiyojonga ezi ndingaziqhelanga so ndikwazi uyazi kengoku uba lena idibana njani, ewe.” Translation: “...the things I am used to help but I would love to go to the lab too and look at the stuff I am not used to and be able to know how these things relate to each other.” (L7)

It could be deduced from the excerpts that learners do not necessarily want to engage in local knowledge integrated experiments and discard the other conventional science experiments. Instead, both laboratory-based experiments and kitchen chemistry can be used to improve the understanding of schoolwork and to motivate learners to do science beyond school. We can also see that the learners’ interest in doing more science, even beyond school, is attached to them learning new things, which they equate to moving out their normal space, learning using things that they are not used to.

Learners related science to working in a laboratory and mixing chemicals to develop new ideas. The idea of being in a laboratory, dressed up as a scientist in lab coats with goggles and doing ‘explosive’ experiments is what they feel is science, or what it means to be a scientist. This view, even with the use of experiments with easily accessible materials, did not change. Learners still find being in the laboratory more fascinating and exciting, and the greatest motivation to do or pursue science careers. However, learners do not want to exclude local knowledge. Instead, they would prefer if it was used together with the ‘conventional laboratory-based science’.

Attitude towards science is a broad concept and is attached to sub-constructs like enjoyment, interest, perception and motivation. When any one of these sub-constructs is affected, the attitude is affected. The learners enjoy experiments in the laboratory more and engaging in such experiments influences an interest in science. Engaging in local knowledge integrated experiments enhances their understanding and develops their perception of science. All these together affect the learners' attitudes, and so a positive attitude can be achieved by engagement in both conventional and local knowledge practicals.

5.3.3 Interviews with the volunteers

Table 5.4 below shows the themes, with the relevant supporting literature from the interviews with the volunteers. Three volunteers were interviewed and themes attempt to answer research question 4, from the volunteers' perspective:

4. From the volunteers' perspectives, what factors affect Grade 8/9 learners' attitudes towards science?

Table 5.4: *The themes that emerged from the volunteers' interviews with relevant literature*

| THEMES | LITERATURE |
|---|---|
| Theme 1: Practical engagement | |
| <ul style="list-style-type: none"> • Experiments • Science clubs | Abrahams & Millar (2008); Dillon (2008); Hartley (2014); Twillman (2006). |
| Theme 2: External influence | |
| <ul style="list-style-type: none"> • Guidance and support • Volunteer/Teacher enthusiasm • Delivery of information | Agunbiade et al (2015); Frenzel, Goetz, Lüdtke, Pekrun, & Sutton (2009); Keller, Neuman & Fischer (2013); Turner & Ireson (2010). |
| Theme 3: Use of familiar content | |
| <ul style="list-style-type: none"> • Prior knowledge • Link to everyday life | Agunbiade et al (2015); Kibirige & Van Rooyen (2006); Kuhlane (2011). |

Each of the themes is discussed below.

Theme 1: Practical engagement

The volunteers expressed that they had not always felt positive about science and pursuing science careers. They claimed that doing activities that are “outside” of the normal classroom setting helped them in developing their attitudes towards science. They spoke from their experiences and what they wished could have been done when they were still at school and could be done now with the learners who are still at school. The following excerpts are examples of what the volunteers had to say about being in science clubs:

“...Science clubs, we get there, do experiments and they get wowed thinking oh, this is this and that and especially experiments that are so small and simple, where you mix this and that and they get all energetic about it. So, it put that spark again of like science rather killing it by just sitting in the desk the whole day at 2 ring the bell, leave, come back and submit an assignment.” (V1)

“...I feel like in a lot of schools, they don't really get that much exploration, like doing science for fun, it's always a lot of science for tests, for the exam. It's never science of, oh yeah, I just wanna find out if this flower has this compound you know, it's never really like, the science club gives you that curiosity, you are more aware of a lot of things that you wouldn't have been in class... but I believe in more of letting them [learners] explore on their own. Like, give them the knowledge that they have and then let them use that, apply it to something else that they have passion in, or something that they like because I know, my, my, my love for chemistry really developed from that, applying the things that I liked.” (V2)

The volunteers claimed that doing science outside the normal classroom setting helps you learn, explore other things and it just brings about excitement and curiosity to do more. This is similar to what Hartley (2014) and Twillman (2006) found, that after being involved in a science club, more learners had a positive attitude and wanted to do more science.

It seems that being outside the formal school classroom, the volunteers felt that it was important to consider the activities in which learners engaged. Examples of what the volunteers had to say:

“...got more into practicals, like more engaged because I am more engaged, I have to do more practicals on it, that's when I started to actually enjoy this thing, when I do more practicals, but back then I really wanted to go into entrepreneurship and business, but then when I got here, I started to develop the love for science.” (V1)

Volunteers said that engaging in practical activities, or experiments was a reason for the development of their attitudes towards science. They claimed that experiments are “fun” and

helped them to enjoy learning science. When excited about something, a person would like to do more of it, because of how it makes you feel. These volunteers enjoyed science experiments so much that they now have a positive view of science and are pursuing science careers. These agree with Abraham and Millar's (2008), who posit that, experiments promote enjoyment of science which ultimately translate to a positive attitude on science learning and science as an entity.

These volunteers stated that it is important to keep learners captivated and motivated in class. This suggests that learners' age, activity and attention span should be taken into consideration when science is taught. Learners cannot listen for a long time, they are really energetic and would rather get out and move around, or just do something with their hands. One volunteer speaking from his experience in facilitating science club activities said that:

"...kids at a young age are actually more into touching, than sitting and listening to you. They are more energetic and having them to go out there and giving them use small microscopes to actually go around and look for small stuff, mix chemicals, small chemicals, builds in them the excitement of chemistry or the excitement of science."
(V1)

Experiments give learners an experience, and experiences linger more than information crammed or read in textbooks. The excitement embedded in the experiences also motivates learners to do more. Furthermore, the volunteers felt that experiments create curiosity in learners. Once they see something exciting happen, they just want to see more, which means, they are now interested in investing their time in this, trying to find out what more could happen. The more they are kept captivated, the more they want to do science.

"...I really liked, I really liked the reactions that we did. They were so fun, uhm... Actually, it was a very simple reaction of metals reacting with water, where I think we put sodium on the water and that thing just blew there, I was so fascinated, I was like 'you can do this,' I was so excited, I was like, what more can you do – you know..."
(V2)

If we can take advantage of that curiosity, we can then have people who are curious about the world and want to understand how it works.

Theme 2: External influence

The volunteers expressed that teachers and volunteers, or any of the people involved in the science learning process, play a role in the kind of attitude learners have towards science. They

suggested that the interactions we have with people on any subject result in our building associations. The problem though is that the associations we build are never really about the people, but about the subject. These associations determine how we view the specific subject, how we learn in that setting and generally how we feel about the subject - science being the subject in this study.

This corresponds with the two theories underlying the study, Wenger's (1998) theory of CoP and Vygotsky's (1978) theory of social constructivism. Both these theories speak to learning as a function of social context and interactions. The interactions with peers, who are at the same level, would be other learners in this study. The following quotes are what the volunteers said about the role teachers play in the development of learners' attitudes towards science:

"...and I would describe mine as negative and it's because the teachers went about it in a way that was either incredibly strict or, I think there was just some part of them that was, probably mean people, mean spirited people, but then I associated the subject with them instead of the course content and that is a big problem." (V3)

"...I think science clubs actually improve the attitudes of learners towards science because... when they actually gonna get students who are fresh, who are almost the same age as them... So, you are getting relevant people who just did what you are doing now, so they have more understanding of the times compared to the ones who have been doing this for so long." (V1)

It turns out that the attitude of the teacher when dealing with learners, plays a role in the attitude learners have towards science. The volunteers feel that the characteristics of the teacher/facilitator and the teaching methods used determine whether the learners will be willing to listen or not, and even how much information the learners can actually take in. Additionally, it is easier to listen to and relate to someone who is close to you in age because they understand the way that you think and can explain concepts in a way that you understand. Additionally, they can make science, exciting by relating it to what the learners consider fascinating at the time.

"...So, you are getting relevant people who just did what you are doing now, so they have more understanding of the times compared to the ones who have been doing this for so long." (V1)

The volunteers also commented on the support and guidance given by teachers and facilitators of science as of utmost importance when it comes to development of attitude in learners. There are a lot of social issues involved in learning, as discussed by Vygotsky (1978), which hinder

or help the learning process of learners. The volunteers said that, sometimes, learners encounter that one person who can make them see their potential and push them in the right direction. This motivates the learners to do better in science. This is in agreement with Turner and Ireson (2010) who claim that, when a teacher is supportive, the learners become interested. One volunteer said that,

“...she believed that I could do science because that’s what I was drawn to... I started to enjoy chemistry towards the end of the year... The way she handled it was so much better.” (V3)

There is also the perception that science is difficult. This is a problem because no one wants to continue doing something he/she feels is beyond his/her capabilities, so learners might be discouraged about pursuing careers in science. The volunteers suggested that learners need teachers who will guide them in their learning and ultimately help them see that doing science is possible. Hopefully, when learners feel positive about their ability in doing science, they will be motivated to do more. The following quote is an example of how the volunteers feel:

“...if somebody can be there to just open up that window so that you can see things, it’s not that these things are hard, it’s not that these things are undoable, it’s just that we need guidance on what to do, yeah.” (V2)

The way that teachers deliver science to learners, influences how they perceive and ultimately feel about the subject. When a teacher, or volunteer, in the case of the science club, is excited and enthusiastic about what they are teaching, the learners also become enthusiastic about science. Keller, Nerman and Fischer (2013) posit that the interest and motivation in a teacher, when teaching, is transferred to the learners. This is supported by what the volunteers say about the enthusiasm of teachers and the attitudes of learners. An example from a volunteer is:

“I think the involvement of science clubs can actually help their attitude more than a lot if you have volunteers that are actually enthusiastic themselves about science ...and when you get there as a volunteer,...you putting that exciting of, ‘ when I get into university, I will study this, I will know this and know this,’ so as a volunteer you are still fresh and you are still exposed to a lot of new scientific stuff that has been discovered and so you give them that inspiration of, ‘I want to do this, I want to do this...’ (V1)

Theme 3: Use of familiar content

According to the volunteers, seeing how science relates to your everyday life is important in developing a positive attitude towards it. They say that science tends to be very abstract, and it becomes difficult to associate with something you cannot see yourself using in your life. So,

in order to understand better, and even begin to identify as scientists, it needs to be taught using examples that we can be able to relate to. Examples of quotes from the volunteers:

“...I ended having a better grasp on some of the concepts...because what she would do, ...she would basically introduce us to a topic and then she base it to everyday life which definitely helped me because it no longer became an abstract thing you know, uhm, I could now see it in action every day, which I really, really liked, and that’s how it helped me learn about chemistry because, you know when you think about chemistry and science, sometimes it can be a bit separate from your life, it’s something that’s over there right, but she integrated it into every day...she would give us an example and one of the ones that always sticks with me is when she explains a glass of water with ice in it, you know energy going in and out of a system.” (V3)

“...more positive impact if the science clubs do these experiments which are IK [Indigenous Knowledge] because I will first introduce IK in schools and actually bring more excitement..., as much as it is experiments, it is useless if I still do not understand the experiment I am doing so it’s better if I am doing the experiment and I understand the experiment itself so that I can link it with the theory I got in class.” (V1)

“...Science is something that happens over there at the university in a special lab and your experiments were like, oh, I use this stuff at home, I drink this stuff, I eat this stuff, and this is actually what it’s doing. Science is so much closer to them, it’s easier to work with and by doing that it breaks down that fear of science because you now are comfortable with it because its something that you work with every day, in a smaller way its not something special that scientists do, we actually working with it on a smaller scale and its not that bad and that’s what’s really nice about it.” (V3)

We can deduce from these excerpts that the volunteers felt that understanding is an integral part of our learning. They claim it is easier to understand something that you can see in your everyday life. They remarked that doing experiments that are integrated into local knowledge, helps them become comfortable in learning science, and even how they can apply the knowledge in their everyday life. This changes their view of “science is difficult” and introduces a new perspective that science can be done by everyone. This promotes even more engagement because the learners are building upon knowledge that they already have. Other scholars such as Agunbiade et al., (2017) and Kuhlane (2011) agree that linking schoolwork to everyday life helps learners with understanding and understanding promotes engagement as the learners begin to see how science can be used in real-life situations.

When learners feel that they can do science, because of how relatable it is to their everyday life, it gives them confidence to question everything else around them. The volunteers suggested that, when we begin to look at everything around us as being scientific, we start to

perceive life around us as some kind of ‘chemical reaction’, this helps us use the information that we have, to question life around us, or even try to explain what is happening. The volunteers also said that increased curiosity to do more science would generate more knowledge about everything that happens around us. One volunteer had this to say:

“...they can even get home and start explaining and sharing their science, like explaining what vinegar is and what it can be used for, so it actually pumps them into getting into this science mood and I feel like it will open their mind and help them discover and explain stuff that we didn’t know and processes happening to them because they will start looking at everything as a process or everything as a chemical reaction so then new stuff are discovered because everything they see is just scientific to them so that thing will open them up to discovering things that we don’t know now. So, I think it will actually help them a lot, it will help them relate more with the experiments happening because they can see things that they see every day and then also open more curiosity on them to seeing everything scientific and trying to explain everything.” (V1)

CHAPTER SIX: SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

The aim of the study was to ascertain the Grade 8 and 9 learners' attitudes towards science when local knowledge has been integrated into their hands-on chemistry practical activities. Informed by Vygotsky's (1978) social constructivist theory and Wenger's (1998) community of practice theory, a mixed-methods approach was used to achieve this goal. Data were gathered using document analysis, questionnaires and semi-structured interviews. A deductive approach was used to analyse quantitative data. On the other hand, an inductive-deductive approach was used to analyse the qualitative data. The analysed data were then discussed in relation to the following questions:

1. What is the attitude that Grade 8/9 learners have towards science prior to the intervention on chemistry hands-on practical activities that integrate local knowledge?
2. How do Grade 8/9 learners' attitudes towards science shift/evolve as a result of doing chemistry hands-on practical activities that integrate local knowledge?
3. How does the intervention of chemistry hands-on practical activities that integrate local knowledge influence the attitudes that Grade 8/9 learners have towards science?
4. From the volunteers' perspectives, what factors affect Grade 8/9 learners' attitudes towards science?

In this chapter, a summary of my findings is presented followed by recommendations emerging from the findings. The limitations of the study are discussed as well as possible areas for future research and a conclusion of the study.

6.2 SUMMARY OF FINDINGS

In this section, I summarise the findings of the study in relation to the research questions that guided this study.

6.2.1 Research Question One

What is the attitude of Grade 8/9 learners have towards science prior to the intervention on chemistry hands-on practical activities that integrate local knowledge?

Based on Figure 5.13, at the beginning of the intervention, 65% of the learners had an average attitude towards science, with 10% and 25% in the low and high attitude categories respectively. Learners that fall into the average and high attitude categories have positive attitudes towards science (Fraser, 1981). The learners had an average to good attitude towards science when they arrived at the clubs. The science clubs happen outside of school hours, and membership of these clubs is voluntary, which explains the learners' good attitude towards science, even before the intervention.

The analysis of the results indicates that the learners at the clubs had a high interest (77%) in science (Figure 5.12) before the intervention programme. This result is similar to Agunbiade's (2015) study which showed that there was a higher percentage of learners, who showed an interest in science before they joined the club, compared to the other two sub-scales. The number of learners who are interested in science is followed by the number of learners that enjoyed science activities (71%) before the intervention (Figure 5.11). The percentage of learners who had a positive perception of science (Figure 5.10) before the intervention, was just above average (54%). This means that most of the learners were interested in science and generally had a positive attitude towards science, but there was still room for improvement in the way they viewed science as an entity.

6.2.2 Research Question Two

How do Grade 8/9 learners' attitudes towards science shift/evolve as a result of doing chemistry hands-on practical activities that integrate local knowledge?

After the intervention programme, the analysis of the results (Figure 5.13) showed that there was a 25% decline in the average attitude category. The 25% decline was split between the low (10%) and the high (15%) attitude categories. Ultimately, after the intervention, there was still

a higher percentage of learners who had a positive attitude towards science, and an increase in the percentage of learners in the high attitude category, but the overall attitude towards science had decreased from 90% to 80%. This corresponds with the 5% decline in the learners' interest in science after the intervention programme. This study, however, disagrees with (Kibirige & Van Rooyen, 2006; Ogunniyi & Ogawa, 2008), who claim that the integration of local knowledge in the curriculum enhances learners' interest and therefore attitude. The reason for this difference could be that, the study used kitchen chemistry, which speak just to the use of household items in experiments as opposed to Kibirige & Van Rooyen (2006) and Ogunniyi & Ogawa (2008), who refer to cultural/traditional practices that were specific to a certain area.

According to the results, there is no statistically significant difference between the means of the sub-scales. This means that there is no statistically significant difference between the learners' attitudes before they joined the club and participated in the intervention programme and their attitudes at the end of the intervention programme. The reason for this is that the learners that joined the club at the beginning of the year already had a positive attitude towards science (which is proven by the pre-survey results) so there was not much to change in how they feel about science. One other reason could be that the intervention only lasted for a few weeks of the term, which is a short time and the learners did not have enough time to reflect on their attitude and any difference thereof, after the programme.

After the intervention, however, the post-test results showed that there was more change in the interest (5%) the learners had compared to the enjoyment and the perception sub-scales. The expectation would be a larger shift in the perception sub-scale because the integration of local knowledge on the curriculum is supposed to address the relatability of science and its applicability thereof to real-life situations (Aikenhead & Jegede, 1999). That would mean that after engaging in activities that are familiar to a learner's context, it would be expected that the learner would be able to relate the activity and the concept to their lives and therefore have a shift in how they view science in relation to the world around them. However, the results show that there was a (1%) increase in the positive perception, which is equal to the (1%) increase on the enjoyment that the learners had. This means that the learners did not really feel any different about science in relation to real life, even after the intervention. The reason for this could be that the TOSRA used for the study was not applicable in the context of this study.

Another reason could be that the experiments integrated local knowledge through the use of easily accessible materials/resources, which were household substances. These substances

were then used to do experiments that were still ‘conventional’ science. Perhaps the use of local activities and explaining the science in the activities, and how it relates to their schoolwork could have a much better impact on the perceptions learners have of science.

6.2.3 Research Question Three

How does the intervention of chemistry hands-on practical activities that integrate local knowledge influence the attitudes that Grade 8/9 learners have towards science?

The study found that when learners engage in chemistry hands-on practical activities that are integrated into local knowledge, they become confident in learning about acids and bases. They understand their school work better and their performance is improved. This then motivates them to do more. Ultimately, they develop a positive attitude towards science.

The other finding is that local knowledge chemistry hands-on practical activities help them learn with understanding. The learners are able to relate their schoolwork to their everyday lives and to understand the world in which they live. They are able to construct new knowledge about science, by building upon the knowledge that they already had. This changes their view on science and develops a positive attitude.

The attitude towards science, as discussed by Fraser (1981) can be measured by looking at the enjoyment of science activities, perception of science and interest in science. The qualitative findings of the study show that the learners’ interest in science shifted because they enjoyed the chemistry hands-on practical activities. They were even interested to pursue science further than Grade 12.

6.2.4 Research Question Four

From the perspective of volunteers, what factors affect Grade 8/9 learners’ attitudes towards science?

Results from the interviews with the volunteers show that attitudes towards science can be influenced when learners participate in chemistry hands-on practical activities. The volunteers observed that learners are generally energetic and are always looking for activities that will feed off that. Additionally, science is more practical than theoretical, and engaging in practical activities give learners an idea of what science is about, and what the life of a scientist is like. When engaged in this manner, learners can then develop a positive attitude in science. The engagement can be anything that takes them out of the classroom setting.

The other factor that the volunteers spoke about was the enthusiasm, the support and the motivation of the people involved in the delivery of science. This could be teachers at school and volunteers in clubs. These people are responsible for showing the learners that science is exciting and enjoyable. The enthusiasm and motivation of the facilitators rubs off on to the students and makes them want to do science. The support that the facilitators give, helps learners develop confidence in themselves and encourages them to do science.

The study also shows that the volunteers felt that the use of familiar content had a role in the attitudes that learners have towards science. When taught with substances with which they are familiar, they are able to grasp concepts and understand the work, and when they understand, they are motivated to do more. When they cannot relate to science and do not understand the concepts, they tend to shy away from science and pursue other options.

6.3 RECOMMENDATIONS

The study recommends that local knowledge should be integrated into the science lessons for Grade 8 and 9 learners. This is because, this helps learners bring context to the science that they are learning at school, which helps them understand and have a mental shift in how they perceive science as an entity. However, the conventional hands-on practical activities could also be practised to help learners have fun and experience science in a laboratory. The study also recommends that science teachers pay close attention to the energy or attitude they bring to class when teaching science because learners pick up on that and build associations with the subject. To improve the learning of science, more hands-on practical activities should be done, however, as suggested by Hodson (1990), they should be enquiry-based and not the 'cookbook' form of experiments that are designed to yield the right results. Furthermore, the volunteers could attend a short course based on facilitating learning in science clubs, to improve the quality their engagements with learners.

6.4 AREAS FOR FUTURE RESEARCH

The study introduced the use of easily accessible materials, such as household substances to aid in the teaching and learning of chemistry in Grades 8 and 9. These materials were used to show learners that science can be practised outside of the laboratory, in fact, at home. One area of future research would be indigenous knowledge. There are some practices, activities at home, that could be used to explain different chemistry concepts.

An example of these activities is the use of the heat from the sun to make bread dough rise faster. The process can be used to explain the rate of a reaction. Attention should be given to specific indigenous activities, finding the science of those activities and using them to explain scientific concepts at school.

Secondly, we could interview teachers from different schools so we can get an understanding of how they feel about the integration of local knowledge on the learners' curriculum. Additionally, one should study the differences in attitudes and performance between the learners who attend the science clubs and engage in these hands-on practical activities and those who do not.

6.5 LIMITATIONS TO THE STUDY

The study was conducted at four different clubs to increase the number of participants. However, there were only 20 participants in total from all the different clubs. This is a limitation because, we cannot give a general conclusion of the attitudes of all learners, and instead, we can only get an idea of how learners feel and what could be done.

The survey was only done with the learners who were voluntary members of the club, and it could be assumed that they might have had some positive attitude towards science at the start of the intervention. Surveys could be done with all the learners in the grades to give a clear indication of all the learners' attitudes towards science.

The third limitation was that there was a lot of absenteeism at the clubs, because of different school activities, and as a result of poor communication with the school coordinators and principals. This meant that the programme was delayed and by the time we did the third experiment, and the interviews, the learners were studying different topics at their respective schools. Additionally, some sessions were cut short because of transport issues, due to lack of communication.

We were not able to approach learners for the pilot TOSRA study, so the pilot was done on first and second-year university students. This meant that the students could understand the structure of the questions, but the learners at the high school level could still find them difficult to understand.

The teachers at the different schools were not really invested in the programme and one teacher fell ill and could not be a part of the science clubs for the year. The plan to interview three teachers fell through because of that limitation, thus, we could not interview science teachers

at all three schools. So, there was limited information about how the teachers felt about the contribution of the local knowledge on the attitudes and the achievement of the learners.

There was not any training done with the volunteers before the programme, so that could have had an effect on the quality of the engagements between the facilitators and the learners.

6.6 CONCLUSION

The goal of the study was to investigate Grade 8 and 9 learners' attitudes when local knowledge was integrated into their chemistry hands-on practical activities. This was addressed by four guiding research questions. A mixed-methods parallel approach was used to generate data for the study. The quantitative data showed that there was a slight decrease (but not statistically significant) in the attitude of the learners after engaging in chemistry hands-on practical activities that have local knowledge integrated to them. On the other hand, the qualitative data showed that there was a positive shift in the attitudes the learners had after they were engaged in the chemistry hands-on practical activities.

The reasons for this contradiction could be the structure of the questions given in the survey. It could be that some learners did not clearly understand the questions in the survey. Additionally, it could be that the survey is in English, which is not their home language. The interviews could have been more representative of the attitude of the learners because they were conducted in isiXhosa, which is their home language. This suggests that the learners could understand the questions and answer them comfortably.

The other finding is that local knowledge helps learners understand their schoolwork better, but they lose interest in the science itself. The conventional science, which would be doing experiments in the laboratory brings excitement and enjoyment of the sciences. So, to help learners stay motivated, both understanding and interest need to be addressed, and an integration of local knowledge into conventional science is key.

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APPENDICES

APPENDIX A: ETHICS APPROVAL



Rhodes University Ethical Standards Committee
PO Box 94, Grahamstown, 6140, South Africa
t: +27 (0) 46 603 8055
f: +27 (0) 46 603 8822
e: ethics-committee@ru.ac.za
www.ru.ac.za/research/research/ethics

6 February 2019

Akhona Ngqinambi

ngqinambiakhona@gmail.com

Dear Akhona Ngqinambi

Re: HUMAN SUBJECTS ETHICS APPLICATION

The influence of Local Knowledge on the dispositions of learners towards science. Reference

number: Ngqinambi20181114

Submitted: 2018/11/14

This letter confirms that the above research proposal has been reviewed by the Rhodes University Ethical Standards Committee (RUESC) – Human Ethics (HE) sub-committee.

The committee's decision is Approved. Gatekeepers permission has been received.

Please note that ethics approval will only for a year. An annual progress report is required in order to renew approval for the following year.

Please ensure that the ethical standards committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the ethics committee on completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the ethical standards committee should be aware of. If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloguing number allocated.

Sincerely,



Prof Jo Dames

Chair: Human Ethics sub-committee, RUESC- HE

Note:

1. The ethics committee cannot grant retrospective ethics clearance.

APPENDIX B: PERMISSION TO CONDUCT RESEARCH

- DEPARTMENT OF EDUCATION

[Redacted] House

The District Director
East Cape Department of Education
Graaff Reinet

17 January 2019

Dear Mr. Godlo

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN SCHOOLS

My name is Akhona Ngqinambi. I am a Science Education Masters candidate in the Chemistry Department at Rhodes University. My research is based on the evaluation of the dispositions of secondary school (Grade 8 - 9) learners towards science, when local knowledge is incorporated into their practical work. The research will be based at science clubs at three schools: [Redacted] school and [Redacted] school.

I would like to request your permission to conduct the study at the afore-mentioned three schools. The learners will undergo an attitude evaluation process that includes two pre-tests (at the start of the science clubs and just before the experiment implementation) and a post-test of disposition Observations, recorded interviews and journal entries on their experiences concerning the activities, will also be conducted with the learners, and the teachers will be asked their opinions on the impact of the science clubs on the learners. The responses of both the learners and teachers may be recorded and published but anonymity of all involved will be maintained.

This proposal has been approved by the Rhodes University Ethics Committee (RUESC). Participation in the research is voluntary and the learners and teachers may withdraw from the research at any given time and there shall be no repercussions. In addition to this, the learners' decision not to participate at any point will not affect their membership of the science club at their school.

Should you have any queries concerning the research, do not hesitate to contact me (ngqinambiakhona@gmail.com) or Mrs. Joyce Sewry (J.sewry@ru.ac.za), my supervisor.

Yours sincerely,
Akhona Ngqinambi

Approved
[Signature]
24/01/2019.

Masters Candidate – Science Education
Chemistry Department
Rhodes University

To give permission for the recruitment of the learners and teachers to participate in the research, please complete the form given below:

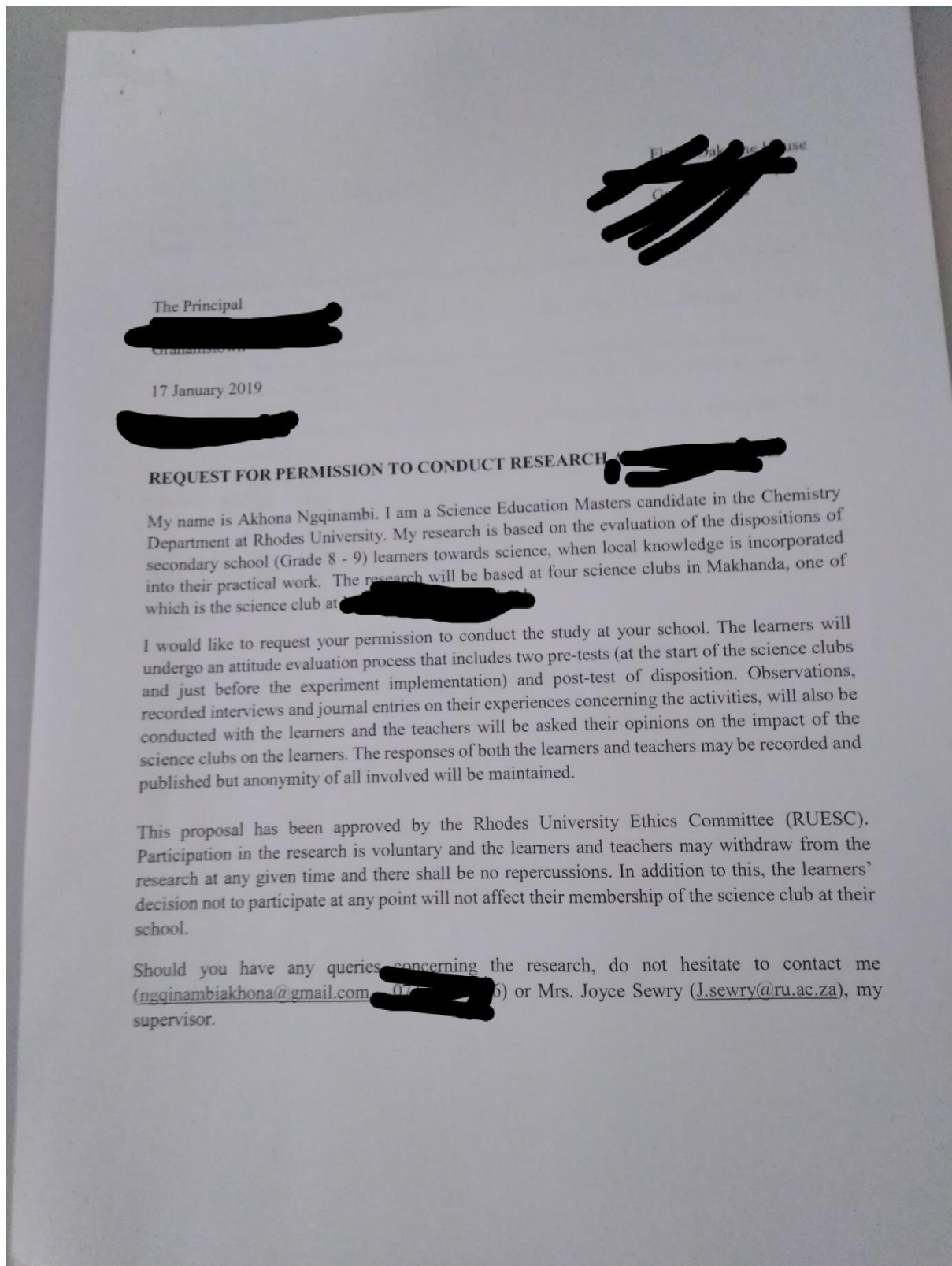
I, Nkosinathi GOALO (FULL NAME), the Director of Education, East Cape Department of Education) SARAH BAARTMAN (District), confirm that :

- I have read and understand the content of the document and the research at large,
- I understand that the teachers and/or the learners will be allowed to withdraw from the study at any given time without repercussions,
- I give permission for the teachers and learners to participate in the research study.

Signature:

| |
|---|
| THE DISTRICT DIRECTOR DEPARTMENT OF EDUCATION PRIVATE BAG X1001 Date: GRAHAMSTOWN 24/01/19 6140 GRAHAMSTOWN DISTRICT |
|---|

REQUEST FOR PERMISSION LETTER




SCHOOL A

Yours sincerely,
Akhona Ngqinambi
Masters Candidate – Science Education
Chemistry Department
Rhodes University

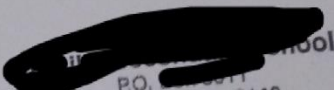
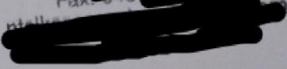
To give permission for the recruitment of the learners and teachers to participate in the research,
please complete the form given below:

I,.....(FULL NAME), the Principal of
Secondary School confirm that :

- I have read and understand the content of the document and the research at large,
- I understand that the teachers and/or the learners will be allowed to withdraw from the study at any given time without repercussions,
- I give permission for the recruitment of the teachers and learners to participate in the research study.

Signature: 

Date: 7 March 2019


P.O.
Grahamstown 6143
Tel:
Fax:


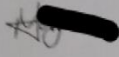
SCHOOL B

Yours sincerely,
Akhona Ngqinambi
Masters Candidate – Science Education
Chemistry Department
Rhodes University

To give permission for the recruitment of the learners and teachers to participate in the research,
please complete the form given below:

I,.....(FULL NAME), the
Principal Senior Secondary School confirm that :

- I have read and understand the content of the document and the research at large,
- I understand that the teachers and/or the learners will be allowed to withdraw from the study at any given time without repercussions,
- I give permission for the recruitment of the teachers and learners to participate in the research study.

Signature: 

Date:
6/2/2019

SCHOOL C

Yours sincerely,
Akhona Ngqinambi
Masters Candidate – Science Education
Chemistry Department
Rhodes University

To give permission for the recruitment of the learners and teachers to participate in the research, please complete the form given below:

I, [REDACTED] (FULL NAME), the Principal of [REDACTED]

- I have read and understand the content of the document and the research at large,
- I understand that the teachers and/or the learners will be allowed to withdraw from the study at any given time without repercussions,
- I give permission for the recruitment of the teachers and learners to participate in the research study.

Signature: [REDACTED]

Date: 7.02.2019

[REDACTED]

High School / Hoërskool
P.O. Box [REDACTED]
GRAHAMSTOWN
Tel : [REDACTED]
Fax : [REDACTED]

KHANYA MATHS AND SCIENCE

Yours sincerely,
Akhona Ngqinambi
Masters Candidate – Science Education
Chemistry Department
Rhodes University

To give permission for the recruitment of the learners to participate in the research, please complete the form given below:

I, [REDACTED] (FULL NAME), the Co-ordinator of
Khanya Maths and Science Club confirm that :

- I have read and understand the content of the document and the research at large,
- I understand that the learners will be allowed to withdraw from the study at any given time without repercussions,
- I give permission for the recruitment of the learners to participate in the research study.

Signature: [REDACTED]

Date: 05/02/2019



RHODES UNIVERSITY

Grahamstown • 6140 • South Africa

OFFICE OF THE REGISTRAR

P O Box 94, Grahamstown, 6140

E-mail: registrar@ru.ac.za

Tel: +27 (0)46 603 8101

Fax: +27 (0)46 603 8127

Ms Akhona Ngqinambi
G14N1753
Chemistry Department

28 February 2019

Dear Ms Ngqinambi

Name of research proposal: The influence of local knowledge on the dispositions of learners towards science.

This serves to confirm that you have been granted permission to conduct your proposed research at Rhodes University as requested.

The University is not obliged to make any arrangements in terms of this research. The onus is on the researcher.

Yours sincerely

Dr Adèle Moodly
REGISTRAR

The parents' consent, the learners' and the volunteers' assent forms.

Flat C Oakdene House
Rhodes University
Grahamstown
6140

PARENT/GUARDIAN CONSENT REQUEST FORM:

Dear Parent

My name is Akhona Ngqinambi. I am a Science Education Masters Candidate in the Chemistry Department at Rhodes University. My research is based on the evaluation of the impact of indigenous knowledge incorporated practical work on the dispositions of secondary school (Grade 7 -9) dispositions towards science. The research will be based on one of the science clubs that your child/ward attends after school.

I would like to request permission to have your child/ward participate in the research. The learners will undergo an attitude evaluation process that includes two pre-tests (at the start of the science clubs and just before the experiments implementation) and post-test of disposition, observations, recorded interviews and journal entries. The responses of the learners may be recorded and published but anonymity of all involved will be maintained.

Participation in the research is voluntary and the learners will be allowed to withdraw from the research at any given time and there shall be no repercussions. In addition to this, the learners' decision to not participate or even forfeit participation will not affect their membership in the science at their school.

Should you have any queries concerning the research, do not hesitate to contact me (ngqinambiakhona@gmail.com – 073 9325 266) or Mrs. Joyce Sewry (J.sewry@ru.ac.za), my supervisor.

Thank you
Akhona Ngqinambi

To give consent for your child/ward to participate on the research, please complete the form given below:

I,.....(PARENT FULL NAME), the parent
of,.....(CHILD FULL
NAME), confirm that:

- I have read and understand the content of the document and the research at large,
- I understand that my child/ward will be allowed to withdraw at any given time without repercussions,
- I consent to having my child/ward participate in the research study.

Signature:

Date:

Flat C Oakdene House
Rhodes University
Grahamstown
6140

LEARNER ASSENT REQUEST FORM:

Dear Learner,

My name is Akhona Ngqinambi. I am a Science Education Masters Candidate in the Chemistry Department at Rhodes University. My research is based on the evaluation of the dispositions of secondary school (Grade 8 - 9) learners towards science, when local knowledge is incorporated into practical work, and will be based on the science club that you attend at your school.

I would like to request that you be a participant in the study. You will undergo an attitude evaluation process that includes two pre-tests (at the start of the science clubs and just before the experiments implementation) and post-test of disposition, observations, recorded interviews and journal entries. All of these – the tests, observations, interviews and journal entries will be used as data for the study. Your response may be recorded and published but your anonymity will be maintained always.

Participation in the research is voluntary and you will be allowed to withdraw from the research at any given time and there shall be no repercussions. In addition to this, your decision not to participate or to withdraw from the study will not affect your membership of the science club at your school.

Should you have any queries concerning the research, do not hesitate to contact me (ngqinambiakhona@gmail.com – 073 9325 266) or Mrs. Joyce Sewry (J.sewry@ru.ac.za), my supervisor.

Thank you
Akhona Ngqinambi

To give assent to participate on the research, please complete the form given below:

I,.....(FULL NAME), confirm that :

- I have read and understand the content of the document and the research at large,
- I understand that I will be allowed to withdraw at any given time without repercussions,
- I assent to participating in the research study.

Signature:

Date:

Flat C Oakdene House
Rhodes University
Grahamstown
6140

VOLUNTEER CONSENT REQUEST FORM:

Dear Volunteer,

My name is Akhona Ngqinambi. I am a Science Education Masters Candidate in the Chemistry Department at Rhodes University. My research is based on the evaluation of the dispositions of secondary school (Grade 8 - 9) learners towards science, when local knowledge is incorporated into practical work, and I plan to work with the learners who are in the science club you volunteer at. Part of the study is to investigate volunteers' opinions are about science attitudes and how they can be developed.

The learners will undergo an attitude evaluation process that includes two pre-tests (at the start of the science clubs and just before the experiments implementation) and post-test of disposition, observations, recorded interviews and journal entries.

In addition to this, I would like to interview you, as the volunteer, to investigate what the volunteers' opinion is about science attitudes and how they are influenced or developed All of these – the tests, observations, interviews and journal entries will be used as data for the study. Your response and the responses of the learners may be recorded and published but anonymity of all involved will be maintained.

Participation in the research is voluntary and the participant may withdraw from the research at any given time and there shall be no repercussions. In addition to this, your decision to not participate or withdraw participation will not affect the learners' membership in the science club you volunteer at.

Should you have any queries concerning the research, do not hesitate to contact me (ngqinambiakhona@gmail.com – 073 9325 266) or Mrs. Joyce Sewry (J.sewry@ru.ac.za), my supervisor.

Thank you
Akhona Ngqinambi

To give consent to participate on the research, please complete the form given below:

I,.....(VOLUNTEER FULL NAME), the volunteer
from,.....(SCIENCE CLUB), confirm that :

- I have read and understand the content of the document and the research at large,
- I understand that I or the learners will be allowed to withdraw from the study at any given time without repercussions,
- I consent to my participation in the research study.

Signature:

Date:

APPENDIX C: THE EXPERIMENT WORKSHEETS USED IN THE STUDY

Experiment 1- ACIDS AND BASES

Substances fall under three categories: acidic, basic and neutral substances.

1. **Acidic substances:** - sour, corrosive and contain a hydrogen.
- E.g. Carbonic, hydrochloric, ethanoic, citrus acids.
2. **Basic substances:** - bitter and slippery, corrosive and are metal oxides/hydroxides.
- E.g. Sodium hydroxide, Ammonia, Calcium hydroxide.
3. **Neutral substances:** - non corrosive, no distinguishable taste.
- E.g. Water, Salt solution, Sugar solution.

Most of these substances can be found in household items such as vinegar, coke, fruit, lemon juice, soap, detergents, baking powder etc. Acids and bases can be either concentrated or dilute, which depends on the amount of the substance per liter of water. A concentrated acid/base has more of the acidic/basic substance compared to the water and a dilute acid/base has more water than the acidic/basic substance.

Acids and bases can be reacted together to form a neutral substance – that is a salt and water. This is called the **neutralization**. – (Acid + Base → Water + Salt).

- E.g. $\text{HCl} + \text{NaOH} \rightarrow \text{H}_2\text{O} + \text{NaCl}$

Indicators are used to determine the acidity or the basicity of a substance. These change colours in different pH levels – depending on the type of indicator used. A **universal indicator** is used to determine the strength of an acid/base.

| INDICATOR | ACID COLOUR | NEUTRAL COLOUR | BASE COLOUR |
|---------------------|-------------|----------------|-------------|
| Red onion water | Red | Violet | Green |
| Phenolphthalein | Colourless | Colourless | Pink |
| Turmeric water | Yellow | Yellow | Red/brown |
| Methyl orange | Red | Orange | Yellow |
| Universal Indicator | Red | Green | Purple |

Experiment: Acidity of household substances and pH indicators

Aim: To measure the acidity of household items using the red cabbage.

Tools and materials: red cabbage, 10 vials, spoon, 3 cups, vinegar, sprite, lemon juice, Oros, apple juice, water, bleach, Handy Andy, baking soda, Dettol, household ammonia, and universal indicator.

Procedure: Divided into three parts.

Part 1: Preparation of red cabbage indicator

- Boil water and cut red cabbage into pieces. Soak the red cabbage in the water for 30 minutes.
- After 30 minutes, filter the red cabbage pieces and collect the filtrate (liquid part) into a cup.

Part 2:

- Label the chemistry kit according to the household substances that you have. (e.g. E1 = vinegar).
 - Add 2 mL of the red cabbage filtrate into the chemistry kit.
 - Pour 5 mL (liquid), 1 spoon (solid) of the substances into their respective vials (vials that have their labels).
- **What happened to the colours in each vial?**

| HOUSEHOLD ITEM | COLOUR | ACIDIC/BASIC/NEUTRAL |
|----------------|--------|----------------------|
| | | |
| | | |
| | | |
| | | |
| | | |
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| | | |
| | | |
| | | |
| | | |

- **What does that tell you about red cabbage? What role does it play in the reactions? -**

- Add 2 drops of universal indicator into each substance in the chem kit.

- **What happens? Is there a difference in colour?**

| HOUSEHOLD ITEM | COLOUR | ACIDIC/BASIC/NEUTRAL |
|----------------|--------|----------------------|
| | | |
| | | |
| | | |
| | | |
| | | |
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| | | |
| | | |
| | | |
| | | |

- **What does that tell you about a universal indicator? -----**

- **Arrange the substances in strength-----**

Part 3:

- Pour 10 mL water into the empty cup.
- Add 10 mL of the red cabbage liquid you have into the cup.
- Add a spoon of baking soda to the cup and stir.

- Add 5 mL of vinegar to the solution, stir and observe what happens.

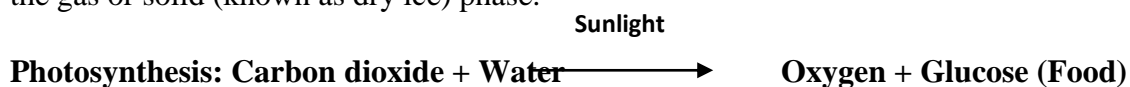
- **What happens? Describe what you see** -----

- **What do you think happened?** -----

- **What do you call this process of acid-base reactions?**-----

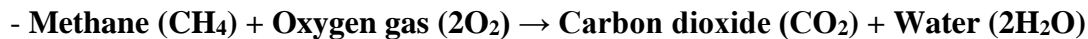
Experiment 2 - CARBON DIOXIDE

Carbon dioxide is a gas made up of carbon and oxygen and is one of the gases in the atmosphere. It is colourless, odourless (has no smell), denser (heavier) than air and is soluble (dissolves) in water – dissolving to form carbonic acid (which means carbon dioxide is acidic in solution). Carbon dioxide is taken in by plants through photosynthesis (where plants use it and water in the presence of sunlight to make their own food and oxygen). Carbon dioxide can be either in the gas or solid (known as dry ice) phase.

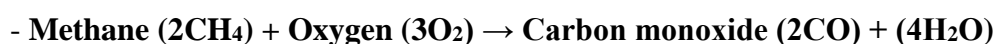


Carbon dioxide is one of the products of **combustion** (burning of substances containing carbon in the presence of oxygen) and **respiration** (breakdown of glucose by oxygen in the living organisms). It is also produced from the reaction of acids with carbonates. Combustion can either be complete or incomplete depending on the amount of oxygen present and the number of carbons on the substance being burnt.

1. Complete combustion – when there is enough oxygen to burn all the carbons in substance (where each carbon will get its two oxygens). A blue flame is usually observed.



2. Incomplete combustion – when there isn't enough oxygen available to burn all the carbon (where there are not enough oxygens for the carbons) which results to the formation of a toxic substance known as carbon monoxide. An orange flame is usually observed



3. The respiration reaction – when glucose is broken down in the presence of oxygen. An example is the process of making bread: flour is broken down by the yeast and the carbon dioxide formed from the process is trapped in the dough and causes the bread to rise.



Carbon dioxide is also formed from the reaction of acids with carbonates. An example of that is the reaction of vinegar (acid) and bicarbonate of soda (base). The production of carbon dioxide is illustrated by the process of **effervescence (bubbling)**.

Acid – Base reactions: The acidic properties of carbon dioxide

Aim of the experiment: To investigate two acid-base reactions. One with carbon dioxide as a reactant and one with carbon dioxide as a product and to determine the acidity of carbon dioxide.

Tools and materials: Measuring cylinder, water, three cold drink bottles with lids, spoon, turmeric, vinegar, household ammonia solution, powdered laundry detergent, baking soda, three small plastic cups and straws.

Procedure: Divided into three reactions.

Reaction 1:

- Measure 100 ml (about 1/3 cup) of water into each of the three cold drink bottles. Label the bottles acid, base and experimental.
- Using the tip of a spoon, add pea-sized amounts of turmeric to the water in each of the bottles. Swirl each bottle to mix the contents. The turmeric will not dissolve entirely.

- **Describe your observation**-----

- Add 2 ml of vinegar to the **Acid** bottle. Close the lid and swirl to mix the contents.

- **Describe what happens?**-----

- Add 2 ml of household ammonia to the **Base** bottle. Close the lid and swirl to mix the contents.

- **Describe what happens?**-----

- Add a spoon of laundry detergent to the **Experimental**. Close the lid and swirl to mix the contents.

- **What happens to the colour?**-----

- **Based on the colour changes seen with vinegar and ammonia, how does the addition of the detergent affect the acidity of the mixture?**-----

- Use a straw to blow gently into the **Experimental** bottle.

- **Describe what happens**-----

- **What happens to the acidity of the mixture?**-----

Reaction 2:

- Weigh $\frac{1}{4}$ spoon of powdered laundry detergent and 1 spoon of bicarbonate of soda. Place the two solids into a small plastic cup and stir to mix the solids.

- Measure 20 ml of vinegar. Pour the vinegar into a clean plastic cup. Add the vinegar all at once to the solid mixture from step 1.

- **Describe what happens**-----

- Repeat steps 1 and 2 without the powdered laundry detergent.

- **Describe what happens**-----

- **What do you think is the role of the detergent in the reaction?**-----

Answer the following questions:

1. **What is the role of carbon dioxide in these reactions? Write the chemical equations.**

Reaction 1: -----

Reaction 2: -----

2. **Why does the solution change colour in Reaction 1? What other natural product has a similar effect in acid–base reactions.** -----

Other natural product: -----

3. Did you notice any difference when you performed Reaction 2 without the powdered laundry detergent? -----

4. What is the role of the detergent in Reaction 1?-----

5. What is the role of the detergent in Reaction 2?-----

Dry Ice Experiment

This experiment will be demonstrated to you.

Aim of the experiment: To investigate the effect of carbon dioxide on the atmosphere.

Tools and materials: Water, universal indicator, NaOH, dry ice.

Procedure:

1. Fill half of the beaker with water
2. Add 2 drops of universal indicator – observe what happens.
3. Add 2 drops of NaOH – observe what happen.
4. Add dry ice – observe what happens.

Answer the following questions:

1. What is the role of the universal indicator in the experiment?-----

2. What happens when the indicator is added into water? -----

- **What does that mean about water? -----**

3. What happens when the NaOH is added into the mixture? -----

- What does that mean about NaOH? -----

4. What happens when dry ice is added into mixture? -----

- What does that mean about CO₂? -----

5. What is the effect of carbon dioxide on our water resources? -----

Experiment 3 - ENERGY TRANSFER IN CHEMICAL REACTIONS

All chemical reactions undergo energy transfer, examples of which is heat, light and sound transfer. The transfer can either be an absorption of energy from the surrounding (energy is taken in) or a release of energy to the surrounding (energy is given off).

The most common transfer of energy is heat energy transfer. There are two types of reactions related to heat energy transfer:

1. Endothermic reaction (*reactants + energy = products*) – heat is taken into the reaction resulting to a cold surrounding.

Example: - putting ice-cubes in water reduces the temperature of the water.

2. Exothermic reaction (*reactants = products + energy*) – the reaction releases heat resulting to a hot environment.

Example: the burning of wood increases the temperature of the surroundings.

Endothermic and exothermic reactions experiment

Aim: To evaluate endothermic and exothermic reactions.

Procedure: In two parts.

Part 1:

Reaction 1:

Tools and materials: vinegar, bicarbonate of soda, cup, thermometer.

1. Pour vinegar into the cup.
2. Take a temperature reading of the vinegar.
3. Add bicarbonate of soda gradually to avoid overflowing.
4. Take the reading of the reaction.

| REACTION | TEMPERATURE (°C) |
|-------------------------------|------------------|
| Vinegar | |
| Vinegar + Bicarbonate of Soda | |

- What happens when you add the bicarbonate of soda to the vinegar? What do we call that process? What did we produce from the reaction? -----

- What happens to the temperature after bicarbonate of soda has been added to the vinegar?-----

- Is heat taken released to or absorbed from the surrounding?-----

- What type of energy transfer reaction is reaction 1?-----

Reaction 2:

Tools and materials: steel wool, vinegar, bleach, thermometer, 2 cups.

1. Wrap the steel wool around the thermometer, place it in the cup and let it stand for 5 minutes.
2. Remove the thermometer and take a reading of temperature.

| STEEL WOOL | TEMPERATURE (°C) |
|---------------------------|------------------|
| Before vinegar and bleach | |
| After vinegar | |
| After bleach | |

3. Label the cups as **VINEGAR** and **BLEACH**. Add the vinegar and the bleach into their respective cups.

4. Cut the steel wool into 2 pieces and put each piece in one of the cups for 5 minutes each.
5. Remove both steel wool pieces from the cups and squeeze the excess vinegar/bleach from the wool.
6. Wrap the steel wool around the thermometer, place it in the jar and leave it for 5 minutes.
7. After 5 minutes, remove the thermometer and take a reading.

- **What happens to the temperature after the steel wool has been soaked in vinegar?**-----

- **What happens to the steel wool when soaked in vinegar?**-----

- **What happens to the temperature after the steel wool has been soaked in bleach?**-----

- **What happens to the steel wool when soaked in bleach for long?**-----

- **With both the vinegar and the bleach, is heat taken released to or absorbed from the surrounding?**-----

- **What type of energy transfer reaction is reaction 2?**-----

- **Which substance will rust the steel wool faster? Acid/base?**-----

APPENDIX D: THE TOSRA SURVEY

SURVEY: WHAT DO YOU THINK ABOUT SCIENCE?

Participation in this survey is voluntary and you may withdraw at any given time with no repercussions. In addition, your decision not to participate or to withdraw participation will not affect your membership in the science club. The results of the survey will be used for research purposes, but your anonymity will be maintained at all times.

Gender: Male _____ Female _____

Surname: _____ Name: _____ Grade _____

Please choose how you feel about each statement by circling the best response. This is **NOT** a test.

| | STATEMENT | RESPONSE | | | | |
|---|---|----------------|-------|----------|----------|-------------------|
| 1 | Science can help make the world a better place. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 2 | Scientists spend their free time in the laboratories. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 3 | I would rather find out why something happens by doing an experiment than by being told how it works. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 4 | I find it interesting to hear about new ideas in science. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 5 | Science lessons are fun. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 6 | I would like to belong to a science club. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 7 | I would like a job as a scientist. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 8 | It is good to spend money on science. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |

| | | | | | | |
|----|--|----------------|-------|----------|----------|-------------------|
| 9 | Scientists are as healthy as other people. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 10 | Doing experiments help me learn as much as finding out information from teachers. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| | It is good to learn new methods of doing science experiments. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 12 | I dislike science lessons. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 13 | I enjoy watching science programs on TV. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 14 | I would like to work with people who make discoveries in science. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 15 | Doing science projects is not a waste. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 16 | Scientists are friendly like other people. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 17 | It is good to do experiments to find out about things. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 18 | I enjoy reading about new things in science that change my ideas. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 19 | Schools should do more practical science lessons each week. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 20 | I would like to be given a science book or a piece of scientific equipment as a present. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 21 | I would like a job in a science laboratory. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 22 | Scientific discoveries are doing more harm than good. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 23 | Scientists like sports as much as other people do. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |

| | | | | | | |
|----|---|----------------|-------|----------|----------|-------------------|
| 24 | To answer a science question. I would think it over before asking for help. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 25 | It is good to repeat an experiment to check if results are correct. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 26 | Science lessons are useful for learning about everyday life. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 27 | I dislike reading books about science in my free time. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 28 | Working in a science laboratory would be interesting. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 29 | Building science laboratories is good for the society. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 30 | Scientists are less friendly than other people. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 31 | I enjoy scientific experiments because I learn from them. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 32 | Finding out about new things in science is not important. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 33 | Science is one of the most interesting school subjects. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 34 | I would like to do science experiments at home. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
| 35 | I would not like to be a scientist because it requires too much education. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |

Adapted from Fraser, B. (1981). *TOSRA test of science-related attitude handbook*. The Australian Council for Educational Research. Victoria: Allenby

APPENDIX E: THE INTERVIEW QUESTIONS

Interview questions for some learners after the practical work has been completed:

1. Why do you come to the club?
2. Is the club helping you? How?
3. Are the experiments helping? How?
4. Why do you think some learners do not come to the club?
5. What do you think about science? (Generally)
6. Do you think science can be applied to real-life situations?
7. Do you enjoy science lessons? Why/Why not? Improving?
8. What problems do you have in learning science?
9. Would you like to be a scientist? Why/Why not?
10. Do you think learning science by relating it to everyday life helps? Why? How? Why not?

Interview questions for the volunteers during the study:

1. What are you studying? Why?
2. Do you think science can be applied to real life problems? Elaborate.
3. What attitude did you have towards science in High School? Why?
4. What attitude do you have towards science now?
5. How did that attitude develop?
6. Do you think science attitudes can be influenced? How?
7. What role do you think science clubs play on influencing learners' attitudes towards science?
8. What role do you think practical activities play on influencing learners' attitudes towards science?
9. What role do you think local knowledge plays on influencing learners' attitudes towards science?
10. Do you think there is any significant shift in the effect on learners' attitudes, when all three (science clubs, practical activities and local knowledge) are utilized simultaneously?

APPENDIX F: GRAPHS SHOWING THE LEARNERS' RESPONSES TO THE SURVEY STATEMENTS.

Figures 1-35 illustrate the differences in frequency between the responses the learners gave to the questionnaire statements in the pre and post surveys.

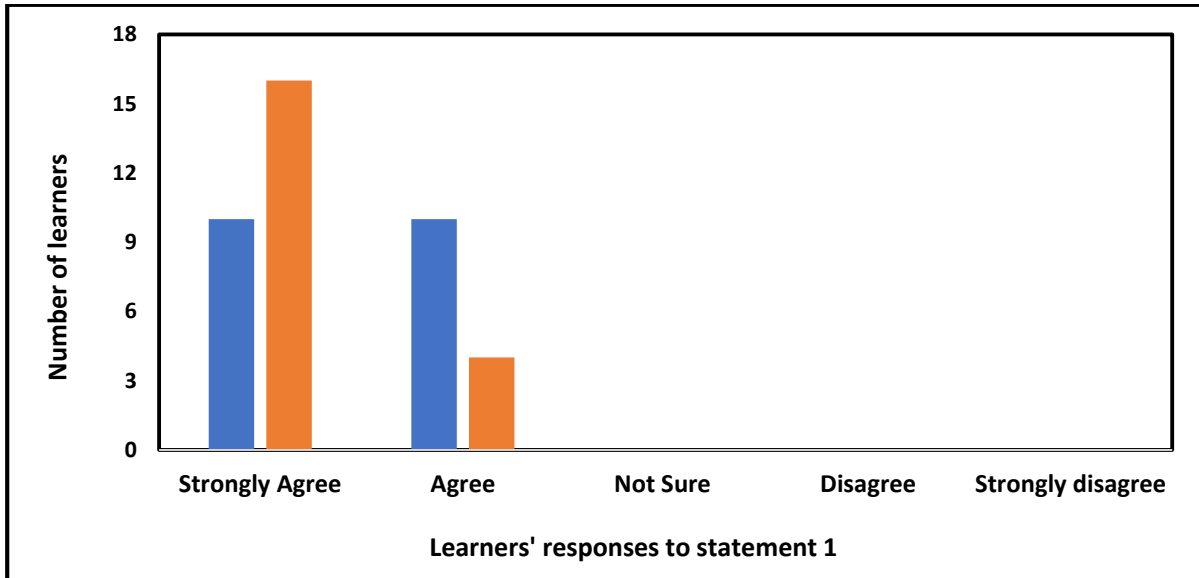


Figure 2: The learners' responses to statement 1 "Science can help make the world a better place," before and after the intervention.

Before the intervention, 10 learners agreed with the statement “science can help make the world a better place” and 10 strongly agreed (Figure 1). This means that all 20 learners had a positive attitude with regards to statement one, before intervention. After the intervention, 4 learners agreed with the statement and 16 learners strongly agreed. After the intervention, all learners still had a positive attitude and more learners strongly agreed with the statement compared to before the intervention.

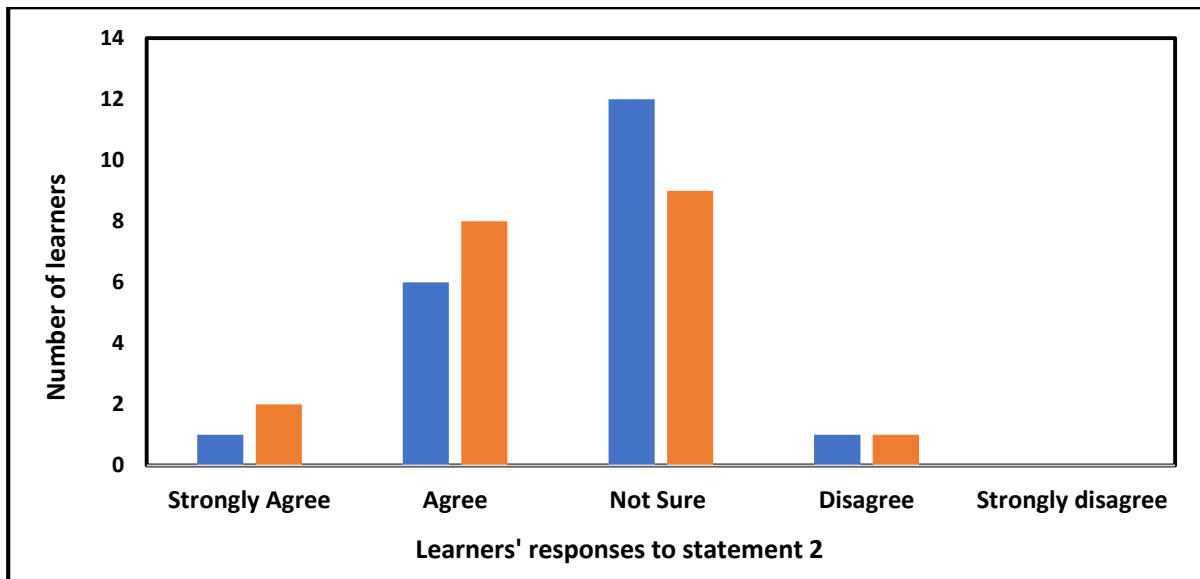


Figure 2: The learners' responses to statement 2" Scientists spend their free time in the laboratories," before and after the intervention.

Before the intervention, 1 learner strongly agreed with the statement “scientists spend their free time in the laboratories,” 6 learners agreed, 12 learners were not sure, and 1 learner disagreed (Figure 2). This means that, out of the 20 learners, 7 learners had a positive attitude with regards to statement two, 12 learners were undecided, and 1 learner had a negative attitude, before the intervention. After the intervention, 2 learners strongly agreed with the statement, 8 learners agreed, 9 were still undecided and 1 learner disagreed. This means that, out of the 20 learners, 10 learners had a positive attitude, 9 were undecided and 1 had a negative attitude with regards to statement two. After the intervention more learners had a positive attitude with regards to the statement, compared to before the intervention.

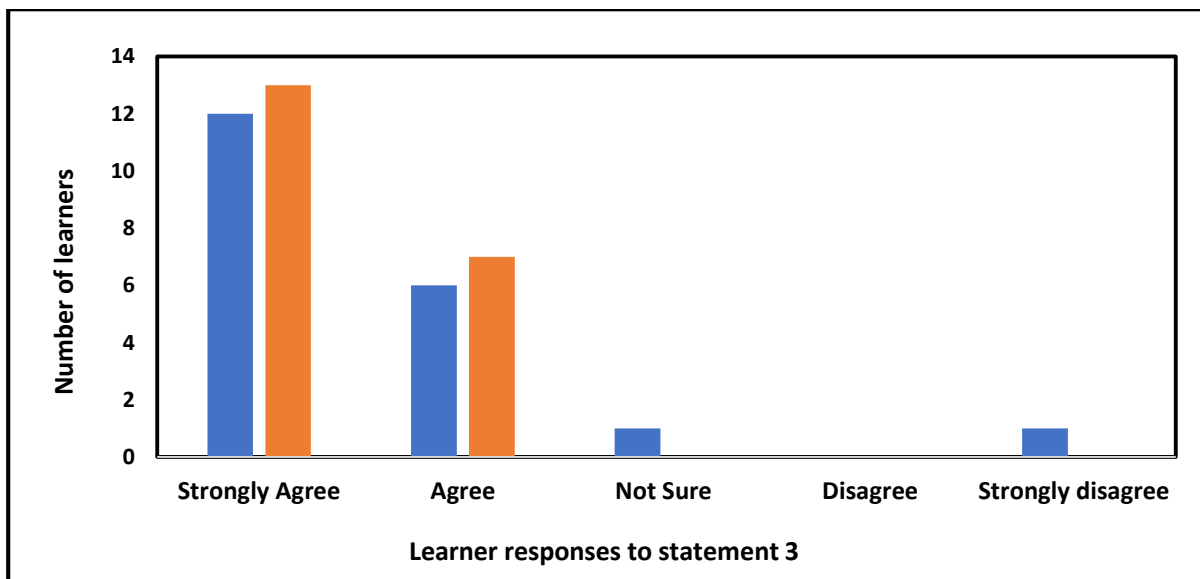


Figure 3: The learners' responses to statement 3 "I would rather find out why something happens by doing an experiment than by being told how it works," before and after the intervention.

Before the intervention, 12 learners strongly agreed with the statement “I would rather find out why something happens by doing an experiment than by being told how it works,” 6 learners agreed, 1 learner was not sure, and 1 learner disagreed (Figure 3). This means that, out of the 20 learners, 18 learners had a positive attitude, 1 learner was undecided, and 1 learner had a negative attitude with regards to statement three, before the intervention. After the intervention, 13 learners strongly agreed with the statement, and 7 learners agreed. After the intervention, all learners had a positive attitude with regards to the statement, compared to before the intervention.

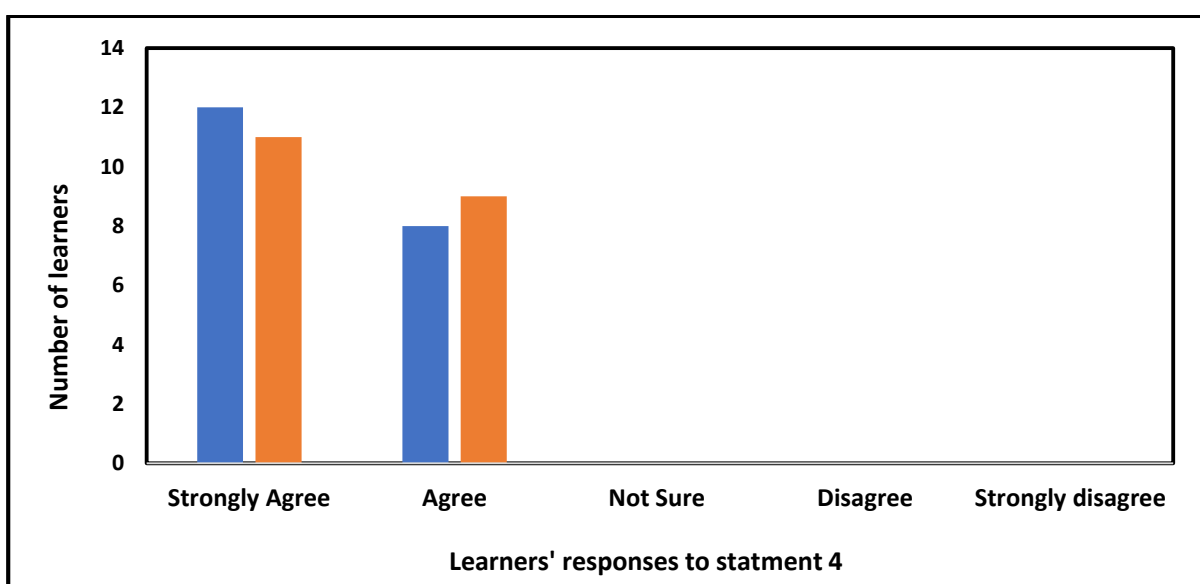


Figure 4: The learners' responses to statement 4 "I find it interesting to hear about new ideas in science," before and after the intervention.

Before the intervention, 12 learners strongly agreed with the statement “I find it interesting to hear about new things in science,” and 8 learners agreed (Figure 4). This means that, all the 20 learners had a positive attitude with regards to statement four, before the intervention. After the intervention, 11 learners strongly agreed with the statement, and 8 learners agreed. After the intervention, all the learners still had a positive attitude with regards to the statement, but more learners agreed, compared to before the intervention.

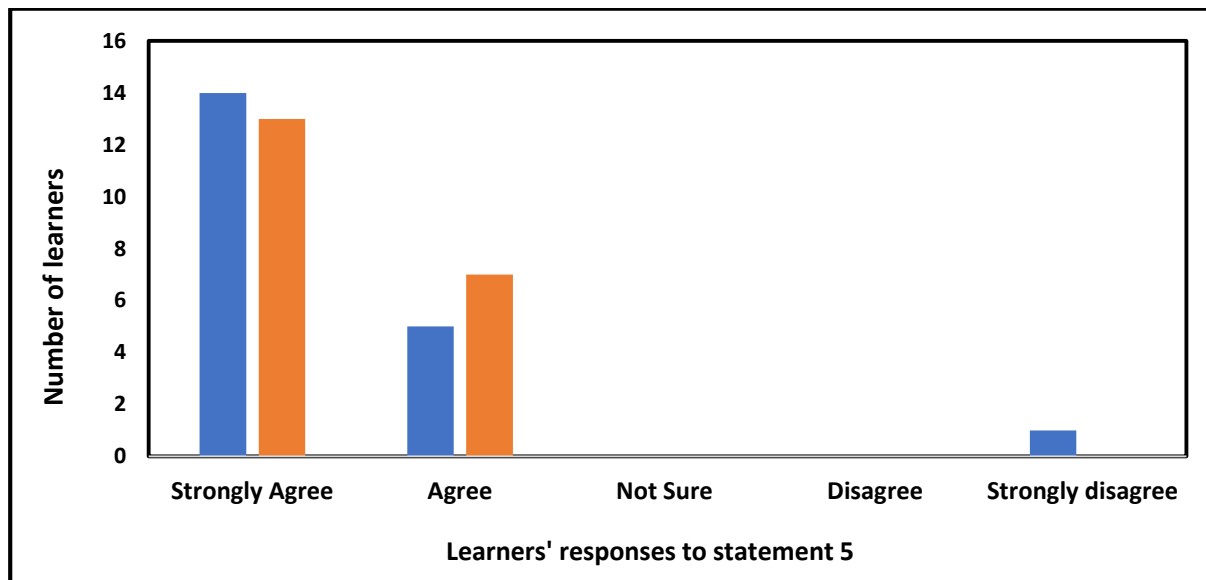


Figure 5: The learners' responses to statement 5 "Science lessons are fun," before and after the intervention.

Before the intervention, 14 learners strongly agreed with the statement “science lessons are fun,” 5 learners agreed, and 1 learner disagreed (Figure 5). This means that, out of the 20 learners, 19 learners had a positive attitude, and 1 learner had a negative attitude with regards to statement five, before the intervention. After the intervention, 13 learners strongly agreed with the statement and, 7 learners agreed. After the intervention more learners had a positive attitude with regards to the statement, compared to before the intervention.

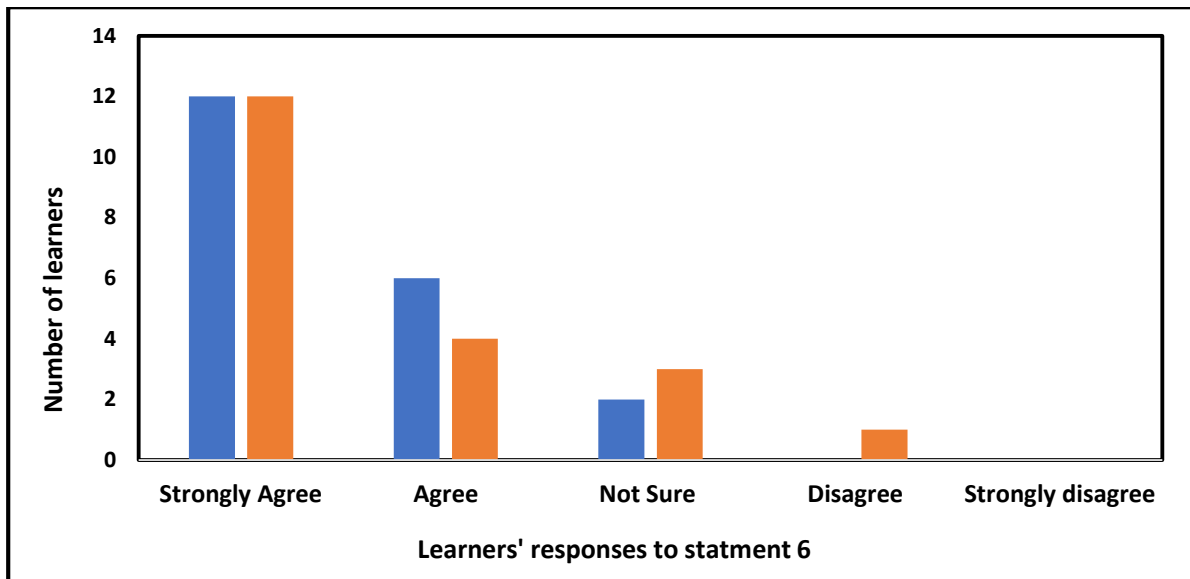


Figure 6: The learners' responses to statement 6 "I would like to belong to a science club," before and after the intervention.

Before the intervention, 12 learners strongly agreed with the statement “I would like to belong to a science club,” 6 learners agreed, and 2 learners were not sure (Figure 6). This means that, out of the 20 learners, 18 learners had a positive attitude with regards to statement six and 2 learners were undecided, before the intervention. After the intervention, 12 learners strongly agreed with the statement, 4 learners agreed, 3 were still undecided and 1 learner disagreed. This means that, out of the 20 learners, 16 learners had a positive attitude, 3 were undecided and 1 had a negative attitude with regards to statement six. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

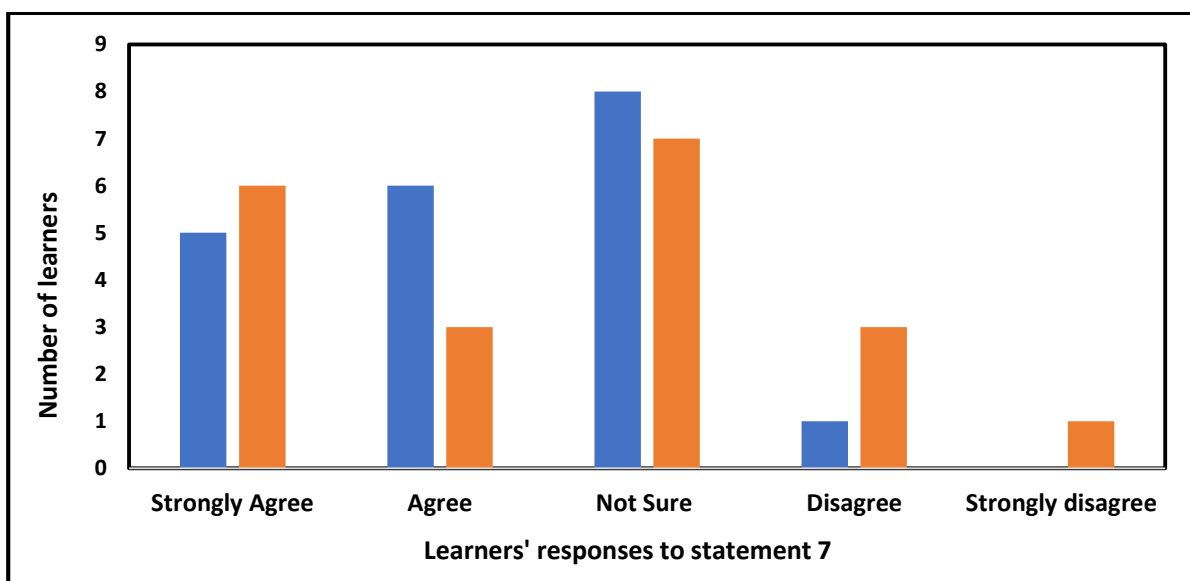


Figure 7: The learners' responses to statement 7 "I would like a job as a scientist," before and after the intervention.

Before the intervention, 5 learners strongly agreed with the statement “I would like a job as a scientist,” 6 learners agreed, 8 learners were not sure, and 1 learner disagreed (Figure 7). This means that, out of the 20 learners, 11 learners had a positive attitude, 6 learners were undecided, and 1 learner had a negative attitude with regards to statement seven, before the intervention. After the intervention, 6 learners strongly agreed with the statement, 3 learners agreed, 7 were still undecided, 3 disagreed and 1 learner strongly disagreed. This means that, out of the 20 learners, 9 learners had a positive attitude, 7 were undecided and 4 had a negative attitude with regards to statement seven. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

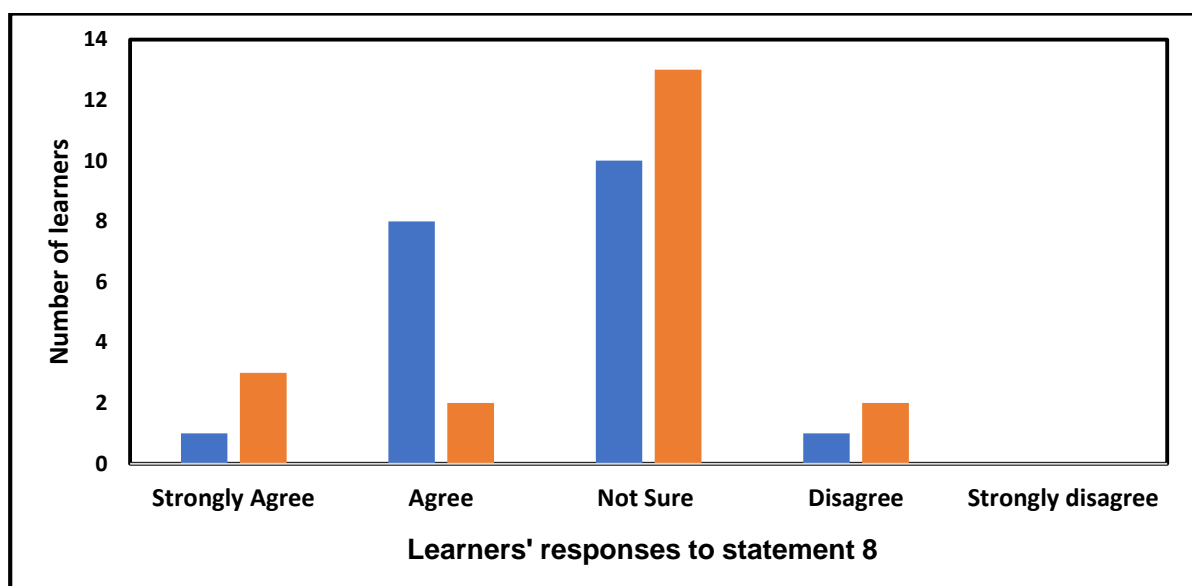


Figure 8: *The learners' responses to statement 8 "It is good to spend money on science," before and after the intervention.*

Before the intervention, 1 learner strongly agreed with the statement “It is good to spend money on science,” 8 learners agreed, 10 learners were not sure, and 1 learner disagreed (Figure 8). This means that, out of the 20 learners, 9 learners had a positive attitude with regards to statement eight, 10 learners were undecided, and 1 learner had a negative attitude, before the intervention. After the intervention, 3 learners strongly agreed with the statement, 2 learners agreed, 13 were undecided and 2 learners disagreed. This means that, out of the 20 learners, 5 learners had a positive attitude, 13 were undecided and 2 had a negative attitude with regards to statement eight. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

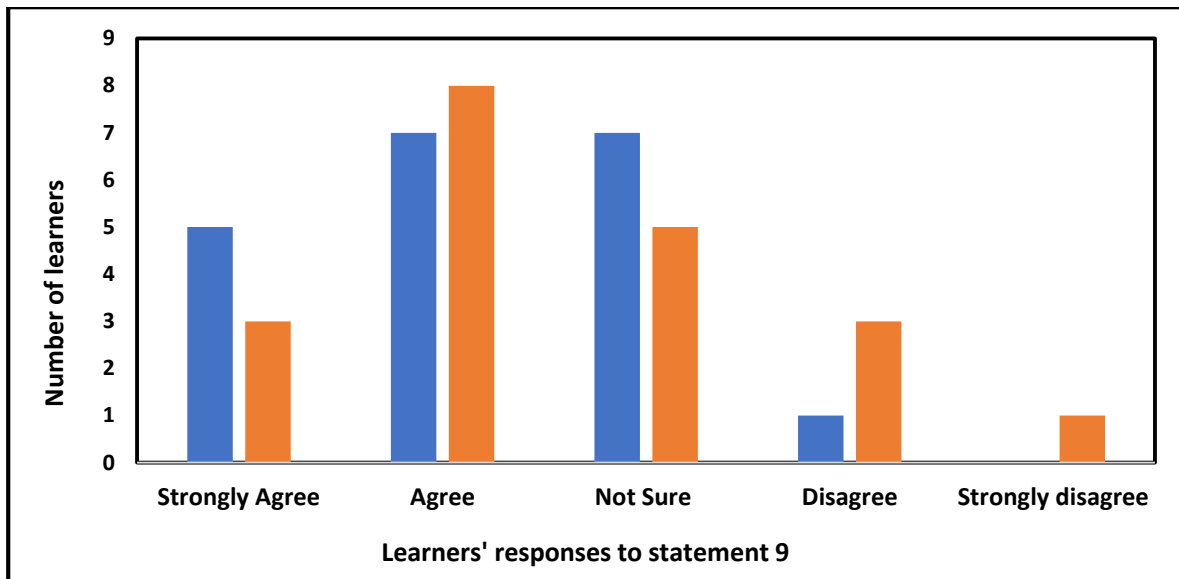


Figure 9: *The learners' responses to statement 9 "Scientists are as health as other people," before and after the intervention.*

Before the intervention, 5 learners strongly agreed with the statement “scientists are as healthy as other people,” 7 learners agreed, 7 learners were not sure, and 1 learner disagreed (Figure 9). This means that, out of the 20 learners, 12 learners had a positive attitude, 7 learners were undecided, and 1 learner had a negative attitude with regards to statement nine, before the intervention. After the intervention, 3 learners strongly agreed with the statement, 8 learners agreed, 5 were undecided, 3 disagreed and 1 learner strongly disagreed. This means that, out of the 20 learners, 11 learners had a positive attitude, 5 were undecided and 4 had a negative attitude with regards to statement nine. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

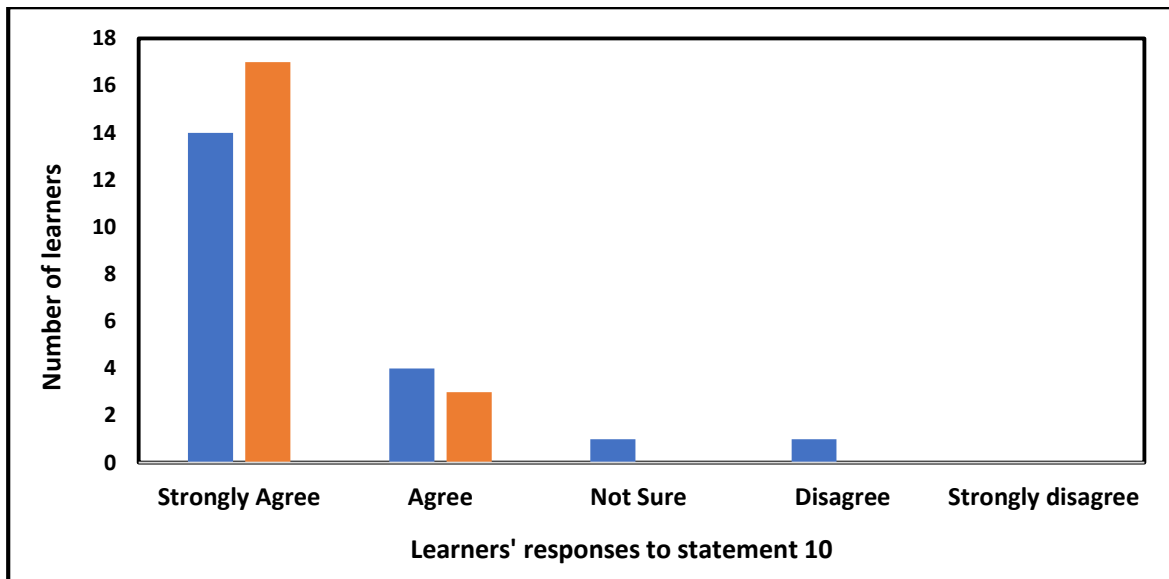


Figure 30: The learners' responses to statement 10 "Doing experiments helps me learn as much as finding out information from the teachers," before and after the intervention.

Before the intervention, 14 learners strongly agreed with the statement “Doing experiments helps me as much as finding out information from the teachers,” 4 learners agreed, 1 learner was not sure, and 1 learner disagreed (Figure 10). This means that, out of the 20 learners, 18 learners had a positive attitude, 1 learner was undecided, and 1 learner had a negative attitude with regards to statement ten, before the intervention. After the intervention, 17 learners strongly agreed with the statement, and 3 learners agreed. After the intervention, all learners had a positive attitude with regards to the statement, compared to before the intervention.

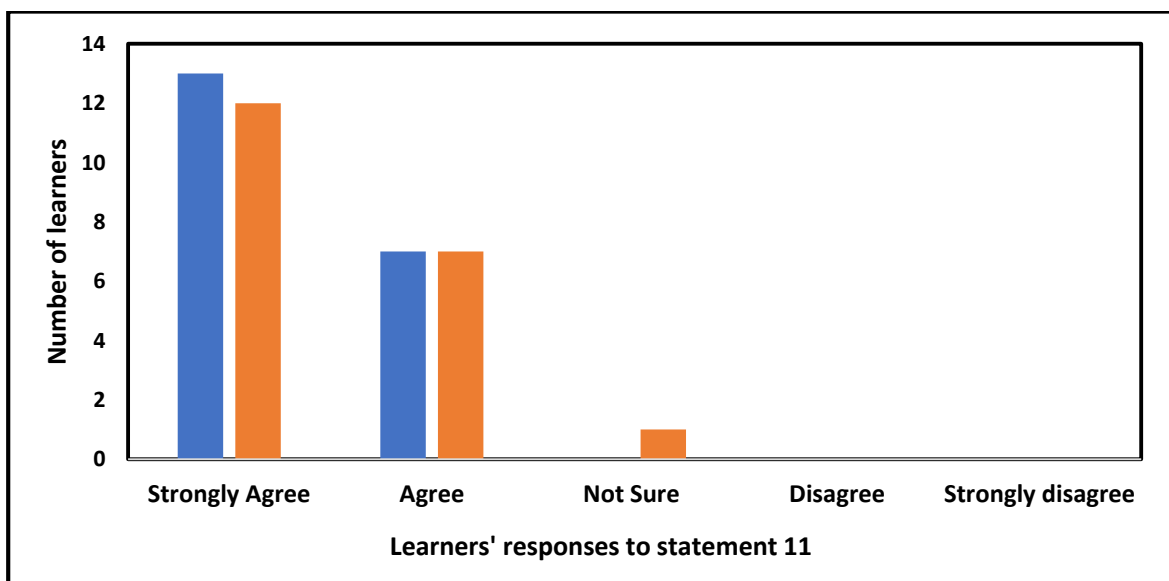


Figure 41: The learners' responses to statement 11 "It is good to learn new methods of doing science experiments," before and after the intervention.

Before the intervention, 13 learners strongly agreed with the statement “It is good to learn new methods of doing science experiments,” and 7 learners agreed (Figure 11). This means that, all the 20 learners had a positive attitude with regards to statement eleven, before the intervention. After the intervention, 12 learners strongly agreed with the statement, and 7 learners agreed. After the intervention, out of the 20 learners, 19 learners had a positive attitude and 1 learner had a negative attitude with regards to statement eleven. Less learners had a positive attitude with regards to the statement after the intervention, compared to before the intervention.

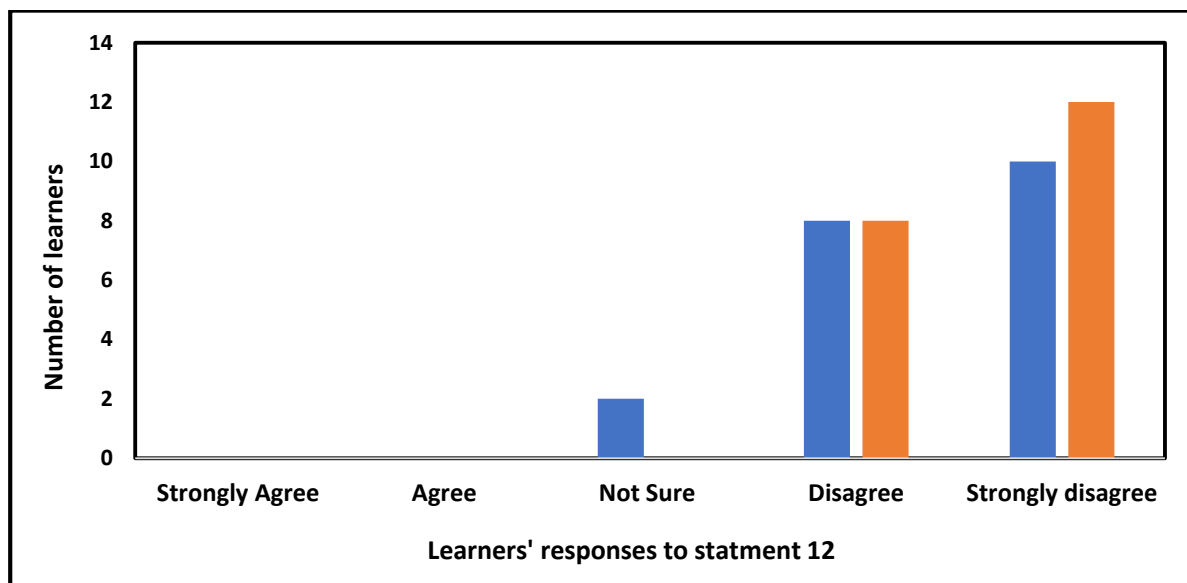


Figure 52: The learners' responses to statement 12 "I dislike science lessons," before and after the intervention.

Before the intervention, 10 learners strongly disagreed with the statement “I dislike science lessons,” 8 learners agreed, and 2 learners were not sure (Figure 12). This means that, out of the 20 learners, 18 learners had a positive attitude with regards to statement 12 and 2 learners were undecided, before the intervention. After the intervention, 12 learners strongly agreed with the statement, and 8 learners agreed. After the intervention, all learners had a positive attitude with regards to statement 12, and more learners had a positive attitude with regards to the statement compared to before the intervention.

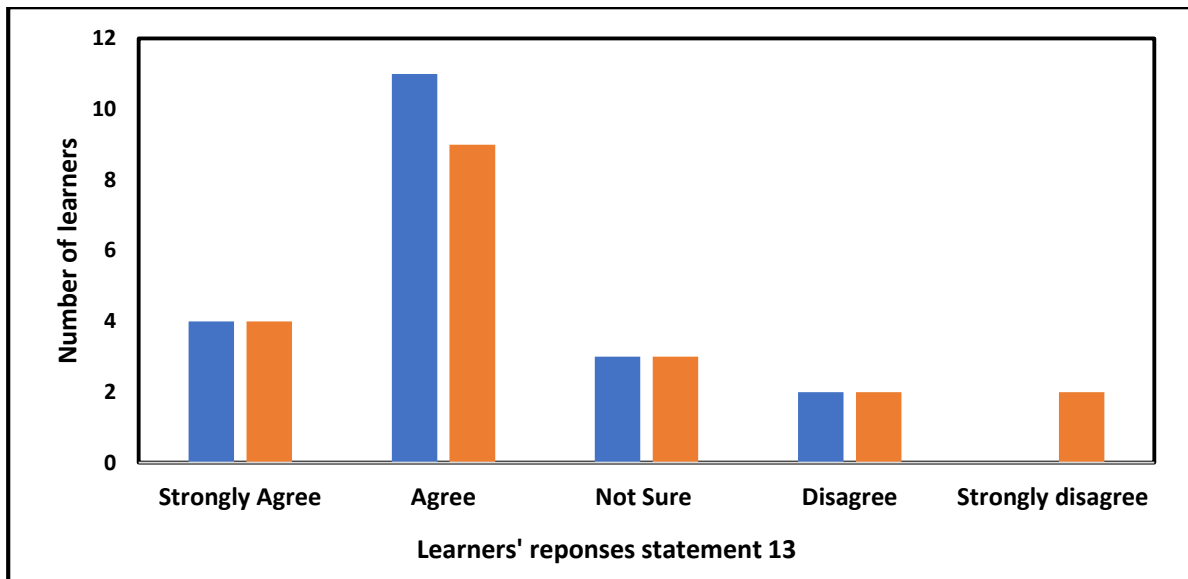


Figure 63: The learners' responses to statement 13 "I enjoy watching science programmes on TV," before and after the intervention.

Before the intervention, 4 learners strongly agreed with the statement “I enjoy watching science programmes on TV,” 11 learners agreed, 3 learners were not sure, and 2 learners disagreed (Figure 13). This means that, out of the 20 learners, 15 learners had a positive attitude, 3 learners were undecided, and 2 learners had a negative attitude with regards to statement 13, before the intervention. After the intervention, 4 learners strongly agreed with the statement, 9 learners agreed, 3 were undecided, 2 disagreed and 2 learners strongly disagreed. This means that, out of the 20 learners, 13 learners had a positive attitude, 3 were undecided and 4 had a negative attitude with regards to statement 13. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

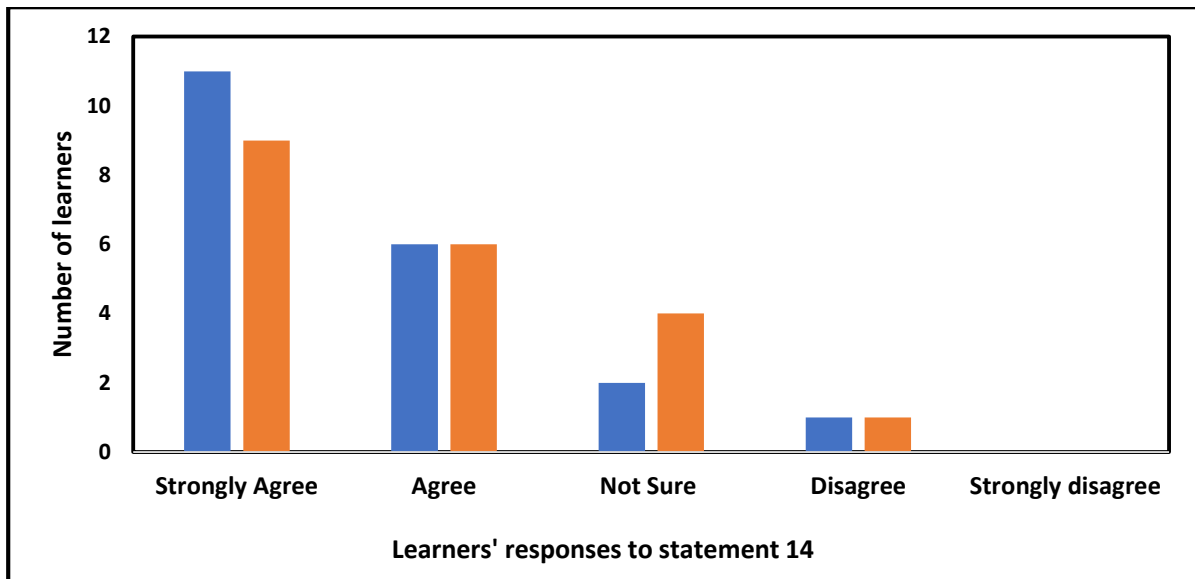


Figure 74: The learners' responses to statement 14 “I would like to work with people who make discoveries in science,” before and after the intervention.

Before the intervention, 11 learners strongly agreed with the statement “I would like to work with people who make discoveries in science,” 6 learners agreed, 2 learners were not sure, and 1 learner disagreed (Figure 14). This means that, out of the 20 learners, 17 learners had a positive attitude, 2 learners were undecided, and 1 learner had a negative attitude with regards to statement 14, before the intervention. After the intervention, 9 learners strongly agreed with the statement, 6 learners agreed, 4 were undecided and 1 learner disagreed. This means that, out of the 20 learners, 15 learners had a positive attitude, 4 were undecided and 1 learner had a negative attitude with regards to statement 14. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

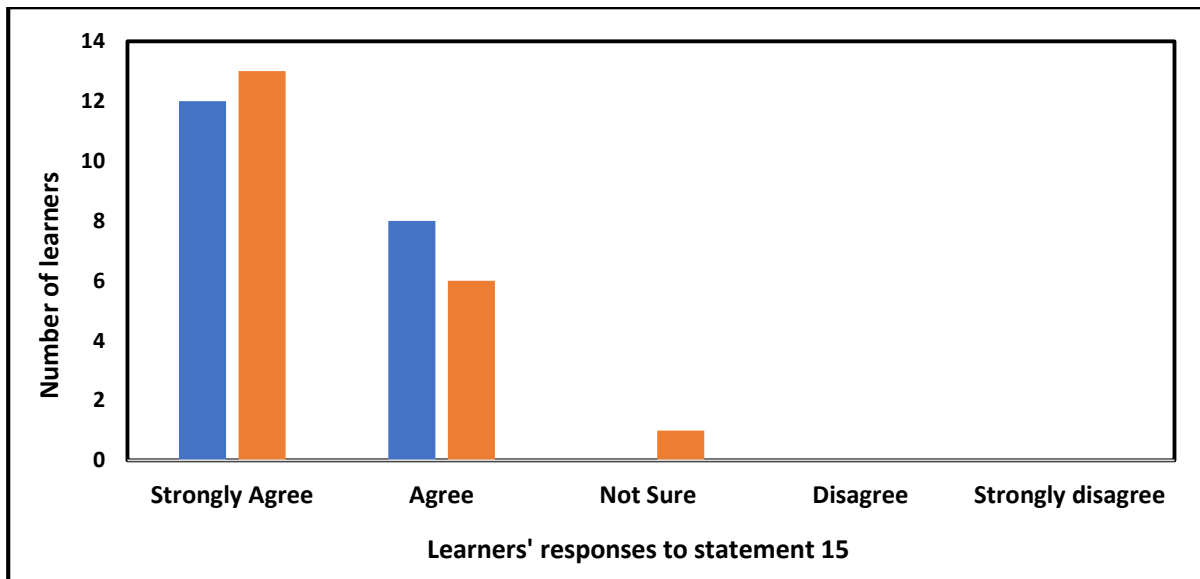


Figure 85: The learners' responses to statement 15 "Doing science projects is not a waste," before and after the intervention.

Before the intervention, 12 learners strongly agreed with the statement “doing science projects is not a waster,” and 8 learners agreed (Figure 15). This means that, all the 20 learners had a positive attitude with regards to statement 15, before the intervention. After the intervention, 13 learners strongly agreed with the statement, 6 learners agreed, and 1 learner was not sure. This means that, out of the 20 learners, 19 learners had a positive attitude with regards to statement 15 and 1 learner was undecided. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

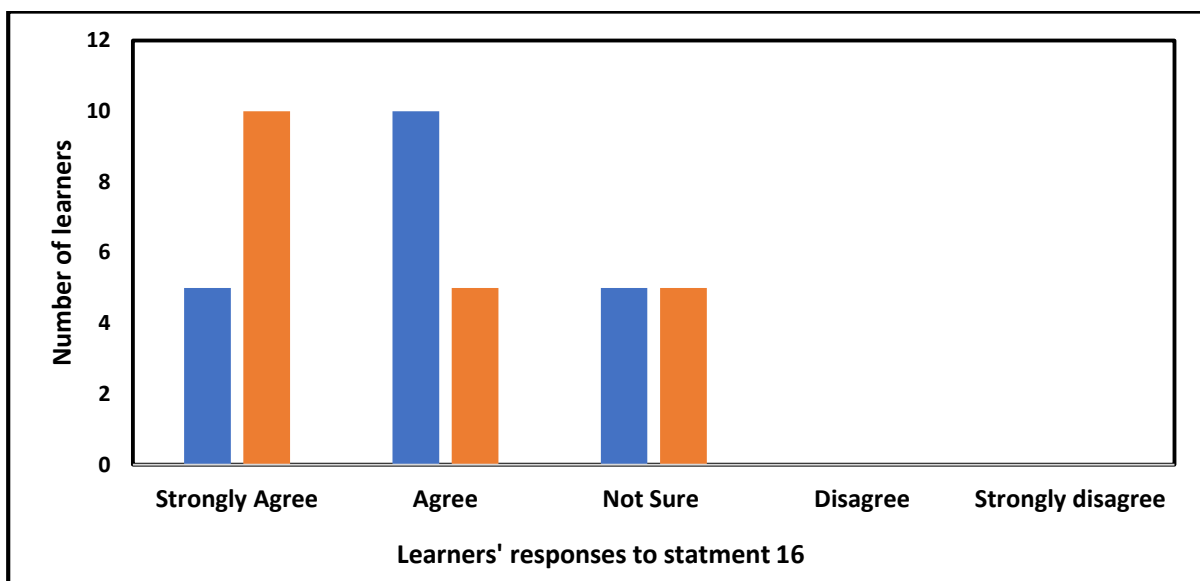


Figure 96: The learners' responses to statement 16 "scientists are friendly like other people," before and after the intervention.

Before the intervention, 5 learners strongly agreed with the statement “scientists are friendly like other people,” 10 learners agreed, and 5 learners were not sure (Figure 16). This means that, out of the 20 learners, 15 learners had a positive attitude with regards to statement 16 and 5 learners were undecided, before the intervention. After the intervention, 10 learners strongly agreed with the statement, 5 learners agreed and 5 were not sure. This means that, out of the 20 learners, 15 learners had a positive attitude with regards to statement 16 and 5 learners were undecided. After the intervention more learners strongly agreed with the statement, compared to before the intervention.

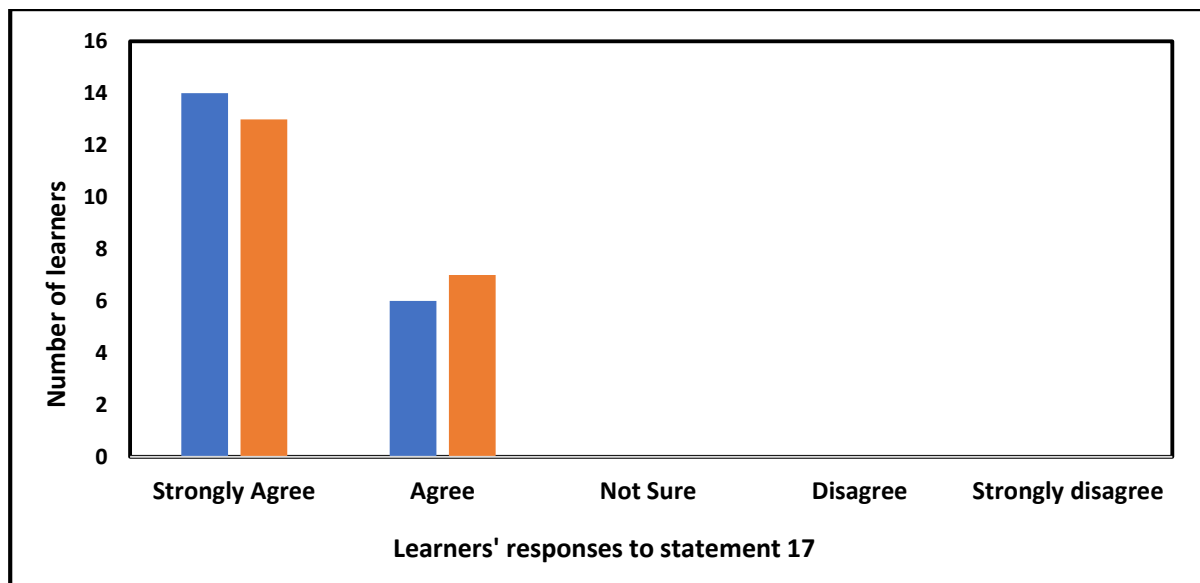


Figure 107: The learners' responses to statement 17 "It is good to do experiments to find out about things," before and after the intervention.

Before the intervention, 6 learners agreed with the statement “It is good to do experiments to find out about things” and 14 strongly agreed (Figure 17). This means that all 20 learners had a positive attitude with regards to statement 17, before intervention. After the intervention, 7 learners agreed with the statement and 13 learners strongly agreed. After the intervention, all learners still had a positive attitude and less learners strongly agreed with the statement compared to before the intervention.

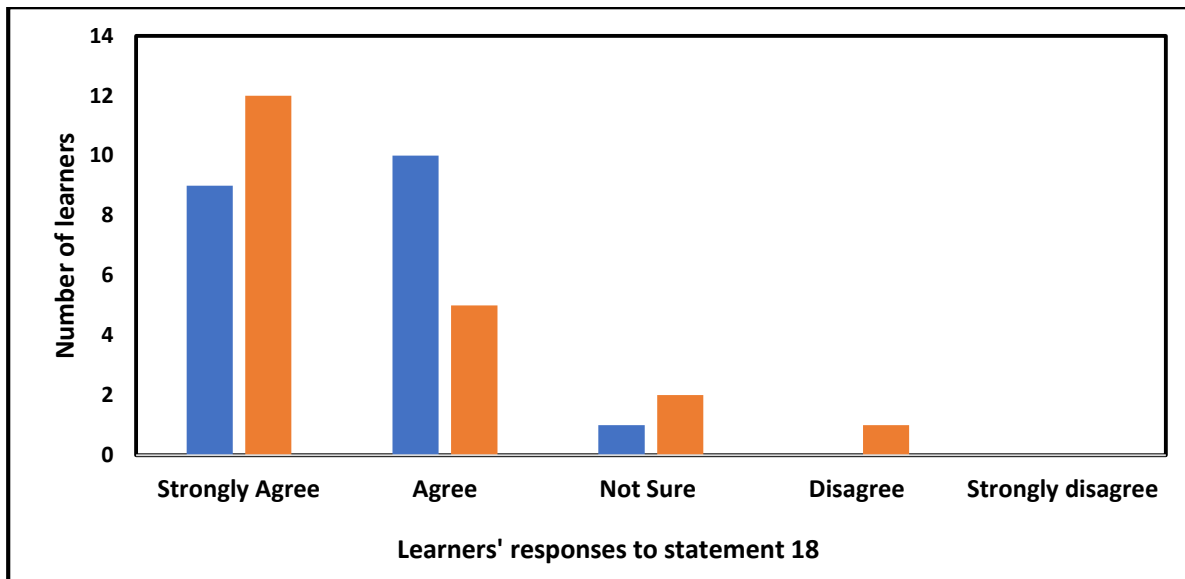


Figure 118: The learners' responses to statement 18 "I enjoy reading about new things in science that change my ideas," before and after the intervention.

Before the intervention, 9 learners strongly agreed with the statement “I enjoy reading about new things in science that change my ideas,” 10 learners agreed, and 1 learner was not sure (Figure 18). This means that, out of the 20 learners, 19 learners had a positive attitude with regards to statement 18 and 2 learners were undecided, before the intervention. After the intervention, 12 learners strongly agreed with the statement, 5 learners agreed, 2 were not sure and 1 learner disagreed. This means that, out of the 20 learners, 17 learners had a positive attitude, 2 were undecided and 1 learner had a negative attitude with regards to statement 18. After the intervention less learners had a positive attitude with regards to the statement, but more learners strongly agreed compared to before the intervention.

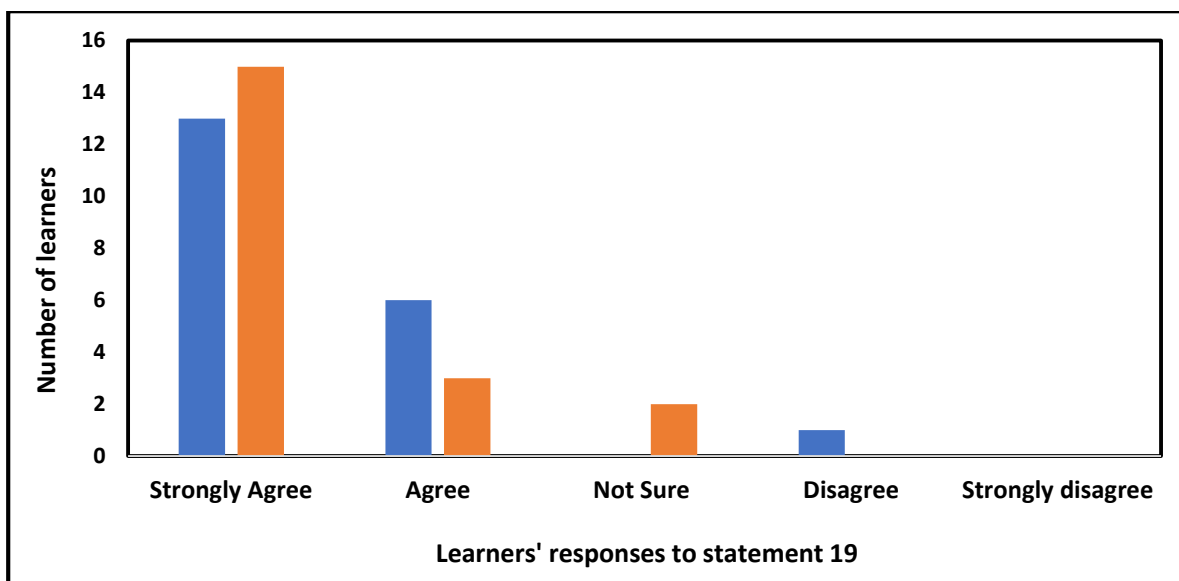


Figure 129: The learners' responses to statement 19 "schools should do more practical science lessons each week," before and after the intervention.

Before the intervention, 13 learners strongly agreed with the statement “schools should do more practical science lessons each week,” 6 learners agreed, and 1 learner disagreed (Figure 19). This means that, out of the 20 learners, 19 learners had a positive attitude and 1 learner had a negative attitude with regards to statement 19, before the intervention. After the intervention, 15 learners strongly agreed with the statement, 3 learners agreed and 4 were not sure. This means that, out of the 20 learners, 18 learners had a positive attitude with regards to statement 19 and 4 learners were undecided. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

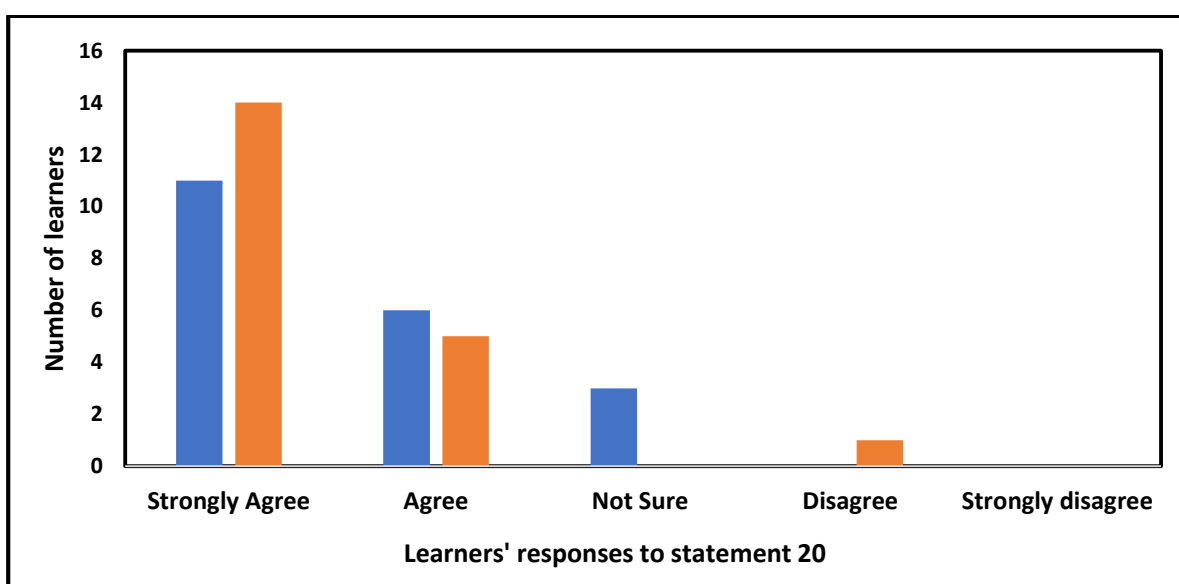


Figure 20: The learners' responses to statement 20 "I would like to be given a science book or a piece of science equipment as present," before and after the intervention.

Before the intervention, 11 learners strongly agreed with the statement “I would like to be given a science book or a piece of scientific equipment,” 6 learners agreed, and 3 learners disagreed (Figure 20). This means that, out of the 20 learners, 17 learners had a positive attitude with regards to statement 18 and 3 learners were undecided, before the intervention. After the intervention, 14 learners strongly agreed with the statement, 5 learners agreed, and 1 learner disagreed. This means that, out of the 20 learners, 19 learners had a positive attitude and 1 learner had a negative attitude with regards to statement 20. After the intervention more learners had a positive attitude with regards to the statement, compared to before the intervention.

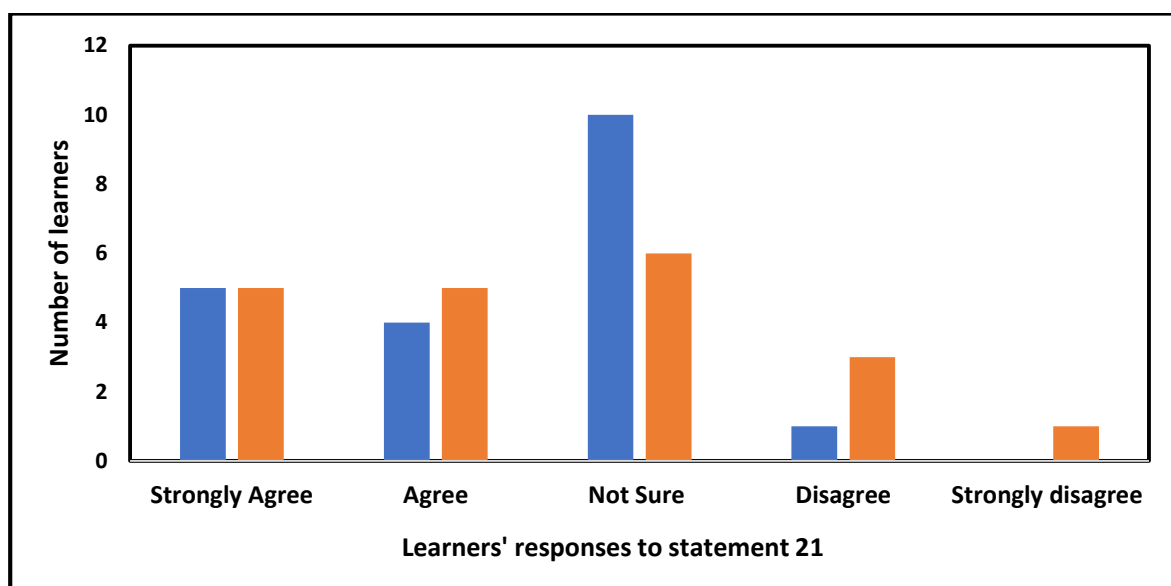


Figure 213: The learners' responses to statement 21 "I would like a job in a science laboratory," before and after the intervention.

Before the intervention, 5 learners strongly agreed with the statement “I would like a job in a science laboratory,” 4 learners agreed, 10 learners were not sure, and 1 learner disagreed (Figure 21). This means that, out of the 20 learners, 9 learners had a positive attitude, 10 learners were undecided, and 1 learner had a negative attitude with regards to statement 21, before the intervention. After the intervention, 5 learners strongly agreed with the statement, 10 learners agreed, 6 were undecided, 3 disagreed and 1 learner strongly disagreed. This means that, out of the 20 learners, 10 learners had a positive attitude, 6 were undecided and 4 had a negative attitude with regards to statement 21. After the intervention more learners had a positive attitude with regards to the statement, compared to before the intervention.

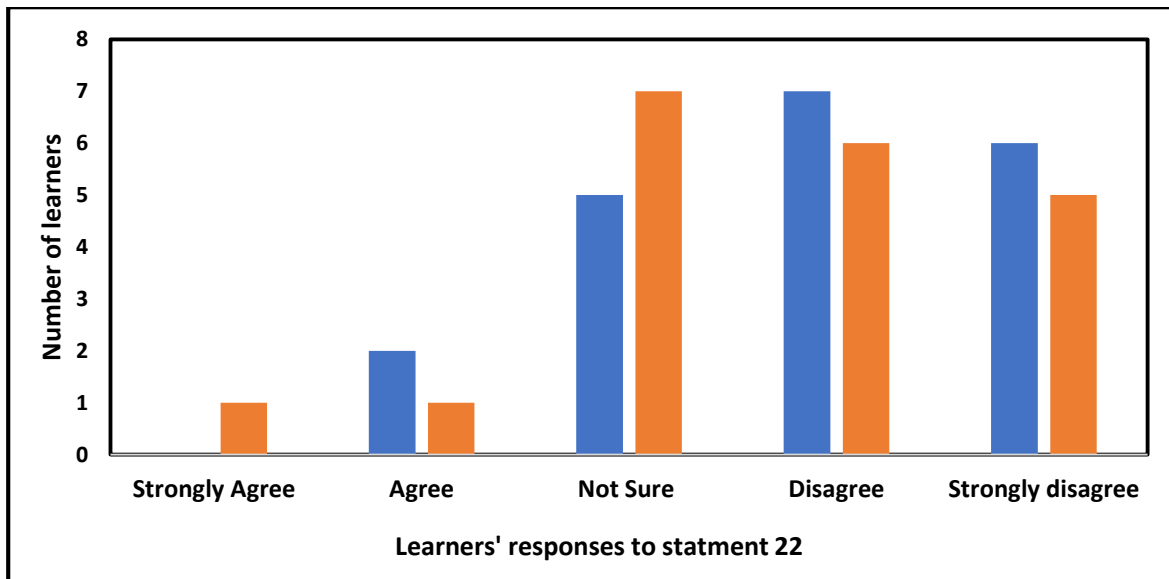


Figure 22: The learners' responses to statement 22 "scientific discoveries are doing more harm than good," before and after the intervention.

Before the intervention, 2 learners agreed with the statement “scientific discoveries are doing more harm than good,” 5 learners were not sure, 7 learners disagreed, and 6 learners strongly disagreed (Figure 22). This means that, out of the 20 learners, 13 learners had a positive attitude, 5 learners were undecided, and 2 learners had a negative attitude with regards to statement 22, before the intervention. After the intervention, 1 learner strongly agreed with the statement, 1 learner agreed, 7 learners were not sure, 6 learners disagreed, and 5 learners strongly disagreed. This means that, out of the 20 learners, 11 learners had a positive attitude, 7 were undecided and 2 learners had a negative attitude with regards to statement 22. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

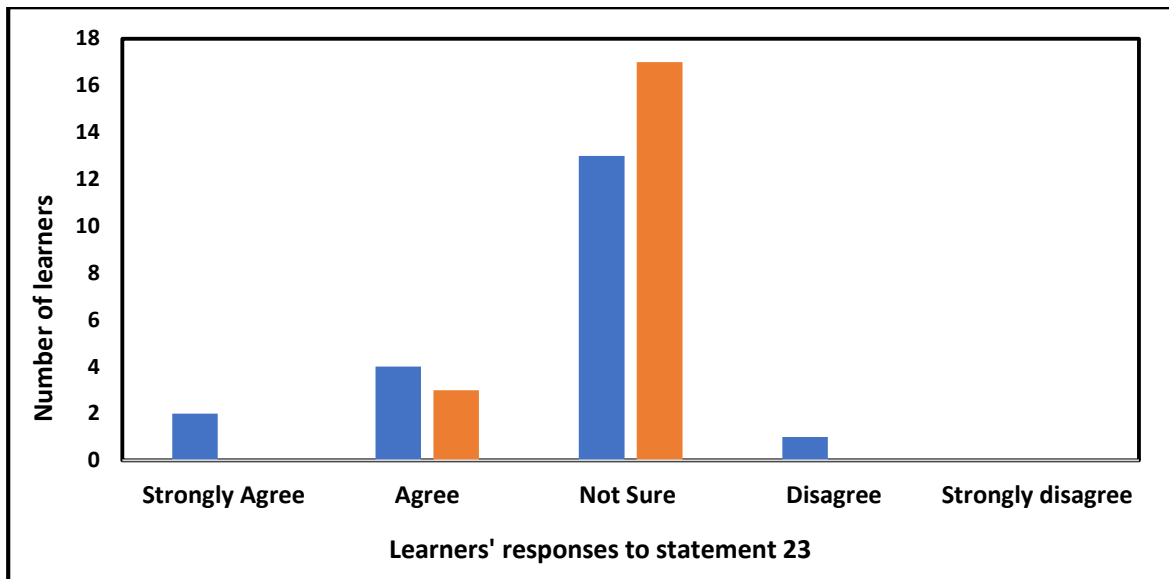


Figure 23: The learners' responses to statement 23 "scientists like sport as much as other people do," before and after the intervention.

Before the intervention, 2 learners strongly agreed with the statement “scientists like sport as much as other people do,” 4 learners agreed, 13 learners were not sure, and 1 learner disagreed (Figure 23). This means that, out of the 20 learners, 6 learners had a positive attitude, 13 learners were undecided, and 1 learner had a negative attitude with regards to statement 23, before the intervention. After the intervention, 3 learners agreed with the statement and 13 learners were undecided. This means that, out of the 20 learners, 3 learners had a positive attitude with regards to statement 23 and 17 were undecided. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

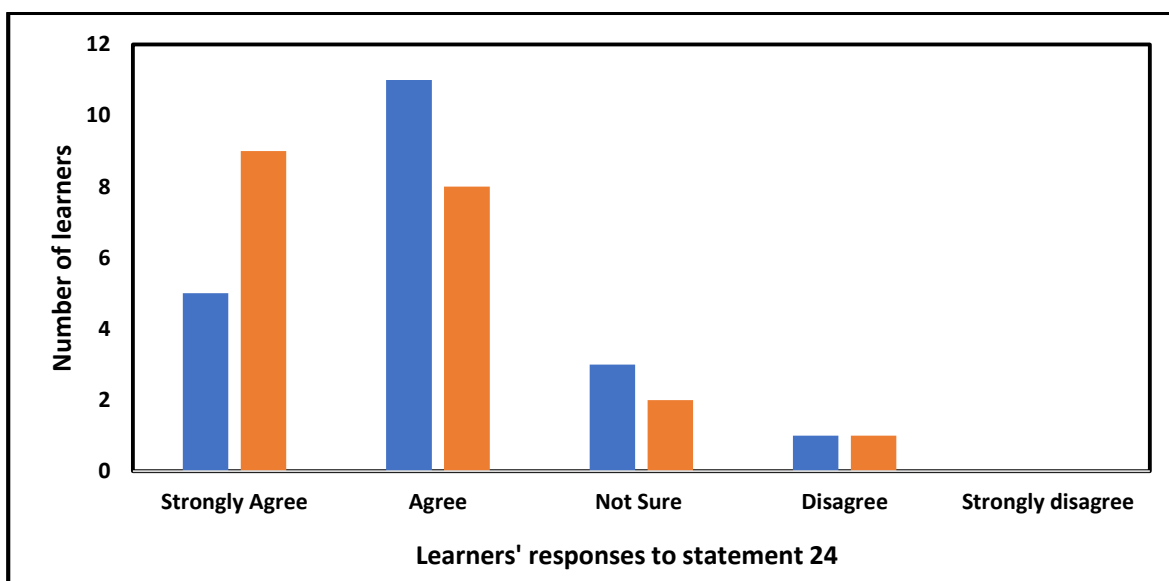


Figure 24: The learners' responses to statement 24 "To answer a science question, I would think it over before asking for help," before and after the intervention.

Before the intervention, 5 learners strongly agreed with the statement “to answer a science question, I would think it over before asking for help,” 11 learners agreed, 3 learners were not sure, and 1 learner disagreed (Figure 24). This means that, out of the 20 learners, 16 learners had a positive attitude, 3 learners were undecided, and 1 learner had a negative attitude with regards to statement 24, before the intervention. After the intervention, 9 learners strongly agreed with the statement, 8 learners agreed, 2 were undecided and 1 learner disagreed. This means that, out of the 20 learners, 17 learners had a positive attitude, 2 were undecided and 1 learner had a negative attitude with regards to statement 24. After the intervention more learners had a positive attitude with regards to the statement, compared to before the intervention.

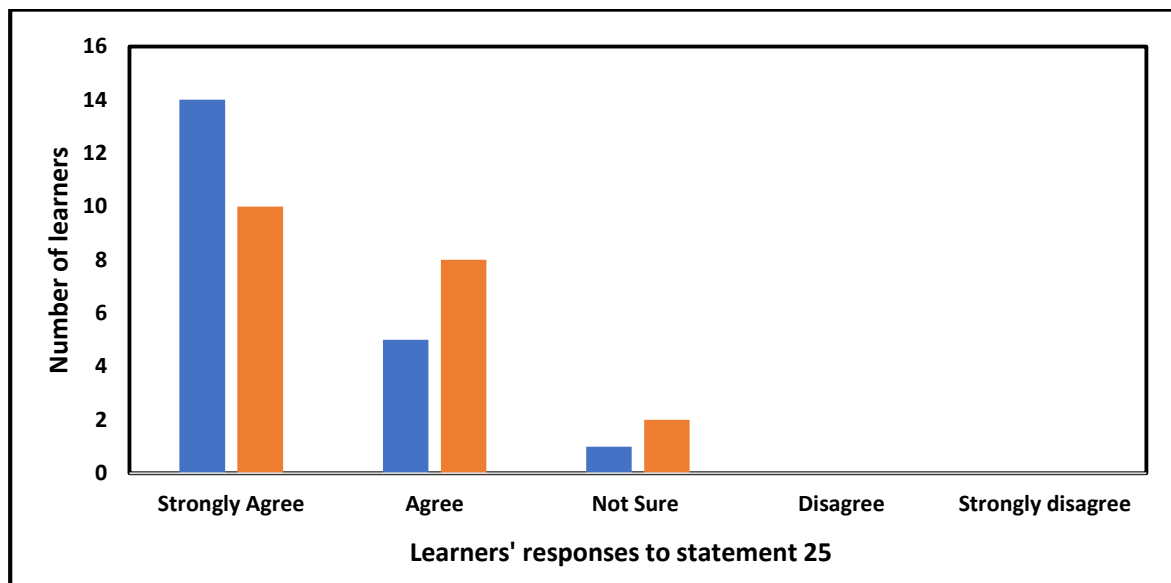


Figure 25: The learners' responses to statement 25 "It is good to repeat an experiment to check if results are correct," before and after the intervention.

Before the intervention, 14 learners strongly agreed with the statement “It is good to repeat an experiment to check if results are correct,” 5 learners agreed, and 1 learner was not sure (Figure 25). This means that, out of the 20 learners, 19 learners had a positive attitude with regards to statement 25 and 1 learner was undecided, before the intervention. After the intervention, 10 learners strongly agreed with the statement, 8 learners agreed, and 2 learners were not sure. This means that, out of the 20 learners, 18 learners had a positive attitude with regards to statement 25 and 2 were undecided. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

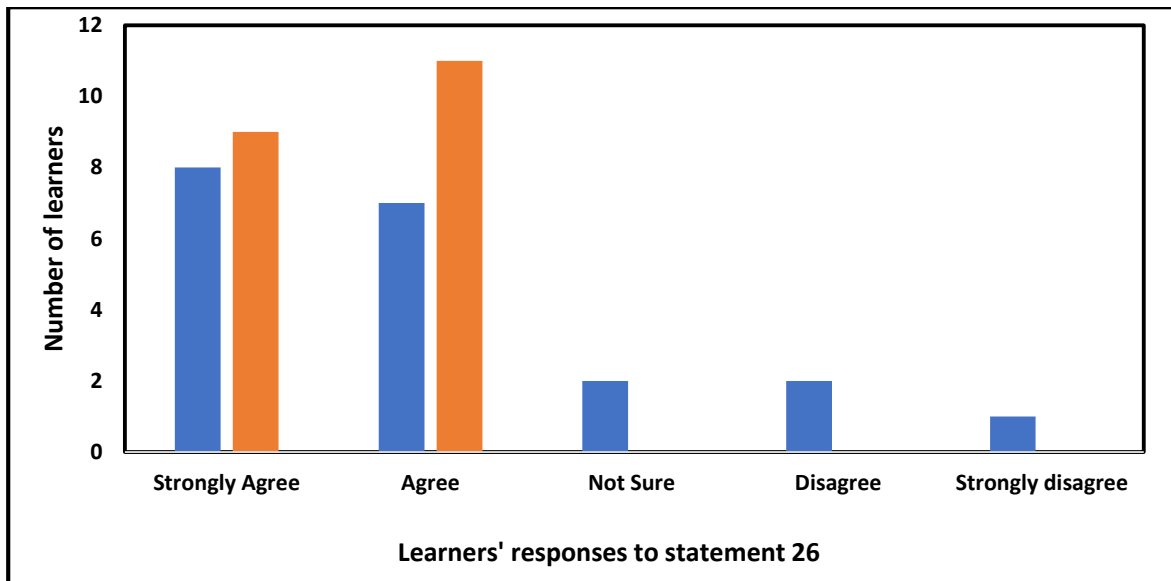


Figure 26: *The learners' responses to statement 26 “science lessons are useful for learning about everyday life,” before and after the intervention.*

Before the intervention, 8 learners strongly agreed with the statement “science lessons are useful for learning about everyday life,” 7 learners agreed, 2 learners were not sure, 2 learners disagreed, and 2 learners strongly disagreed (Figure 26). This means that, out of the 20 learners, 15 learners had a positive attitude, 2 learners were undecided, and 3 learners had a negative attitude with regards to statement 25, before the intervention. After the intervention, 9 learners strongly agreed with the statement and 11 learners agreed. This means that all the 20 learners, had a positive attitude with regards to statement 25. After the intervention more learners had a positive attitude with regards to the statement, compared to before the intervention.

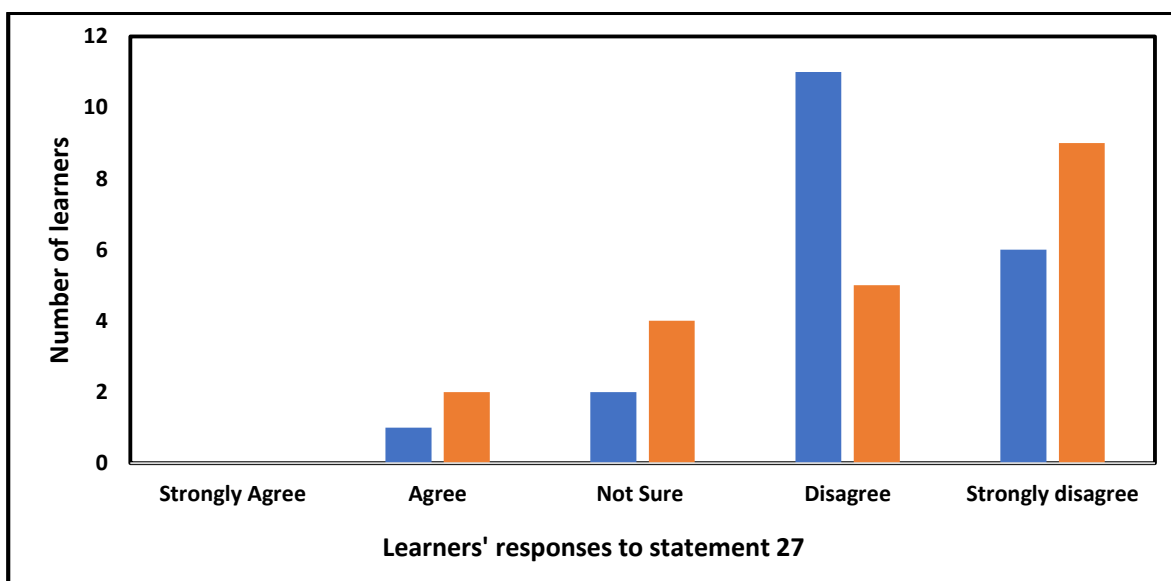


Figure 27: *The learners' responses to statement 27 "I dislike reading books about science in my free time," before and after the intervention.*

Before the intervention, 1 learner agreed with the statement “I dislike reading books about science in my free time,” 2 learners were not sure, 11 learners disagreed, and 6 learners strongly disagreed (Figure 27). This means that, out of the 20 learners, 17 learners had a positive attitude, 2 learners were undecided, and 1 learner had a negative attitude with regards to statement 27, before the intervention. After the intervention, 2 learners agreed with the statement, 4 were undecided, 5 disagreed and 9 learners strongly disagreed. This means that, out of the 20 learners, 14 learners had a positive attitude, 4 were undecided and 2 had a negative attitude with regards to statement 27. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

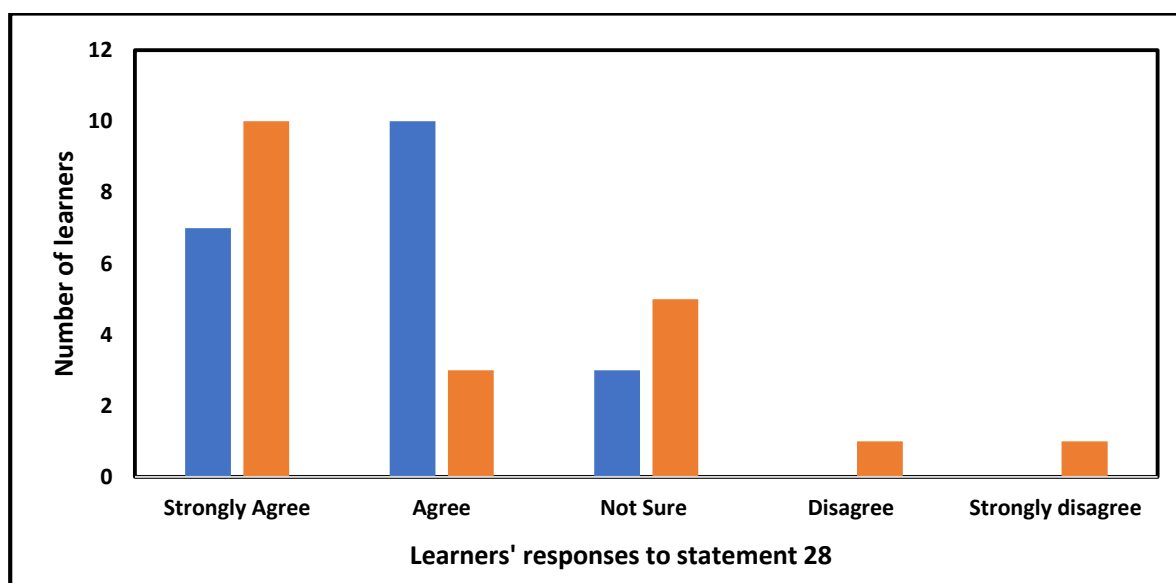


Figure 28: The learners' responses to statement 28 “Working in a science laboratory would be interesting” before and after the intervention.

Before the intervention, 7 learners strongly agreed with the statement “Working in a science lab would be interesting,” 10 learners agreed, and 3 learners were not sure (Figure 28). This means that, out of the 20 learners, 17 learners had a positive attitude with regards to statement 28 and 3 learners were undecided, before the intervention. After the intervention, 10 learners strongly agreed with the statement, 3 learners agreed, 5 were undecided, 1 disagreed and 1 learner strongly disagreed. This means that, out of the 20 learners, 13 learners had a positive attitude, 5 were undecided and 2 learners had a negative attitude with regards to statement 28. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

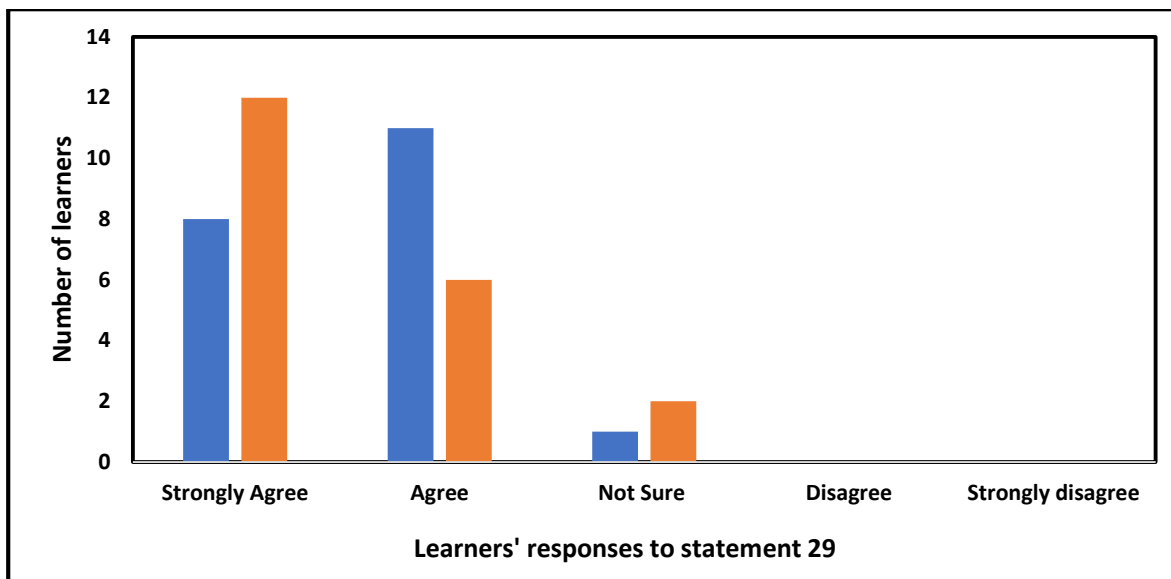


Figure 29: The learners' responses to statement 29 "building science laboratories is good for the society," before and after the intervention.

Before the intervention, 8 learners strongly agreed with the statement “building science labs is good for the society,” 11 learners agreed, and 1 learner was not sure (Figure 29). This means that, out of the 20 learners, 19 learners had a positive attitude with regards to statement 29 and 1 learner was undecided, before the intervention. After the intervention, 12 learners strongly agreed with the statement, 6 learners agreed, and 2 learners were not sure. This means that, out of the 20 learners, 18 learners had a positive attitude with regards to statement 29 and 3 learners were undecided. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

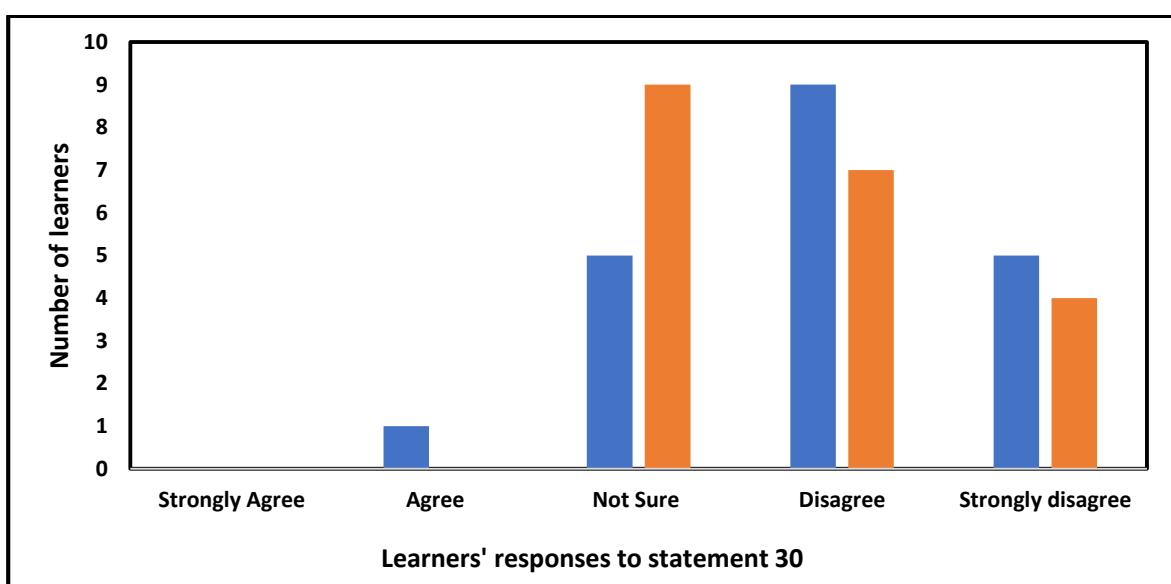


Figure 30: The learners' responses to statement 30 "scientists are less friendly than other people," before and after the intervention.

Before the intervention, 1 learner agreed with the statement “scientists are less friendly than other people,” 5 learners were not sure, 9 learners disagreed, and 5 learners strongly disagreed (Figure 30). This means that, out of the 20 learners, 14 learners had a positive attitude, 5 learners were undecided, and 1 learner had a negative attitude with regards to statement 30, before the intervention. After the intervention, 9 learners were not sure about the statement, 7 disagreed and 4 learners strongly disagreed. This means that, out of the 20 learners, 11 learners had a positive attitude with regards to statement 30 and 9 learners were undecided. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

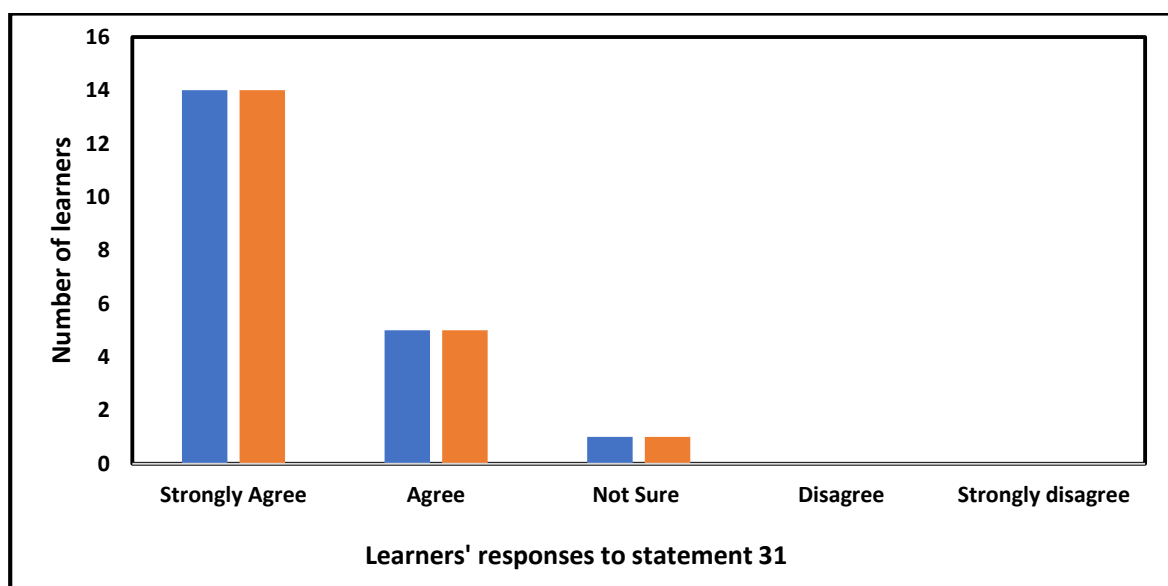


Figure 31: The learners' responses to statement 31 "I enjoy scientific experiments because I learn from them" before and after the intervention.

Before the intervention, 14 learners strongly agreed with the statement “I enjoy scientific experiments because I learn from them,” 5 learners agreed, and 1 learner was not sure (Figure 31). This means that, out of the 20 learners, 19 learners had a positive attitude with regards to statement 31 and 1 learner was undecided, before the intervention. After the intervention, 14 learners strongly agreed with the statement, 5 learners agreed, and 1 learner was not sure. This means that, out of the 20 learners, 19 learners had a positive attitude with regards to statement 31 and 1 learner was undecided. After the intervention there was no change in the attitude the learners had with regards to the statement, compared to before the intervention.

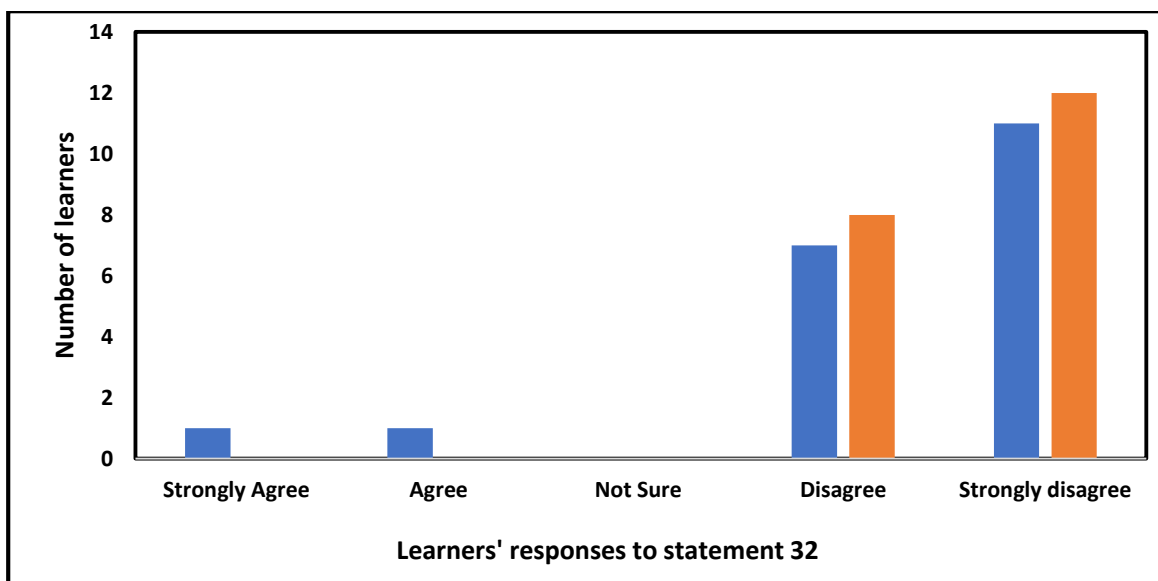


Figure 32: The learners' responses to statement 32 "finding out about new things in science is not important," before and after the intervention.

Before the intervention, 1 learner strongly agreed with the statement “finding out about new things in science is not important,” 1 learner agreed, 7 learners disagreed, and 11 learners strongly disagreed (Figure 32). This means that, out of the 20 learners, 18 learners had a positive attitude and 2 learners had a negative attitude with regards to statement 32, before the intervention. After the intervention, 8 disagreed with the statement and 12 learners strongly disagreed. This means that, all the 20 learners had a positive attitude with regards to statement 32. After the intervention more learners had a positive attitude with regards to the statement, compared to before the intervention.

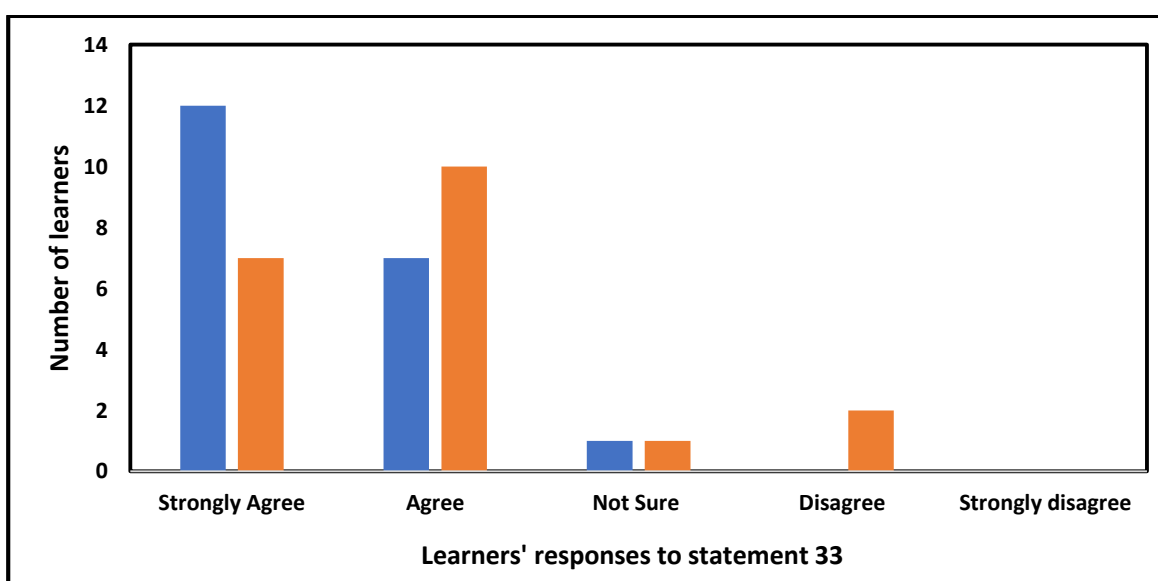


Figure 33: The learners' responses to statement 33 "science is one of the most interesting school subjects," before and after the intervention.

Before the intervention, 12 learners strongly agreed with the statement “science is one of the most interesting school subject,” 7 learners agreed, and 1 learner was not sure (Figure 33). This means that, out of the 20 learners, 19 learners had a positive attitude with regards to statement 33 and 1 learner was undecided, before the intervention. After the intervention, 7 learners strongly agreed with the statement, 10 learners agreed, 1 learner was not sure, and 2 learners disagreed. This means that, out of the 20 learners, 17 learners had a positive attitude, 1 learner was undecided, and 2 learners had a negative attitude with regards to statement 33. After the intervention less learners had a positive attitude with regards to the statement, compared to before the intervention.

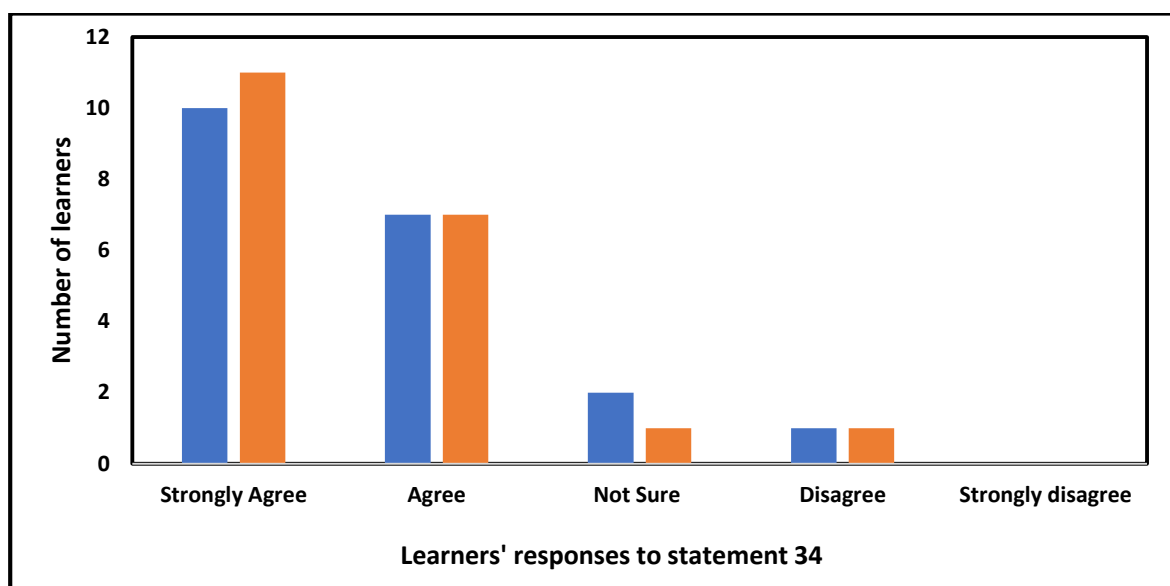


Figure 34: The learners' responses to statement 34 "I would like to do science experiments at home," before and after the intervention.

Before the intervention, 10 learners strongly agreed with the statement “I would like to do science experiments at home,” 7 learners agreed, 2 learners were not sure, and 1 learner disagreed (Figure 34). This means that, out of the 20 learners, 17 learners had a positive attitude, 2 learners were undecided, and 1 learner had a negative attitude with regards to statement 34, before the intervention. After the intervention, 11 learners strongly agreed with the statement, 7 learners agreed, 1 learner was not sure, and 1 learner disagreed. This means that, out of the 20 learners, 18 learners had a positive attitude, 2 learners were undecided, and 1 learner had a negative attitude with regards to statement 32. After the intervention more learners had a positive attitude with regards to the statement, compared to before the intervention.

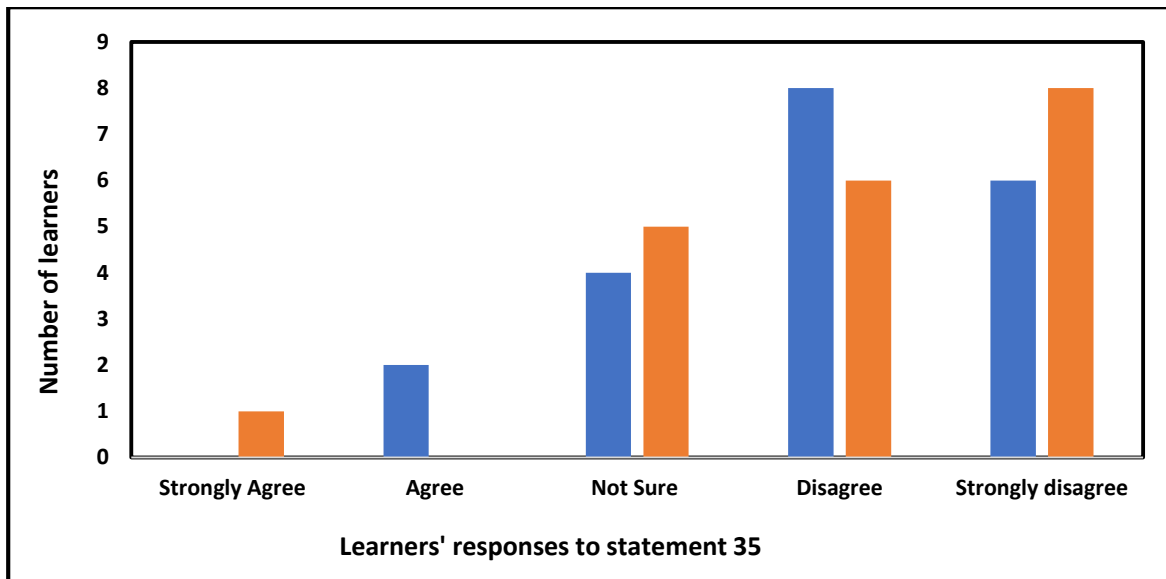


Figure 35: The learners' responses to statement 35 "I would not like to be a scientist because it requires too much education" before and after the intervention.

Before the intervention, 2 learners agreed with the statement “I would not like to be a scientist because it requires too much education,” 4 learners were not sure, 8 learners disagreed, and 6 learners strongly disagreed (Figure 35). This means that, out of the 20 learners, 14 learners had a positive attitude, 4 learners were undecided, and 2 learners had a negative attitude with regards to statement 35, before the intervention. After the intervention, 1 learner strongly agreed with the statement, 4 learners were not sure, 6 learners disagreed, and 8 learners strongly disagreed. This means that, out of the 20 learners, 14 learners still had a positive attitude, 5 learners were undecided, and 1 learner had a negative attitude with regards to statement 35. After the intervention less learners had a negative attitude with regards to the statement, compared to before the intervention.

APPENDIX G: THE TRANSCRIBED INTERVIEWS

The learners' and volunteers' interviews.

Learner 1

| <i>VERBATIM</i> | <i>TRANSLATED TO ENGLISH</i> |
|---|---|
| <p><i>Interviewer: Uhm, so, uqale nini ukuza kwiClub?</i></p> <p><i>Learner: Eh, ndiqale, term... ngoku bekuqala iclub.</i></p> | <p><i>Interviewer: When did you start coming to the club?</i></p> <p><i>Learner: I started when the club started.</i></p> |
| <p><i>Interviewer: Uze oko? Oko usiza, oko iqalile iclub?</i></p> <p><i>Learner: Ha.ah, zikhona isessions endiziMiss(ileyo) due to istudy.</i></p> | <p><i>Interviewer: Did you attend all lessons?</i></p> <p><i>Learner: No, there are some sessions I missed because of the study at school.</i></p> |
| <p><i>Interviewer: Uxelelwe ngubani? Kutheni uDecide(e) uba mawuze kwiscience club nje?</i></p> <p><i>Learner: I needed help with Natural sciences and uMam'Depi uthe uba izinto esizifunda kwiNatural science, we can get help apha kwiClub.</i></p> | <p><i>Interviewer: Who told you about the club? Why did you decide to join?</i></p> <p><i>Learner: I needed help with Natural Sciences and my teacher told me that we can get help, with our schoolwork, at the science club.</i></p> |
| <p><i>Interviewer: Okay, so oko ufikile kwiScience club iyenzeka lonto?</i></p> <p><i>Learner: Ewe, iyenzeka.</i></p> | <p><i>Interviewer: Okay, so, do you feel like that has been happening?</i></p> <p><i>Learner: Yes, it is happening.</i></p> |

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| <p><i>Interviewer: Nyani nyani? Uthethe inyani ne, ungaboni mna. So, do you feel like iyenzeka lonto leyo?</i></p> <p>Learner: Ewe hayi iyenzeka yona.</p> | <p><i>Interviewer: Really? I need you to be honest with me, do you feel like it had been happening?</i></p> <p>Learner: Yes, it is happening.</p> |
| <p><i>Interviewer: UyaUndrstand(a) betele xa ukwiscience club?</i></p> <p>Learner: Ewe</p> | <p><i>Interviewer: You understand better?</i></p> <p>Learner: Yes.</p> |
| <p><i>Interviewer: Kanjani mhlambi?</i></p> <p>Learner: Uhm, iscience club, for example icircuits parallel besingekazifundi zona, ndazifundiswa ngubuti. But then, xa sesezifunda ndabe ndiyazi yonke into ebekufuneka ndiyazile ngazo. So kengoku xa kufuneka siphendulile ndaba right kengoku kwianswers. Ndaba neUnderstanding yazo.</p> | <p><i>Interviewer: How?</i></p> <p>Learner: We had not done circuits at school, one of the volunteers taught us. By the time we did them at school, I knew everything that I was supposed to know about them. So, I was answering questions and I had an understanding.</p> |
| <p><i>Interviewer: Ndyakuva.KweziExperiments sizenzayo ke zonke from uTerm 2, eziya wawuzenzile zeAcids and bases, xa ucinga zikuncedile? Emsebenzini wakho weskolo?</i></p> | <p><i>Interviewer: I hear you. Now do you think the experiments we did on acids and bases in term 2 helped you? With your schoolwork?</i></p> <p>Learner: Yes, they helped me.</p> |

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| <p>Learner: Ewe, zindincedile.</p> | |
| <p><i>Interviewer: Kanjani? Ndzoba buza oko ke o'Kanjani.'</i></p> <p>Learner: Zindenzele lula uba ndizazi izinto uba okay, if you mix into, lena nalena, iresults zayo ibe yile. And if lena into andiyiunderstandi kakuhle ndzoyiExperimenta ivele uba ithini na iconclusion yayo.</p> | <p><i>Interviewer: How? I will be asking 'how' a lot.</i></p> <p>Learner: They made it easy for me to understand stuff, like what happens when you mix two things and if you do not understand something, you can always conduct an experiment to get a conclusion.</p> |
| <p><i>Interviewer: Nikhe nayiteach(wa) eskolweni, ezinye zezinto ebesizenzile kwiscience club?</i></p> <p>Learner: Ewe sike sayiteach(wa).</p> | <p><i>Interviewer: Have you been taught any of the work we did at the club?</i></p> <p>Learner: Yes, we have.</p> |
| <p><i>Interviewer: Xa ucinga kutheni abanye abantwana bengazi?</i></p> <p>Learner: Hayi ma'am, to be honest, mhlambi maybe because idibene nento yofunda because besigcwele ekuqeleni kwe...ekuqaleni konyaka besigcwele, but then siye sahla sahla sahla because ngexesha esiphuma ngalo. Then sathi ha.ah Its too much, abafuni, abasoze bahlalele ukufunda like half a day, oko bebemke engo7 kokwabo bayogoduka ngo4.</p> | <p><i>Interviewer: Why don't others think others come to the club in your opinion?</i></p> <p>Learner: Honestly, it has to do with school. There was a lot of us at the beginning of the year, but the number declined because of the time the club ends. So, we thought that it was too much, we can't be at school for half a day, leaving home at 7am and only returning at 4pm.</p> |

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| <p><i>Interviewer: Ndiyakuva. Wena generally, what do you think about science?</i></p> <p><i>Learner: To me science is fun and its great to learn new things and have a better understanding of what happens around us.</i></p> | <p><i>Interviewer: I hear you. What do you think about science?</i></p> <p><i>Learner: To me science is fun and its great to learn new things and have a better understanding of what happens around us.</i></p> |
| <p><i>Interviewer: So, have you always felt like this about science?</i></p> <p><i>Learner: Yes, I always felt like this.</i></p> | <p><i>Interviewer: So, have you always felt like this about science?</i></p> <p><i>Learner: Yes, I always felt like this.</i></p> |
| <p><i>Interviewer: Uqale nini?</i></p> <p><i>Learner: At a very age because, bendithanda ubukela i...iscience, izinto zescience, like o319, natural science nentoni. Bendibukela zona to actually learn iNatural Science for ngomso, ezinto sizozStudy(isha) ngomso ndiziUnderstand(e). But then I got to uthanda iscience, ndathanda nokwenza iexperiments...</i></p> | <p><i>Interviewer: When did you start?</i></p> <p><i>Learner: At a very young age because I really enjoyed watching science programmes such as channel 319. I watched them to learn Natural Sciences for the following year/grade. The I got to love science and doing experiments.</i></p> |
| <p><i>Interviewer: Andikuvanga, ncela uphinde...</i></p> <p><i>Learner: Ndithi bendikade ndipha ku3..., ikhon ichannel pha yeskolo. iNatural science bendiyijonga pha uGrade 8 ngoku bendisenza ugrade 7, kwazi xa ndifika apha mhlambi ndibe ndifully prepared for lento yenzekayo.</i></p> | <p><i>Interviewer: I didn't really get that...</i></p> <p><i>Learner: There is a school channel 319. When I was in grade 7, I used to watch the grade 8 Natural Sciences curriculum to prepare myself for the following year.</i></p> |

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| <p><i>Interviewer: Okay ndayakuva. So ukhona umahluko kengoku kwindlela oziva ngayo oko usiza kwiscience club?</i></p> <p><i>Learner: Ewe ikhona because ndifumene ibetter understanding yento ebendingazazi pha xa sizifundiswa, ndiyazazi mna, uyasifundisa utishara ndibe ndizazi mna. So andnangxaki.</i></p> | <p><i>Interviewer: I hear you. Do you feel any different now that you've been coming to the club?</i></p> <p><i>Learner: Yes, because I gotten a better understanding of the things I did not understand, when we taught at school, I already know them and so, I do not have a problem.</i></p> |
| <p><i>Interviewer: So, would you say kengoku uba uyithanda more iscience okanye wehlile ukuyithanda oko usiza kwiscience club?</i></p> <p><i>Learner: Ndiyithanda more oko ndisiza kwiscience club.</i></p> | <p><i>Interviewer: So, would you say you love science more or less since you've been coming to the club?</i></p> <p><i>Learner: I love it more.</i></p> |
| <p><i>Interviewer: So, do you think that iscience iyakwazi udibana nobomi bamanyani okanye ucinga uba iAbstract mhlambi ucinga uAlbert Einstein xa ucinga iscience?</i></p> <p><i>Learner: Oh, iyakwazi udibana because, izinto ezenzeka eee...around us ziyiscience and iresearch ihelp(a) us uba siUnderstand(e) the world around us so iscience iyasinceda kwiresearch.</i></p> | <p><i>Interviewer: Do you think is relatable and can be applied to real life situations? Or do you see it as abstract, maybe relating more to Albert Einstein?</i></p> <p><i>Learner: It is relatable to real life because, it is about what happens around us and research helps us to understand the world around us.</i></p> |

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| <p><i>Interviewer: Ndiyakuva. UyaziEnjoy(a) iscience lessons? Uthethe inyani.</i></p> <p><i>Learner: Hayi ndiyaziEnjoy(a) ma'am.</i></p> | <p><i>Interviewer: I hear you. Do you enjoy science lessons?</i></p> <p><i>Learner: Yes, I do enjoy them ma'am.</i></p> |
| <p><i>Interviewer: Ezaphi? Ezalapha, ezaseskolweni or everything about science?</i></p> <p><i>Learner: Everything about science ndiyayiEnjoy(a) because its interesting to learn more about science.</i></p> | <p><i>Interviewer: At the club, at school or just everything science?</i></p> <p><i>Learner: I enjoy everything about science because its interesting to learn more about science.</i></p> |
| <p><i>Interviewer: So, do you think, there is anything engenziwa to improve indlela eteach(wa) ngayo iscience ngoku?</i></p> <p><i>Learner: Uhm, ya, singabane science lab so that sikwazi ufunda kakuhle iscience. Singabe sihamba hamba eziclassini, nje uba siyazi ilaboratory yindawo esizofundela kuyo iscience sense iexperiments.</i></p> | <p><i>Interviewer: So, do you think there is anything that can done to improve the lessons?</i></p> <p><i>Learner: We can have science labs so we can learn science better. Substitute going to classrooms by going to the laboratory knowing that is where we learn science and do experiments.</i></p> |
| <p><i>Interviewer: Nenze iexperiments, so into oyirhalelayo kukwenza iexperiments?</i></p> <p><i>Learner: Yes</i></p> | <p><i>Interviewer: Do experiments. So, all you want is to do experiments?</i></p> <p><i>Learner: Yes.</i></p> |

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| <p><i>Interviewer: So nenze iexperiments ngezinto ezasemakhaya oziqhelileyo okanye nenze ngezinto zaselab?</i></p> <p><i>Learner: Into zaselab to learn new things nento zasemakhaya to understand uba kwenzeka ntoni but into zaselab ukwazi uzazi izinto ezintsha like, iexperiments zawudibanise le nale kuzokwenzeka ntoni kwireactions.</i></p> | <p><i>Interviewer: Do you prefer experiments with things that you are familiar or with lab stuff?</i></p> <p><i>Learner: I prefer lab stuff to learn new things, but with things that I know also for understanding but I prefer lab stuff to learn new things and do new experiments, like knowing the products of some reactions.</i></p> |
| <p><i>Interviewer: So, what problems do you have with learning science wena?</i></p> <p><i>Interviewer: Mna iscience uhm, ekuqaleni konyaka bendingekho ngaka kwinatural science, for example kwireport yam, I got... bendiqhele ufumana u7 phaya eNyaluza, but here I got 4. But then uMam'Depi wathi mandize apha and then I got to understand more and more and more and read my books more and more and more. I reached for uLevel 6 but this term I am aiming for level 7.</i></p> | <p><i>Interviewer: So, what problems do you have with learning science?</i></p> <p><i>Interviewer: At the beginning of the year, I didn't do so well in Natural Sciences, I got level 4. My teacher told me to join the club, I did and I began to understand my work better, worked more and studied more. I got level 6 and I am now aiming for level 7.</i></p> |
| <p><i>Interviewer: Well done! So, would you like to be a scientist?</i></p> <p><i>Learner: Yes, I would like to be a scientist yeah. Yah, ndiyafuna uba yiscientist.</i></p> | <p><i>Interviewer: Well done! So, would you like to be a scientist?</i></p> <p><i>Learner: Yes, I would like to be a scientist yeah. Yah, I really want to be a scientist.</i></p> |

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| <p><i>Interviewer: Eyiphi mhlambi?</i></p> <p><i>Learner: Iscientist that studies i...iAstronomy.</i></p> | <p><i>Interviewer: Which one?</i></p> <p><i>Learner: A scientist that studies astronomy.</i></p> |
| <p><i>Interviewer: Uyayithanda iphysics?</i></p> <p><i>Learner: Yeah</i></p> | <p><i>Interviewer: Do you love physics?</i></p> <p><i>Learner: Yeah</i></p> |
| <p><i>Interviewer: Why mhlambi?</i></p> <p><i>Learner: Ewe ma'am. There's other things in the universe that we do not know, for example, how, where does the galaxies take us to where, how old is the sun? There is many rumours that the sun is, the age about the sun is there are many rumours and how the earth began there are many rumours. So, I want to understand more about the sun and the universe. If there are living organisms, other, in other planets other than earth, if there are any life forms.</i></p> | <p><i>Interviewer: Why?</i></p> <p><i>Learner: Yes, because there are things we don't know about the universe, for example, where do galaxies lead us to? How old is the sun? There are many rumours about the age of the sun and about how the earth began. So, I want to understand more about the sun and the universe. I also want to know if there are any living organisms in other planets besides the earth.</i></p> |
| <p><i>Interviewer: Mmmh, ndiyakuva. So izinto ezinjalo, they fascinate and excite you?</i></p> <p><i>Learner: Yes</i></p> | <p><i>Interviewer: I hear you. So, such things are fascinating/exciting to you?</i></p> <p><i>Learner: Yes.</i></p> |

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| <p><i>Interviewer: So, do you think ukufunda iscience by relating it to everyday life helps?</i></p> <p><i>Learner: Yes, it really helps because you get a better understanding because like, ikhona into ebesiyifunda pha eclass(ini) about ilighning. Ilightning, kutwa you cannot run to lightning because it causes... I think it causes ifriction so.</i></p> | <p><i>Interviewer: So, do you think learning science by relating it to everyday life helps?</i></p> <p><i>Learner: Yes, because you get a better understanding. There is something we learnt at school about lightning, apparently, we shouldn't run to lighting because it causes friction...</i></p> |
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Learner 2

| VERBATIM | TRANSLATED TO ENGLISH |
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| <p><i>Interviewer: Ufike nini kwiScience club?</i></p> <p><i>Learner: Ndiqale kuTerm 1</i></p> | <p><i>Interviewer: When did you start coming to the science club?</i></p> <p><i>Learner: I started in Term 1.</i></p> |
| <p><i>Interviewer: Why usiza kwiScience club?</i></p> <p><i>Learner: Because bendiFail(isha) iNatural Science</i></p> | <p><i>Interviewer: Why do you come?</i></p> <p><i>Learner: Because I used to fail Natural Sciences.</i></p> |
| <p><i>Interviewer: So waFeel(isha) ngathi xa usiza kwiscience club kuzokwenzeka ntoni?</i></p> | <p><i>Interviewer: So, what did you think would happen if you came to the club?</i></p> |

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| Learner: Andikuya. | Learner: I didn't get that. |
| <p><i>Interviewer: WaFeel(isha) ngathi xa usiza kwiscience club uzopasa mhlambi?</i></p> <p>Learner: Ewe</p> | <p><i>Interviewer: You felt that coming to the science club would help you pass?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: Uve ngobani ubana kukhona iscience club and mhlambi ungapasa xa usiza kiscience club?</i></p> <p>Learner: Ndiva ngomam wam.</p> | <p><i>Interviewer: Who told you about the science club, and that you could get help to pass?</i></p> <p>Learner: My teacher told me</p> |
| <p><i>Interviewer: Okay. Iyakunceda ke iscience club xa ubona wena?</i></p> <p>Learner: Ewe iyandinceda</p> | <p><i>Interviewer: Is the club helping?</i></p> <p>Learner: Yes, it helps</p> |
| <p><i>Interviewer: Ikunceda kwintoni mhlambi okanye, kanjani?</i></p> <p>Learner: Indinceda kwezinye indawo endingaziUnderstand(iyo).</p> | <p><i>Interviewer: How is it helping?</i></p> <p>Learner: It helps with things that I do not understand.</p> |
| <p><i>Interviewer: Mmmmmmh, yenza njani?</i></p> | <p><i>Interviewer: How?</i></p> |

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| <p>Learner: Yintoni oyibuzayo?</p> | <p>Learner: What are you asking?</p> |
| <p><i>Interviewer: Ikunceda njani kwinto ongaziUnderstand(iyo) okanye zintoni ezi ikuncede kuzo?</i></p> <p>Learner: Ndichaze noba yeyiphi?</p> | <p><i>Interviewer: How does it help? Or what has it helped you with?</i></p> <p>Learner: Should I choose any?</p> |
| <p><i>Interviewer: Ewe. Noba ubona ingathi yintoni ekuncedileyo. Ubona ngathi uncedakelel ngoku ne?</i></p> <p>Learner: Ewe.</p> | <p><i>Interviewer: Yes. Or what do you think has helped? So, you feel like, you've been helped now right?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: Ubone ntoni uba uncedakele mhlambi? UyaUnderstand(a) more okanye uyapasa more?</i></p> <p>Learner: Ndipasa more</p> | <p><i>Interviewer: What changed? Do you understand more, or do you pass more?</i></p> <p>Learner: I am passing</p> |
| <p><i>Interviewer: Nini?</i></p> <p>Learner: Uqala kuTerm 1 bendingapasa, kuTerm 2 ndapasa kengoku</p> | <p><i>Interviewer: When?</i></p> <p>Learner: In term 1, I failed and then I passed in term 2.</p> |

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| <p><i>Interviewer: Kunini apho uqale iscience club, 1 or 2?</i></p> <p><i>Learner: Term 1</i></p> | <p><i>Interviewer: When did you start again? Term 1 or term 2?</i></p> <p><i>Learner: Term 1</i></p> |
| <p><i>Interviewer: Okay, so zintoni ozenzayo pha kwiscience club?</i></p> <p><i>Learner: Sifundiswa ngeExperiment</i></p> | <p><i>Interviewer: Okay, what do you do at the science club?</i></p> <p><i>Learner: We are learning about experiments</i></p> |
| <p><i>Interviewer: Nifunda ngeExperiment. EziExperiment nizifundayo zinento edibaniselene nomsebenzi wakho wesikolo?</i></p> <p><i>Learner: Ewe</i></p> | <p><i>Interviewer: Do these experiments have anything to do with your schoolwork?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: So, ikhona into entsha oyifundileyo from iscience clubs?</i></p> <p><i>Learner: Ewe.</i></p> | <p><i>Interviewer: So, have you learnt anything from science clubs?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: Okay, ziyakunceda iexperiments uba uunderstand(e) umsebenzi wakho wesikolo?</i></p> <p><i>Learner: Ewe ziyandanceda</i></p> | <p><i>Interviewer: Do the experiments help you understand your schoolwork?</i></p> <p><i>Learner: Yes, they help me.</i></p> |

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| <p><i>Interviewer: Xa ucinga kutheni abanye abantwana bengazi kwiscience club?</i></p> <p><i>Learner: Andiyazi, ingathi abayithandi kakuhle iscience.</i></p> | <p><i>Interviewer: Why do you think others don't come to the club?</i></p> <p><i>Learner: I don't know, it seems like they don't really love science.</i></p> |
| <p><i>Interviewer: Wena uyayithanda?</i></p> <p><i>Learner: Ewe</i></p> | <p><i>Interviewer: Do you love it?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: Ubuyithanda before uze kiscience club okanye uyayithanda ngoku kuba usiza kwiscience club?</i></p> <p><i>Learner: Bendingayithandi kakulu</i></p> | <p><i>Interviewer: Have you always felt like this or does it have to do with the science club?</i></p> <p><i>Learner: I didn't really like it</i></p> |
| <p><i>Interviewer: Ngoku uyayithanda?</i></p> <p><i>Learner: Ndiyayithanda</i></p> | <p><i>Interviewer: Do you like it now?</i></p> <p><i>Learner: I love it</i></p> |
| <p><i>Interviewer: Kutheni uyithanda ngoku, kutshintshe ntoni mhlambi?</i></p> <p><i>Learner: Because indifundise izinto ezinintsi</i></p> | <p><i>Interviewer: Why now? What changed?</i></p> <p><i>Learner: It taught me a lot of things</i></p> |

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| <p><i>Interviewer: Iscience club okanye iscience?</i></p> <p>Learner: zoy2</p> <p><i>Interviewer: Iscience club ikufundise izinto ezininzi kwisicence?</i></p> <p>Learner: Ewe</p> | <p><i>Interviewer: The science club? Or science?</i></p> <p>Learner: Both</p> <p><i>Interviewer: So, the science club taught you things about science?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: So ngoku ingondo yakho ivulekile and ufuna uyenza more?</i></p> <p>Learner: Ewe</p> | <p><i>Interviewer: So, your mind was now open, and you wanted to do it more?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: So xa ucinga ngesicence kuthi qata ntoni engqondweni yakho?</i></p> <p>Learner: Ndinga ngezinto ezenzekayo apha emhlabeni.</p> | <p><i>Interviewer: When you think about science, what comes to mind?</i></p> <p>Learner: I think about things happening in the world</p> |
| <p><i>Interviewer: Xa uzicinga ke, uyicinge uba you also want to be a part of ezozinto okanye uye ufuna unceda kwezosolutions okanye you just like, yiyoh hai iscience.</i></p> <p>Learner: Ndifuna uba yipart of it.</p> | <p><i>Interviewer: Do you also want to be a part of this, help in coming up with solutions or are you just like, whatever?</i></p> <p>Learner: I want to be a part of it</p> |

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| <p><i>Interviewer: Do you think that iscience iyakwazi usebenza ebomini bamanyani okanye iphelela eskolweni?</i></p> <p>Learner: Xan ndicinga iphelela apha eskolweni.</p> | <p><i>Interviewer: Do you think that science can be applied in real life, or it ends at school?</i></p> <p>Learner: I think it ends at school</p> |
| <p><i>Interviewer: Yintoni ekwenza ucinge njalo?</i></p> <p>Learner: Andiboni bantu baninzi bayithandayo iscience.</p> | <p><i>Interviewer: Why do you think that?</i></p> <p>Learner: I don't see a lot of people who love science.</p> |
| <p><i>Interviewer: Sowukhe wabona abantu abayenzayo?</i></p> <p>Learner: Kanjani?</p> <p><i>Interviewer: Mhlambi abantu abenza iexperiments?</i></p> <p>Learner: Ewe, sendsuka.</p> | <p><i>Interviewer: Have you seen people do it?</i></p> <p>Learner: How?</p> <p><i>Interviewer: Like people doing experiments?</i></p> <p>Learner: Yes</p> |

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| <p><i>Interviewer: So, xa uzijongile iexperiments ingathi zipha eskolweni sodwa, like awunokwazi uziibanisa nasekhaya?</i></p> <p><i>Learner: Ziphelela pha. Andikwazi uyenza ekhaya ndikwazi uyenza eskowleni.</i></p> | <p><i>Interviewer: When looking at experiments, do you think they only end at school or they could apply at home?</i></p> <p><i>Learner: They end at school. I can't do them at home, I can only do them at school.</i></p> |
| <p><i>Interviewer: Eza experiments besizenza ekuqaleni konyaka, uye wazienjoya(a)?</i></p> <p><i>Learner: Ewe</i></p> | <p><i>Interviewer: Did you enjoy the experiments we did at the beginning of the year?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: Awunokwazi uzenza kokwenu zona?</i></p> <p><i>Learner: Ndingakwazi uzenza ezinye zazo</i></p> | <p><i>Interviewer: Don't you feel like you can do them at home?</i></p> <p><i>Learner: I could be able to do some of them</i></p> |
| <p><i>Interviewer: Zikhona ongenokwazi uzenza kokwenu?</i></p> <p><i>Learner: Yes</i></p> | <p><i>Interviewer: Are there some you cannot do at home?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: UyaziEnjoy(a) ezi ukwazi uzenza kokwenu okanye uthanda ezi funeka uyozenzela elab?</i></p> | <p><i>Interviewer: Do you enjoy the ones you can do at home or do you prefer the ones done at the lab?</i></p> |

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| <p>Learner: Ndithanda ezi ndiyozenzela elab</p> | <p>Learner: I love the ones at the lab</p> |
| <p><i>Interviewer: Ngoba?</i></p> <p>Learner: Ngoba ekhaya mhlambi azikho ezinye izinto ezifunekayo, endizozidinga xa ndizokwenza iExperiment.</p> | <p><i>Interviewer: Why?</i></p> <p>Learner: Because I might not have some of the things I need at home, the things I'd need for the experiment.</p> |
| <p><i>Interviewer: Okay, if ubunonikwa zonke izinto zaselab, unikwe zonke ezazinto besizisebenza ngoku besisenza iexperiments ngoterm 2, kutwe yenza eza eperiments okanye wenze iexperiments zaselab, unikwe yonke into that you need ukuze ukwazi ukwenza zonke ezaexperiments, ungakhetha eyipi?</i></p> <p>Learner: Ndingakhetha le zasendlini</p> | <p><i>Interviewer: If you could get everything you need for both experiments, which one would you choose?</i></p> <p>Learner: I would choose the ones at home</p> |
| <p><i>Interviewer: Ngoba?</i></p> <p>Learner: Endlini ndibacomfortable more</p> | <p><i>Interviewer: Why?</i></p> <p>Learner: I am more comfortable at home</p> |
| <p><i>Interviewer: Ngoba endlini ndibacomfortable more, xa usenza ngento oziqhelileyo?</i></p> <p>Learner: Ewe</p> | <p><i>Interviewer: When you working with stuff you are used to?</i></p> <p>Learner: Yes</p> |

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| <p><i>Interviewer: Uya understand(a) more okanye kuyafana.</i></p> <p><i>Learner: Ndiya Understand(a) more</i></p> | <p><i>Interviewer: Do you understand more or is it still the same?</i></p> <p><i>Learner: I understand more</i></p> |
| <p><i>Interviewer: I lessons zescience uyazi enjoy(a)? Uthethe inyani.</i></p> <p><i>Learner: Mmmh</i></p> | <p><i>Interviewer: Do you enjoy science lessons? Be honest.</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: Indlela oteach(wa) ngayo iscience eskolweni nendlela oteach(wa) ngayo apha, uyayienjoy(a)?</i></p> <p><i>Learner: Ewe</i></p> | <p><i>Interviewer: Do you enjoy the way you taught at school and the way you taught at the science club?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: Kutheni uyiEnjoy(a) mhlambi?</i></p> <p><i>Learner: Ngoba indifundisa izinto ezininzi</i></p> | <p><i>Interviewer: Why do you think you enjoy them?</i></p> <p><i>Learner: I get to learn a lot of things</i></p> |
| <p><i>Interviewer: Ayikho enye into ocingba ingenziwa ukuze ukwazi uunderstand(a) better? Okanye uve better?</i></p> <p><i>Learner: Andiva.</i></p> | <p><i>Interviewer: Is there anything you think can be done for you to understand better?</i></p> <p><i>Learner: I didn't get that</i></p> |

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| <p><i>Interviewer: Ucinga uba lendlela kwenziwa ngayo ngoku iright for wena?</i></p> <p>Learner: Ewe</p> | <p><i>Interviewer: Do you feel like everything done now is enough for you?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: Ndiyakuva. So, zintoni ezikunzimelayo wena xa ufunda iscience? Mhlambi ufeel(a) ngathi inzima, mhlambi iyabhora, mhlambi ufeel(a) ilanguage yakhona awukwazi uyiunderstand(a), okanye ufeel(a) ilula awunazingxaki?</i></p> <p>Learner: Yilanguage</p> | <p><i>Interviewer: I hear you. What challenges do you have in learning science? Is it difficult? Is it boring is it the language? Or all is well with you?</i></p> <p>Learner: It's the language</p> |
| <p><i>Interviewer: Like ngagama akhona, ophotosynthesis?</i></p> <p>Learner: Ewe</p> | <p><i>Interviewer: Words like photosynthesis?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: So ufeel(a) ngathi uba kungahliswa lawamagama kungaba betele?</i></p> <p>Learner: Ewe</p> | <p><i>Interviewer: Do you think if the words can be worked on, it would be better?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: Would you like to be a scientist?</i></p> <p>Learner: Ewe</p> | <p><i>Interviewer: Would you like to be a scientist?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: Why?</i></p> | <p><i>Interviewer: Why?</i></p> <p>Learner: Because I love science a lot</p> |

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| Learner: <i>Ngoba iscience ndiyayithanda kakulu</i> | |
| Interviewer: <i>Xa ucinga, ufuna uba yeyiphi iscientist, ezokwenza ntoni?</i> | Interviewer: <i>Which scientist would you like to be?</i> |
| Learner: ... | Learner: ... |
| Interviewer: <i>Awukayicingi ngoku?</i> | Interviewer: <i>You haven't thought about it?</i> |
| Learner: <i>Ewe</i> | Learner: <i>Yes</i> |
| Interviewer: <i>Wena engqondweni yakho, xa umdala ufuna uba yintoni?</i> | Interviewer: <i>What do you wanna be when you grow up?</i> |
| Learner: <i>Ndifuna uba ngugqirha</i> | Learner: <i>I want to be a doctor</i> |
| Interviewer: <i>Uyamazi ugqirha uba wenza iscience? Uyayazi uba yiscience leya ayenzayo?</i> | Interviewer: <i>Did you know that a doctor does science?</i> |
| Learner: <i>Ewe</i> | Learner: <i>Yes</i> |
| Interviewer: <i>Why ufuna uba ngugqirha?</i> | Interviewer: <i>Why do you wanna be a doctor?</i> |
| Learner: <i>Ndifuna unceda abantu</i> | Learner: <i>I want to help people</i> |
| Interviewer: <i>Umbuzo wam wokugqibela kengoku. Do you think that, xa ufunda iscience usebenzisa izinto zakokwenu oziqhelileyo</i> | Interviewer: <i>This is my last question. Do you think learning science using things stuff that you</i> |

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| <p><i>ozibona everyday kubetetele kuna xa uyifunda eclassini ngetextbook nangezinto zaselab?</i></p> <p>Learner: Kubetele ufunda ngezinto zaselab</p> | <p><i>know from home is better than using stuff from the lab?</i></p> <p>Learner: I prefer stuff from the lab</p> |
| <p><i>Interviewer: Ngoba?</i></p> <p>Learner: Ngoba kaloku ezinye izinto andinazo ekhaya</p> | <p><i>Interviewer: Why?</i></p> <p>Learner: Because I don't have some of the things at home</p> |
| <p><i>Interviewer: If ubuzoba nazo zonke izinto, ubuzokhetha eyiphi?</i></p> <p>Learner: Bendizokhetha le yasekhaya</p> | <p><i>Interviewer: If you would have everything?</i></p> <p>Learner: I would choose the one from home</p> |
| <p><i>Interviewer: Ujonge ukuyienjoy(a) iscience ibe mnandi okanye ujonge uyiUnderstand(a)?</i></p> <p>Learner: Zoy2</p> | <p><i>Interviewer: Are you looking more into enjoying or understanding science?</i></p> <p>Learner: Both</p> |
| <p><i>Interviewer: So funeke uthi ze uunderstand(e) uyienjoy(e).</i></p> <p>Learner: Ewe</p> | <p><i>Interviewer: So, you need to enjoy in order to understand?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: So ungafeel(a) ngathi kulonyaka uye wayiunderstand(a) wayienjoy(a)?</i></p> | <p><i>Interviewer: Do you feel like you enjoyed and understood this year?</i></p> |

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| <i>Learner: Ewe</i> | <i>Learner: Yes</i> |
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Learner 3

| VERBATIM | TRANSLATED TO ENGLISH |
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| <p><i>Interviewer: Why do you come to the science club?</i></p> <p><i>Learner: Because ndifuna ufunda izinto ezintsha, like izinto endingazaziyo, ngescience.</i></p> | <p><i>Interviewer: Why do you come to the science club?</i></p> <p><i>Learner: Because I want to learn new things, like things I do not know about science.</i></p> |
| <p><i>Interviewer: So, uve kuthwa xa usiza kwiscience club uzofikauzive the things ofuna ukuzifunda?</i></p> <p><i>Learner: Ewe, sasicaciselwe olohlobo uba, like iscience, ndifuna uba yiscientist xa ndimdala, ndaqondaba kengoku mandize kwiscience club.</i></p> | <p><i>Interviewer: So, you heard that coming to the science club will help you learn the new things you want to learn?</i></p> <p><i>Learner: Yes. That, how it was explained to us. I want to be a scientist when I grow up, so I thought that I should go to science club.</i></p> |
| <p><i>Interviewer: Okay ndiyakuva. Iyakunceda iscience club?</i></p> <p><i>Learner: Ewe iyandinceda</i></p> | <p><i>Interviewer: Okay, I hear you. Is the science club helping you in any way?</i></p> <p><i>Learner: Yes, it is helping.</i></p> |

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| <p><i>Interviewer: Ikunceda kanjani?</i></p> <p><i>Learner: Indincedisa kwizinto, mhlambi endingazivayo eclassini ndiziunderstande kwiscience club.</i></p> | <p><i>Interviewer: How is it helping you?</i></p> <p><i>Learner: It helps me with things I don't understand in class. I get to understand them in the science club.</i></p> |
| <p><i>Interviewer: Do you feel like iexperiments ezenziwayo ziyakunceda?</i></p> <p><i>Learner: Ewe ziyandinceda</i></p> | <p><i>Interviewer: Do you feel like the experiments are helping?</i></p> <p><i>Learner: Yes, they are helping</i></p> |
| <p><i>Interviewer: Uyakwazi xa ujonga iexperiments ubone uba lento ithethwayo yile ibithethwa eclassini?</i></p> <p><i>Learner: Ewe</i></p> | <p><i>Interviewer: Are you able to connect the work you do at the club with the work you do at school?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: Xa sithetha ngeexperiments kengoku zonke, not last week but uyazikhumbula ezi zasizenzile before sivala? NgeHandy Andy, ngoku wawblow(a) ibotile ngokwakho, neziya zangokuya sasisenza isteel wool, usazikumbula?</i></p> <p><i>Learner: Ewe, sisi</i></p> | <p><i>Interviewer: When talking about all experiments, not just last week but the ones before schools closed, With Handy Andy, blowing into the bottles and the ones with the steel wool, do you steel remember them?</i></p> <p><i>Learner: Yes, I do.</i></p> |
| <p><i>Interviewer: So ufeel(a) ngathi zona zakunceda kumsebenzi wakho wesikolo?</i></p> | <p><i>Interviewer: Do you feel like they helped you with your school work?</i></p> |

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| <p>Learner: <i>Ewe zandineda sisi</i></p> | <p>Learner: <i>Yes, they helped.</i></p> |
| <p>Interviewer: <i>Kanjani?</i></p> <p>Learner: <i>Zandineda, ezinye izinto andizifundiswa eclassini sometimes, ndifunde izinto ezinew apha kwiscience club.</i></p> | <p>Interviewer: <i>How?</i></p> <p>Learner: <i>They helped. Some things I am not taught at school, so I learn new things here at the club.</i></p> |
| <p>Interviewer: <i>Kengokuukwazi uzidibanisa nomsebenzi wakho waseskolweni kengoku?</i></p> <p>Learner: <i>Ewe sisi</i></p> | <p>Interviewer: <i>Can you them make connections between them and your school work?</i></p> <p>Learner: <i>Yes</i></p> |
| <p>Interviewer: <i>Mhlambi xa udibanalo msebenzi eskolweni and then ubuzwe iquestions, uyakwazi ukuphendula, like uyakwazi ubona uba lequestion ikwinto ebendiyifundisiwe kwiscience club umzekelo?</i></p> <p>Learner: <i>Ewe zikhona into ezinjalo sisi because, besikhe safundiswa nangefriction, then kengoku ndingumntu ohlala notakulu so ibattery yakhe ibingasebenzi, then ndayenza ifriction zatransfereka ipositive something, ndiyilibele then ewe yasebenza ibattery. But not for Iesha elide so ezinto ziyandineda.</i></p> | <p>Interviewer: <i>When asked questions at school, are you able to remember that you had learnt something at the science club, and answer?</i></p> <p>Learner: <i>Yes, they are things like that, because, we learnt about friction. I leave with my grandfather, so when his battery wasn't working, I did the friction thing, the positive "something" was transferred – I forgot what it is, and then the battery worked, but not for long. So, they do help.</i></p> |

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| <p><i>Interviewer: So ucingba eyona nto ikuncedayo kukuba kuthethwe ufundiswe okanye kukwenza?</i></p> <p><i>Learner: Kukwenza sisi</i></p> | <p><i>Interviewer: Do you feel like what helps is listening/talking or doing?</i></p> <p><i>Learner: It's doing</i></p> |
| <p><i>Interviewer: Ngoba kutheni?</i></p> <p><i>Learner: Mhlambi ukwenza, mhlambi ndinga disturb(wa) uthetha, abanye abantu abathethayo so kengoku ndiUnderstand ngokwenza.</i></p> | <p><i>Interviewer: Why?</i></p> <p><i>Learner: There can be interruptions when talking, because other people can also be talking, but I can understand with doing.</i></p> |
| <p><i>Interviewer: So why do you think abanye abantwana abezi kwiscience club?</i></p> <p><i>Learner: Abakho interested okanye bona baunderstanda kakuhle izinto abazifundiswayo.</i></p> | <p><i>Interviewer: Why do you think other don't come to the club?</i></p> <p><i>Learner: They are not interested, or they understand everything they are taught better.</i></p> |
| <p><i>Interviewer: Sowena uza because awuunderstandi kakuhle and two uinterested?</i></p> <p><i>Learner: Ewe sisi</i></p> | <p><i>Interviewer: So, you come because you do not understand and are interested?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: So, oko wawuInterested kiscience wena?</i></p> <p><i>Learner: Ewe</i></p> | <p><i>Interviewer: Have you always been interested in science?</i></p> <p><i>Learner: Yes</i></p> |

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| <p><i>Interviewer: Even before uzapa kwiscience club?</i></p> <p><i>Learner: Ewe sisi, before ndifunde nalapha kwesiskolo.</i></p> | <p><i>Interviewer: Even before you came to the club?</i></p> <p><i>Learner: Yes, before I even came to this school.</i></p> |
| <p><i>Interviewer: Ucinga ntoni ngescience wena?Ucingba iyakwazi usetyenziswa ebominibamanyani?Like iphume kwitextbook, sicinge iscience sesihleli emakhaya?</i></p> <p><i>Learner: Ewe sisi, njengalento bendiyithetha yefriciton, iyakwazi unceda.</i></p> | <p><i>Interviewer: What do you think about science? Do you think it can applied in real life situations, like actually be used at home for an example?</i></p> <p><i>Learner: yes, like what I said about friction, it does help.</i></p> |
| <p><i>Interviewer: Uyaziejoy(a) ileasons zescience? Uthethe inyani.</i></p> <p><i>Learner: Ewe ndyazienjoya.</i></p> | <p><i>Interviewer: Do you enjoy science lessons? Be honest.</i></p> <p><i>Learner: Yes, I enjoy them</i></p> |
| <p><i>Interviewer: Ezaseclassini xa uteach(wa) naxa kusenziwa iexperiments apha?</i></p> | <p><i>Interviewer: In class and when we doing experiments here?</i></p> |

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| <p>Learner: Ewe sisi because yifavourite subject yam.</p> | <p>Learner: Yes, because science is my favourite subject.</p> |
| <p>Interviewer: YiNatural science ifavourite subject yakho?</p> <p>Learner: Ewe yiNatural Science nePhysical science</p> | <p>Interviewer: Natural science is your favourite?</p> <p>Learner: Yes, Natural science and Physical science</p> |
| <p>Interviewer: Yintoni ocingba fanba ingenziwa betele xa kuteach(wa) isciense oqondba wena ingakwenza wonwabe – okanye ufeela ngathi yonke lento yenziwayo iright akhonto ifuna utshintshwa?</p> <p>Learner: Ayikho into efuna utshintshwa sisi</p> | <p>Interviewer: What do you think can be improved int the teaching of science?</p> <p>Learner: Nothing.</p> |
| <p>Interviewer: So indlela oyiteach(wa) ngayo iright?</p> <p>Learner: Ewe uyayikwazi because kudala wafundisa, wayefundisa nomama bam so into ayithethayo iyaunderstandeka.</p> | <p>Interviewer: So, you are happy with how you are taught?</p> <p>Learner: Yes, my teacher knows it she has been teaching for so long and she taught my mom, so I understand what she says.</p> |

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| <p><i>Interviewer: Then xa ufika apha?</i></p> <p><i>Learner: Naxa ndifika apha, ewe iyaunderstandeka because siyayenza, sometimes siyayithetha but ixesha elininzi siyayenza so ndiunderstande more xa siyenza.</i></p> | <p><i>Interviewer: And then when you got here?</i></p> <p><i>Learner: Even when I got here, it's understandable because we are doing it, sometimes we talk about it but we do it most of the time, so I understand more when we do it.</i></p> |
| <p><i>Interviewer: Ndiyakuva. Zintoni ingxaki oba nazo wena xa usenza iscience? Ekumameleni nasekufundeni iscience?</i></p> <p><i>Learner: Izinto zescience sometimes zibanzima because zininzi, ilento, iprotons... zininzi so kengoku kuba nzima uziunderstanda, but otherwise, ndiyazigeta ngoku.</i></p> | <p><i>Interviewer: I hear you. What challenges do you have in learning science?</i></p> <p><i>Learner: Science because difficult sometimes because it's a lot, like protons and... they are a lot and it becomes difficult to understand but otherwise I get them now.</i></p> |
| <p><i>Interviewer: So ucinga mhlambi lento kunzima ukuzigeta yilento yoba mhlambi kusithwa, kthethwa ngezinto ongazange wazibona?</i></p> <p><i>Learner: Lento kuthethwa ngezinto endingaziqhelanga</i></p> | <p><i>Interviewer: So, do you think it is difficult its things you don't know and have never seen?</i></p> <p><i>Learner: Its because, its things I am not familiar with.</i></p> |
| <p><i>Interviewer: Xa kuziswa izinto oziqhelileyo, oqhele usebenza ngazo ozaziyo, iyakunceda lonto? Ikwenzela betele?</i></p> <p><i>Learner: Ewe ndyazkumbula sisi.</i></p> | <p><i>Interviewer: Does working with things that you are familiar with help?</i></p> <p><i>Learner: Yes, I remember</i></p> |

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| <p><i>Interviewer: So, ungathanda wena ufudiswa iscience kusetyenziswa izinto oziqhelileyo ozaziyo okanye uthanda uba ufundiswe....</i></p> <p>Learner: Endiziqhelileyo nezinye enzele ndizokwazi more.</p> | <p><i>Interviewer: So, do you wanna be taught with things that you are familiar with....?</i></p> <p>Learner: Things I am familiar with but also things I don't know so I can learn new things.</p> |
| <p><i>Interviewer: So kuqalwe kufundiswe ngoziqhelileyo then kulinkwe oziqhelileyo kwezi ungazaziyo?</i></p> <p>Learner: Ewe sisi</p> | <p><i>Interviewer: So, be taught with the ones you are familiar with and then that be linked to the ones you do not know?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: If unganikwa kutwe uzokwenza iexperiment umzekelo, okanye eza experiments besizenzile, kutwe khetha eyione, uba uzokwenza iexperiment ngebleach apha okanye uzoya elab, mhlambi eRhodes uyokwenza iexperiments ngeacids nebases zaselab, ungakhetha eyiphi?</i></p> <p>Learner: Ibases zaseLab</p> | <p><i>Interviewer:If you were to choose between doing the experiments we did and the going to the lab and doing experiments using acids and bases from the lab, which one would you choose?</i></p> <p>Learner: Bases from the lab</p> |
| <p><i>Interviewer: Ngoba?</i></p> | <p><i>Interviewer: Why?</i></p> |

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| <p><i>Learner: Because, elab yindawo endifuna uba kuyo xa ndimdala and ndifuna ufunda more and ababantu bafundisa pha elab ngabantu abaziscientists.</i></p> | <p><i>Learner: Because, I want to work at the lab when old, and I want to learn more and the people who teach at the lab are scientists.</i></p> |
| <p><i>Interviewer: Le ufuna uba yiyo...</i></p> <p><i>Learner: Ewe sisi</i></p> | <p><i>Interviewer: Which you want to be?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: So xa ufika pha ubebusy ngeacids and bses zaselab, uzounderstanda ungaqale wenzelwe umzekelo?</i></p> <p><i>Learner: Ndingaqale ndenzelwe umzekelo ngenziziqhelileyo</i></p> | <p><i>Interviewer: Would you be able to understand without, without an example of something you know?</i></p> <p><i>Learner: I would get an example with the things I am familiar with first.</i></p> |
| <p><i>Interviewer: Utshilo uba ungathanda uba yiscientist. Why ufuna uba yiscientist?</i></p> <p><i>Learner: Iscientist ziyakwazi ufind out izinto ezintsha, like izinto ezingaziwayo njengecomputer, izinto ezingaziwayo. So that's why ndifuna uba yiscientist.</i></p> | <p><i>Interviewer: You said you wanted to be a scientist. Why do you want to be a scientist?</i></p> <p><i>Learner: Scientists can find out new things, things that are not know, like computers. So, that's why I want to be a scientist.</i></p> |
| <p><i>Interviewer: So, xa ucinga ukufunda iscience ngokumane uyidibanisa with your everyday, things that you know and things that you've seen kuyakunceda ke?</i></p> | <p><i>Interviewer: So, do you think learning science by linking it with your everyday life, things that you know and things that you've seen, helps?</i></p> |

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| <p><i>Learner: Ewe kuyandinceda</i></p> | <p><i>Learner: yes, it helps.</i></p> |
| <p><i>Interviewer: Kanjani?</i></p> <p><i>Learner: Kuyandinceda ngezinto mhlambi endingaziqhelanga, ndizidibanise mhlambi ndizifunde eskolweni ndiyenze kwilifetime yam.</i></p> | <p><i>Interviewer: How?</i></p> <p><i>Learner: It helps, maybe with things I am not used to, when I learn about them at school, and do them in my lifetime, like the friction thing.</i></p> |
| <p><i>Interviewer: Ucingba itshintshile oziva ngayo ngescience?</i></p> <p><i>Learner: Ndiyithanda more ngoba apha kwiscience club izinto ndiya ndiziunderstand(a) easier.</i></p> | <p><i>Interviewer: Is there any difference in how you feel about science now?</i></p> <p><i>Learner: I love it more because I understand easier at the science club.</i></p> |

Learner 4

| <i>VERBATIM</i> | <i>TRANSLATED TO ENGLISH</i> |
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| <p><i>Learner: My name is Lithitha Lombo. I am currently studying at Nombulelo Sen... Secondary School. Grade 8.</i></p> | <p><i>Learner: My name is Lithitha Lombo. I am currently studying at Nombulelo Sen... Secondary School. Grade 8.</i></p> |

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| <p><i>Interviewer: When did you start coming to the science club?</i></p> <p><i>Learner: From last year.</i></p> | <p><i>Interviewer: When did you start coming to the science club?</i></p> <p><i>Learner: From last year.</i></p> |
| <p><i>Interviewer: When you were still doing seven?</i></p> <p><i>Learner: Yes</i></p> | <p><i>Interviewer: When you were still doing seven?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: Why did you decide to come to the club?</i></p> <p><i>Learner: Because my brother and sister were coming here. And it helped them very much.</i></p> | <p><i>Interviewer: Why did you decide to come to the club?</i></p> <p><i>Learner: Because my brother and sister were coming here. And it helped them very much.</i></p> |
| <p><i>Interviewer: So, you wanted the same help?</i></p> <p><i>Learner: Yes</i></p> | <p><i>Interviewer: So, you wanted the same help?</i></p> <p><i>Learner: Yes</i></p> |
| <p><i>Interviewer: Okay, so, is it helping you ke? If it helped them and you decided to come, is it helping you?</i></p> <p><i>Learner: Yes, its really helping me because the things that we do here, when we do them at school, I already know them.</i></p> | <p><i>Interviewer: Okay, so, is it helping you ke? If it helped them and you decided to come, is it helping you?</i></p> <p><i>Learner: Yes, its really helping me because the things that we do here, when we do them at school, I already know them.</i></p> |

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| <p><i>Interviewer: What do you mean by things? Things maths, things science or things both?</i></p> <p><i>Learner: Both</i></p> | <p><i>Interviewer: What do you mean by things? Things maths, things science or things both?</i></p> <p><i>Learner: Both</i></p> |
| <p><i>Interviewer: So how do you feel about the science, because I am doing science moss, how do you feel about the science particularly at KMSC?</i></p> <p><i>Learner: Its interesting because we find out about new things and new researches every day.</i></p> | <p><i>Interviewer: So how do you feel about the science, because I am doing science moss, how do you feel about the science particularly at KMSC?</i></p> <p><i>Learner: Its interesting because we find out about new things and new researches every day.</i></p> |
| <p><i>Interviewer: Is it helping though, like everything that you do, are they helping with your actual work? Like the work that you do at school?</i></p> <p><i>Learner: Yes, it is helping because when we are doing practicals, I already know what the outcomes will be.</i></p> | <p><i>Interviewer: Is it helping though, like everything that you do, are they helping with your actual work? Like the work that you do at school?</i></p> <p><i>Learner: Yes, it is helping because when we are doing practicals, I already know what the outcomes will be.</i></p> |
| <p><i>Interviewer: When you get to school, you mean?</i></p> <p><i>Learner: Yes</i></p> | <p><i>Interviewer: When you get to school, you mean?</i></p> <p><i>Learner: Yes</i></p> |

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| <p><i>Interviewer: I was gonna ask ke, are the experiments helping, particularly the ones that you did at the beginning of the year. The ones ebezineSteel wool, neVinegar and things like that. Were you here when we did those experiments?</i></p> <p><i>Learner: Yes, I was here.</i></p> | <p><i>Interviewer: I was gonna ask, are the experiments helping, particularly the ones that you did at the beginning of the year. The ones with Steel wool and vinegar and things like that. Were you here when we did those experiments?</i></p> <p><i>Learner: Yes, I was here.</i></p> |
| <p><i>Interviewer: So, zikuncedile zona? Did you understand kqala?</i></p> <p><i>Learner: Yes, I understood them. From the acid/base and others.</i></p> | <p><i>Interviewer: So, did they help? Did you understand?</i></p> <p><i>Learner: Yes, I understood them. From the acid/base and others.</i></p> |
| <p><i>Interviewer: Okay, did they help you?</i></p> <p><i>Learner: Yes, it helped me, to know what to expect if we mix two substances.</i></p> | <p><i>Interviewer: Okay, did they help you?</i></p> <p><i>Learner: Yes, it helped me, to know what to expect if we mix two substances.</i></p> |
| <p><i>Interviewer: Why do you think some learners do not come to the science club?</i></p> <p><i>Learner: Because they see science as a boring subject.</i></p> | <p><i>Interviewer: Why do you think some learners do not come to the science club?</i></p> <p><i>Learner: Because they see science as a boring subject.</i></p> |
| <p><i>Interviewer: Okay, and how do you see science?</i></p> | <p><i>Interviewer: Okay, and how do you see science?</i></p> |

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| <p><i>Learner: I see it as a new way to explore things.</i></p> | <p><i>Learner: I see it as a new way to explore things.</i></p> |
| <p><i>Interviewer: How did you get to this way of thinking about science? Have you always seen science as a way to explore things? Like oko wawuyithanda?</i></p> <p><i>Learner: No, I thought it was boring but when I came here at KMSC xa ndibona iExperiments zisenziwa ndaybona hayi, iinteresting.</i></p> | <p><i>Interviewer: How did you get to this way of thinking about science? Have you always seen science as a way to explore things? Like, have you always loved it?</i></p> <p><i>Learner: No, I thought it was boring but when I came here at KMSC, I saw experiments and felt it interesting.</i></p> |
| <p><i>Interviewer: So ngoku you are interested in science?</i></p> <p><i>Learner: Bendibone izinto ezenziwa khona ndabona uba innandi moss.</i></p> | |
| <p><i>Interviewer: Uhm, so okay. I think singatsho ke that... Infact mandikubuze so that sibesure. Ucinga ntoni ngescience ngescience or uziva njani ngescience generally?</i></p> <p><i>Learner: Yisubject endingayenza ngenye imini, endiyibona mna Iinteresting.</i></p> | <p><i>Interviewer: Uhm, so okay. I think we could say that... Infact let me ask so that we can be sure. What do you think about science? Or rather, how do you feel about science – generally?</i></p> <p><i>Learner: It's a subject I could do some day, one I see as interesting.</i></p> |
| <p><i>Interviewer: Uyayithanda?</i></p> <p><i>Learner: Ndiyayithanda</i></p> | <p><i>Interviewer: Do you love it?</i></p> <p><i>Learner: I love it.</i></p> |

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| <p><i>Interviewer: More than the other subjects or iza emva kwenye mhlambi?</i></p> <p>Learner: Iphakathi kwezinye.</p> | <p><i>Interviewer: More than the other subjects or iza emva kwenye mhlambi?</i></p> <p>Learner: Within others</p> |
| <p><i>Interviewer: What do you love the most?</i></p> <p>Learner: Maths</p> | <p><i>Interviewer: What do you love the most?</i></p> <p>Learner: Maths</p> |
| <p><i>Interviewer: But awucingi uba iAbstract because somethings ufundiswe, I don't know, mhlambi ngePhotosynthesis, awukhe uhlale uzbuze uba lento ndiyifundiswayo ndizoysebenzisa ebomini bam?</i></p> <p>Learner: Ewe ikhe ifike lonto yobana ndizaythini lento ndiyifundiswayo apha, but ke, lizobakhona ixesha ufumane into enjena ukwazi uyenza.</p> | <p><i>Interviewer: But don't you think that it is abstract? Like, don't you ever think about where you would apply all the information in life?</i></p> <p>Learner: I do think about that sometimes, but there will be a time when I would be required and then able to do something like this.</p> |
| <p><i>Interviewer: Okay ndiyakuva. Uhm, sendzogqiba ne. So, do you enjoy science lessons.</i></p> <p>Learner: Yes, yes</p> | <p><i>Interviewer: Okay I hear you... Uhm, a ne. So, do you enjoy science lessons.</i></p> |

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| | Learner: Yes, yes |
| <p><i>Interviewer: Honestly.</i></p> <p>Learner: Yes.</p> <p><i>Interviewer: You being very honest ne?</i></p> <p>Learner: Yes.</p> | <p><i>Interviewer: Honestly.</i></p> <p>Learner: Yes.</p> <p><i>Interviewer: You being very honest ne?</i></p> <p>Learner: Yes.</p> |
| <p><i>Interviewer: EzaseClass(ini), ezaseskolweni sakho xa uteach(wa) ngescience nezalapha xa uteach(wa) ngescience, kungekho ziExperiments kuhleliwe phantsi nje being taught in class? Do you enjoy that?</i></p> <p>Learner: Yes</p> | <p><i>Interviewer: Her or at school? Without experiments, just being taught in class? Do you enjoy that?</i></p> <p>Learner: Yes</p> |
| <p><i>Interviewer: Why?</i></p> <p>Learner: Because ndayazi lento ndiyifundayo, I might be able to do it one day.</p> | <p><i>Interviewer: Why?</i></p> <p>Learner: Because I know I might be able to do what I am studying it one day.</p> |
| <p><i>Interviewer: Okay, so you go in with that mentality?</i></p> <p>Learner: Yeah</p> | <p><i>Interviewer: Okay, so you go in with that mentality?</i></p> <p>Learner: Yeah</p> |

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| <p><i>Interviewer: So awucingi uba ikhona enye into engenziwa to improve indela eteach(wa) ngayo iscience? If ungahlala eclassini kuteach(we) ngetextbook for life kanjeya, that's okay for you?</i></p> <p>Learner: I think experiments are better.</p> | <p><i>Interviewer: So you are fine with how things are done now, you don't think there is anything that can be done to improve the teaching of science?</i></p> <p>Learner: I think experiments are better.</p> |
| <p><i>Interviewer: You think experiments are better than being in the classroom?</i></p> <p>Learner: Yes, but even the information that we get from the textbooks.</p> | <p><i>Interviewer: You think experiments are better than being in the classroom?</i></p> <p>Learner: Yes, but even the information that we get from the textbooks.</p> |
| <p><i>Interviewer: Its important also.</i></p> <p>Learner: Yes.</p> <p><i>Interviewer: So, mixing the experiments with the information in class?</i></p> <p>Learner: Yes.</p> | <p><i>Interviewer: Its important also.</i></p> <p>Learner: Yes.</p> <p><i>Interviewer: So, mixing the experiments with the information in class?</i></p> <p>Learner: Yes.</p> |
| <p><i>Interviewer: So, xa sithetha ngeExperiments, do you think experiments that you do, like iexperiments ezenziwa ngezinto zakokwenu, like things that you know or experiments ezeziwa</i></p> | <p><i>Interviewer: So, speaking about experiments, do you like experiments that you do, like the experiments with stuff from home, like things that you know or experiments in the lab, for an</i></p> |

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| <p><i>elab, xa nisiwe pha eRhodes for an example fike nenze iExperiments pha, okanye the experiments that we did here umzekelo?</i></p> <p>Learner: <i>Hayi, zoyi2. Because apha senza ezi zipha kum ekhaya, ndiyayazi uba if ndyamix(a) into ethile nethile, ingenza into enje and iyandenza uba ndibe aware uba into ezithile azidibani.</i></p> | <p><i>example, the experiments you do when you go to Rhodes?</i></p> <p>Learner: <i>Both. Because here, we are working with things that I have at home, so I am aware of what would happen if I mixed some things together.</i></p> |
| <p><i>Interviewer: And then leya yaselab?</i></p> <p>Learner: <i>Le yaselab ifundisa izinto ezintsha endingazaziyo.</i></p> | <p><i>Interviewer: What about the ones from the lab?</i></p> <p>Learner: <i>We get to learn new things.</i></p> |
| <p><i>Interviewer: Alright. So, ucinga uba, uhm, yeyiphi enganceda in your understanding. Is it ezaselab or is it ezi uzokwazi uzenza kokwenu?</i></p> <p>Learner: <i>Zezi ndizokwazi uzenza ekhaya because ndzokwazi uzipractice(a) ndiyibone.</i></p> | <p><i>Interviewer: Alright. So, which one do you think would help your understanding?</i></p> <p>Learner: <i>The ones I can do at home, then I can practise.</i></p> |
| <p><i>Interviewer: Uzokwazi urelate(a) kuzo?</i></p> <p>Learner: <i>Yes</i></p> | <p><i>Interviewer: You would relate to them?</i></p> <p>Learner: <i>Yes</i></p> |

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| <p><i>Interviewer: Uhm, So, wena personally, zinto ichallenge odibana nazo xa ufunda iscience? Is it the language mhlambi in science, is it how science is taught, okanye you are fine, awunazo iproblems?</i></p> <p><i>Learner: Hayi, yiLanguage of science endibethayo.</i></p> | <p><i>Interviewer: Uhm, what problems do you have with learning science? The language, just how its taught? Or, are you fine?</i></p> <p><i>Learner: The language used in science is a problem.</i></p> |
| <p><i>Interviewer: Okay, the words?</i></p> <p><i>Learner: Yes, indlela abekwa ngayo</i></p> | <p><i>Interviewer: Okay, the words?</i></p> <p><i>Learner: Yes.</i></p> |
| <p><i>Interviewer: Ingase kungathini xa ucinga mhlambi?</i></p> <p><i>Learner: Ingathi imeaning zawo zingaDefine(wa) in a more understandable way.</i></p> | <p><i>Interviewer: What do you think can be done?</i></p> <p><i>Learner: The meanings can be defined in a more understandable way.</i></p> |
| <p><i>Interviewer: Okay, in a way that you can relate to?</i></p> <p><i>Learner: Yes, yeah.</i></p> | <p><i>Interviewer: Okay, in a way that you can relate to?</i></p> <p><i>Learner: Yes, yeah.</i></p> |
| <p><i>Interviewer: So, would you like to be a scientist?</i></p> <p><i>Learner: I could consider it</i></p> | <p><i>Interviewer: So, would you like to be a scientist?</i></p> <p><i>Learner: I could consider it</i></p> |
| <p><i>Interviewer: What do you want to be?</i></p> | <p><i>Interviewer: What do you want to be?</i></p> |

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| <i>Learner: A lawyer</i> | <i>Learner: A lawyer</i> |
| <i>Interviewer: A lawyer. Okay, so you could consider being a scientist?</i> | <i>Interviewer: A lawyer. Okay, so you could consider being a scientist?</i> |
| <i>Learner: Yes</i> | <i>Learner: Yes</i> |
| <i>Interviewer: Okay, why do you wanna be a lawyer?</i> | <i>Interviewer: Okay, why do you want be a lawyer?</i> |
| <i>Learner: Why do I want to? Because I see crime everyday happening on daily basis, so I'd like to change.</i> | <i>Learner: Why do I want to? Because I see crime everyday happening on daily basis, so I'd like to change.</i> |
| <i>Interviewer: So, do you think learning science by relating it to everyday life is actually helping you in your learning of science?</i> | <i>Interviewer: So, do you think learning science by relating it to everyday life is actually helping you in your learning of science?</i> |
| <i>Learner: Yes, because, when we are doing everyday lives we see the things that we are used to, mixed together.</i> | <i>Learner: Yes, because, when we are doing everyday life we see the things that we are used to, mixed together.</i> |
| <i>Interviewer: So, would you say that, iscience ngoku uyithanda more okanye wehlile ukuyithanda okanye usaythanda ngalandlela iyione?</i> | <i>Interviewer: So, would you say that, there is any change in how you feel about science?</i> |
| <i>Learner: Ndiyithanda more than ngoku.</i> | <i>Learner: I love it more now.</i> |

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| <p><i>Interviewer: After you've done the experiments okanye?</i></p> <p><i>Learner: After the experiments because bendicinga uba haisuka ndizayithini na iscience?</i></p> | <p><i>Interviewer: After you've done the experiments?</i></p> <p><i>Learner: After the experiments because bendicinga uba haisuka ndizayithini na iscience?</i></p> |

Learner 5

| VERBATIM | TRANSLATED TO ENGLISH |
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| <p><i>Interviewer: Uqale nini ukuza kwiscience clubs?</i></p> <p><i>Learner: Ndiqale last of last year</i></p> | <p><i>Interviewer: When did you start coming to the club?</i></p> <p><i>Learner: Lat of last year.</i></p> |
| <p><i>Interviewer: Why usiza?</i></p> <p><i>Learner: Its because of, oko ndaza apha for the first time ndiziswa nguchomi wam, eskowleni ndandistrugglisha ngoku ndaza apha, then ndafunda lukhulu apha. Zange ndiphinde ndifune uyeka ukuza apha ngoba apha sifundiswa izinto esizazenza eskolweni so xa selifika elaxesha loba masenze ezizinto sizenze apha, sele mna ndizazi.</i></p> | <p><i>Interviewer: Why do you come?</i></p> <p><i>Learner: My friend introduced me, I was struggling at school, and I learnt a lot here. I didn't wanna stop coming because we are taught things before we learn them at school, so by the time I get to do them at school, I already know them.</i></p> |

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| <p><i>Interviewer: Zintoni ezi uthetha ngazo mhlambi nizifundiswayo apha? Izinto ezifana nantoni?</i></p> <p><i>Learner: Ngoku besifunde lento yecartesian plain, icartesian plane siyayifunda eskolweni and then nalapha siyayifunda. Lento yenziwa apha, andikayenzi ngapha eskolweni, kusayenzwa ezi zincinci pha eskolweni, iOrdered pairs. Apha siyaplota, eskolweni asikaploti kwicartesian plane. So, by the timendisplota eskolweni ndzobe sendizazi ngoba nalapha ndiyazazi.</i></p> | <p><i>Interviewer: Things like what? Give me an example.</i></p> <p><i>Learner: Like the cartesian plane. We taught about the cartesian both here and at school, but we haven't done some of the work we are doing here at school. We still doing ordered pairs at school and we already plotting here. So by the time we plot at school, I will be fine because I can plot already.</i></p> |
| <p><i>Interviewer: So eyona nto uyizelayo apha yimaths?Not iscience?</i></p> <p><i>Learner: Zoy2 ngoba iscience ndyastrugglisha kuyo.</i></p> | <p><i>Interviewer: So, you actually for maths and not science, right?</i></p> <p><i>Learner: Both because I am also struggling in Natural sciences.</i></p> |
| <p><i>Interviewer: Ezizinto uzenzileyo apha ziyakunceda eskolweni?</i></p> <p><i>Learner: Ewe ziyandinceda</i></p> | <p><i>Interviewer: Are the things that you are doing here helping with your school work?</i></p> <p><i>Learner: Yes, they are helping.</i></p> |
| <p><i>Interviewer: Kanjani, kwiscience?</i></p> <p><i>Learner: Kwiscience, icalculation andiyikwazi, like xa ndinikwe iformula ndiyayikwazi. Ngoku apha njeba besinikwe iformula yedensity, iformula yedensity</i></p> | <p><i>Interviewer: How, in science?</i></p> <p><i>Learner: I can't do calculations, but I can do it when I get a formula I can. I couldn't do it with density formula, I didn't know the density. Now I get, so maybe it will help.</i></p> |

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| <p><i>bendingayazi. Ngoku, ndiyayibona so, maybe ingandincea.</i></p> | |
| <p><i>Interviewer: So, eza experiments bezisenziwa, eziya zeacids and bases, zikuncedile?</i></p> <p><i>Learner: Besingekazenzi eskolweni iznto ezinjalo.</i></p> | <p><i>Interviewer: Did the experiments we did on acids and bases help?</i></p> <p><i>Learner: We hadn't done that at school.</i></p> |
| <p><i>Interviewer: So ufeel(a) njani wena ngeza experiments? Ubuzienjoy(a) okanye?</i></p> <p><i>Learner: Hayi, bendizienjoy(a).</i></p> | <p><i>Interviewer: How did you feel about the experiments; did you enjoy them?</i></p> <p><i>Learner: Yes, I enjoyed them.</i></p> |
| <p><i>Interviewer: Kutheni ubuzienjoy(a)?</i></p> <p><i>Learner: Ngoba mna khange ndiyazi uba xa uAdd(a) ivinegar kwisteel wool, like ukubone xa usebenzisa isteel wool kwimbiza ne usbeka pha, sizajika sibengathi siba goldish. Then, khange ndiyazi uba xa ugalela ivinegar kwisteel wool sizawjika. Ongakhange uqale ushlambe embizeni.</i></p> | <p><i>Interviewer: Why?</i></p> <p><i>Learner: Because I didn't know that, when you add vinegar on steel wool, the steel wool rusts. I thought that only happened after using it to wash pots.</i></p> |
| <p><i>Interviewer: So uyayithanda wena iscience?</i></p> <p><i>Learner: Kwezinye indawo sisi</i></p> | <p><i>Interviewer: So, do you love science?</i></p> <p><i>Learner: In some parts.</i></p> |

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| <p><i>Interviewer: Indawo ezifana neyiphi?</i></p> <p><i>Learner: Indawo ezifana ne, ukhubone moss, amanzi nguH₂O ne. Ezandazwo, eskolweni bendingazazi. Ezinye indawo endizienjoyayo zezi sizenzayo ngoku, ezizokhangela IDNA kwistrawberry nebanan, nezi zogalela ivinegar kwisteel wool. Ndyazi enjoya zona. Endingazienjoyiyo zezi zoHO₂, nton lento, iperiodic table, andiyienjoyi.</i></p> | <p><i>Interviewer: Like?</i></p> <p><i>Learner: You know how water is H₂O, I don't understand that part at school. I enjoy the parts about extracting DNA from strawberries and bananas, and mixing vinegar and steel wool. I don't enjoy the periodic table ones.</i></p> |
| <p><i>Interviewer: Okay, yintoni umahluko ngeperiodic table, yintoni enza uba uzithande ezi kodwa ungazithandi iperiodic table?</i></p> <p><i>Learner: Iperiodic table, ukhubone, kwitest, mandithi ndizonikwa iAluminium, funeka la aluminium ndibhale isymbol yayo nezinye ke endingazaziyo kwiperiodic table ngoba iperiodic table andiyifundi iskokoko, nddinamaxesha ndiyifunde, ndinamaxesha ndingayifunda. Kwitest ndinikwe ialuminium, kutwe ndibhale isymbol, not zonke ndiyazazi isymbol zezazinto, andizazi zonke kodwa kwicala lezi zeperiodic table, iyanditrick(a). Kukhona lapho kufunwa ubalance imethods, andiykwazi kakuhle.</i></p> | <p><i>Interviewer: Okay, what is the difference, why do you love the other and not the periodic table ones?</i></p> <p><i>Learner: You know with the periodic table, they'll give you aluminium and tell you to write its symbol and stuff, and whole lot of others that I don't know, because I don't read the periodic table all the time. The periodic table is tricky to me. Even with where you have to balance reactions, I can't really do that.</i></p> |

Interviewer: Xa uyenza iexperiments apha, zeziphi ozipreferishayo, mhlambi ujonga Idna yestrawberry nokwenza iexorthemic reaction zevinegar nesteel wool. Ukhetha ezo iexperiments zezinto ozaziyo okanye ukhetha uba ungahamba uye elab uyosebenza ngezinto zaselab?

Learner: Andazi uba ndingathini, cela uphinde umbuzo.

Interviewer: Which experiments do you prefer, the ones with stuff you are familiar with or the ones from the lab maybe?

Learner: I don't know what to say. Please repeat the question.

Interviewer: Ukubone xa niye eRhodes, fike nisebenzise IHCL pha nenze iexperiments, naxa nilapha nenze ngevinegar nbleach enizaziyo from home but ngenye indlela, yeyiphi oyikhethayo? Emnandi kuwe ngoba ke imnandi eyaselab inebomb?

Learner: To be honest, ndikhetha ezi ndiziqhelileyo ngoba ngalamini sasipha, ndandingayazi noba senza njani, yeyipi ichemical ethenthen, ndandingazazi, that's why mna ndikhetha ezi zongalela ivengar kwisteel wool nestrawbeery. Ndikhetha zona more than eziya zechemicals nton, ngoba kukhona enye ichemical apha ebesiyibona last week, uyabona ndiyilibele negama layo. La chemical ingathi ngamanzi apha, ubeke nalachemical uthi mna mandithathe yona ndzothatha eyiphi? Ndzathi icolour yechemical ezinye nezinye ziyafana. That's why mna ndingayithandi leya ngoba ndzothatha ewrongo melba ndithathe le.

Interviewer: You know how you guys would go to Rhodes and do experiments there with the chemicals like HCL for acids, and when you here doing the ones with vinegar and stuff. Which one do you prefer?

Learner: To be honest, I prefer the ones with the things I am familiar with. When we went to Rhodes, I didn't even know what we were doing, that's why I prefer the ones I know like vinegar and strawberries. I choose them because, with the chemicals, there is this chemical that we used last week, I forgot its name. That chemical looks like water, so if you were to put water and that chemical and tell me to choose, which one would I choose? Let me just say that, some chemicals have the same colours, so I might choose one I wasn't supposed to.

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| <p><i>Interviewer: Ungatsho uba indlela oziva ngayo ngescience itshintshile oko usenza eziexperiments zezinto oziqhelileyo?</i></p> <p>Learner: Ndisanyuka nayo kakuhle iscience yona, ndiyayithanda ndiyayiva, ndiyayifeela. Ndiyayithanda ngenza yalapha.</p> | <p><i>Interviewer: Would you say there is any change in how you feel about science?</i></p> <p>Learner: I am still moving well science. I love science, I get it, I feel it. I love science here.</p> |
| <p><i>Interviewer: Xa ucinga iscience, based on lendlela iteach(wa) ngayo eskolweni, nalendlela yenziwa ngayo apha, singakwazi uyisebenzisa ebomini bamanyani ingabiyonto ephelela eskolweni? Like ungakwazi uthatha lento uyifundiswayo uyisebnziseebomin nyani?</i></p> <p>Learner: Hayi, andikuva.</p> | <p><i>Interviewer: When you think about science, based on how it is taught here and at school, do you feel like it can be applied in real life?</i></p> <p>Learner: Hayi, I don't get you.</p> |
| <p><i>Interviewer: Ucingaba iscience iphelele phaclassini ufike ufundiswe kutwe, uhm, iphotosynthesis yilento umzekelo, ireactions uzibalansisa kanje umzekelo, kukhona iendo/exothermic reactions and then iphelele apha, ubhale itest neExam iphele. Okanye, uyakwazi uthatha ezizinto uzifundiswayo, uzojonga izinto ezenzeka manyani, like iexperiments ezenziwa ezintweni ozaziyo like IDNA umzekelo? Xa ucinga lento uyifundiswa</i></p> | <p><i>Interviewer: Do you think the information you learn in science at school can be used outside of school?</i></p> <p>Learner: With how I see it at school, with the side of the periodic table, I don't see it.</p> |

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| <p><i>eskolweni ungakwazi uyusebenzisa ebomini bamanyani okanye iphelela eskolweni?</i></p> <p><i>Learner: Ubona kwam, indlela endifunda ngayo eskolweni kwiscience, kwelicala leperiodic table, andiboni ndingayisebenzisa.</i></p> | |
| <p><i>Interviewer: Lendlela uyifunda ngayo apho, ucingba ungayisebenzisa?</i></p> <p><i>Learner: Ewe, ndingayisebenzisa.</i></p> | <p><i>Interviewer: And the way that it's taught here?</i></p> <p><i>Learner: Yes, It can be used.</i></p> |
| <p><i>Interviewer: Uyazithanda ilessons zescience eskowleni?</i></p> <p><i>Learner: Ezinye zazo</i></p> | <p><i>Interviewer: Do you enjoy science lessons?</i></p> <p><i>Learner: Some of them.</i></p> |
| <p><i>Interviewer: Zeziphi ozthandayo, zeziphi ongazthandiyo?</i></p> <p><i>Learner: Njengoba benditshilo, elacala leperiodic tables, andilithandi.</i></p> | <p><i>Interviewer: Which one do you love, which one don't you love?</i></p> <p><i>Learner: Like I said, I don't like the side with periodic table, I don't like it.</i></p> |

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| <p><i>Interviewer: Uthanda ezi theni?</i></p> <p><i>Learner: Ezineexperiments. Ndifuna ukwenza ngezandla.</i></p> | <p><i>Interviewer: Which one do you love?</i></p> <p><i>Learner: One with experiments, I want to work with my hands.</i></p> |
| <p><i>Interviewer: Uyafuna uba yiscientist xa umdala?</i></p> <p><i>Learner: Ndingatsho uba ndiyafuna ngoba iscientist noba ngugqirha.</i></p> | <p><i>Interviewer: Do you want to be a scientist?</i></p> <p><i>Learner: I would say, because a doctor is a scientist.</i></p> |
| <p><i>Interviewer: Yiscientist ewe, ngoba usebenzisa iscience unyanga abantu.</i></p> <p><i>Learner: Ewe</i></p> | <p><i>Interviewer: Yes, because you do use science.</i></p> <p><i>Learner: Yes.</i></p> |
| <p><i>Interviewer: Ngoba?</i></p> <p><i>Learner: Uba ngugqirha kuzondinika umsebenzi omninzi</i></p> | <p><i>Interviewer: Why?</i></p> <p><i>Learner: Being a doctor will give me a lot of work.</i></p> |
| <p><i>Interviewer: Ufuna umsebenzi omninzi wena?Nyani nyani? Ngoku abantu bafuna uphumla wena ufuna usebenza kakulu</i></p> | <p><i>Interviewer: So, you want a lot of work? With people looking to rest, you are looking to work more?</i></p> |

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| <i>Learner: Ewe.</i> | <i>Learner: Yes.</i> |
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Learner 6

| VERBATIM | TRANSLATED TO ENGLISH |
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| <p><i>Interviewer: What do you wanna be xa umdala?</i></p> <p><i>Learner: Yet, I think I just want to do law.</i></p> | <p><i>Interviewer: What do you wanna be xa umdala?</i></p> <p><i>Learner: Yet, I think I just want to do law.</i></p> |
| <p><i>Interviewer: What subjects are you going to take after ugqibile? When you start grade 8... I mean grade 10?</i></p> <p><i>Learner: I just want to take iCommerce: Accounting, Economics and Business.</i></p> | <p><i>Interviewer: What subjects are you going to take after ugqibile? When you start grade 8... I mean grade 10?</i></p> <p><i>Learner: I just want to take iCommerce: Accounting, Economics and Business.</i></p> |
| <p><i>Interviewer: So, you don't want Physics, Life Sciences and Geography?</i></p> <p><i>Learner: I want it because... I don't know, andazi.</i></p> | <p><i>Interviewer: So, you don't want Physics, Life Sciences and Geography?</i></p> <p><i>Learner: I want it because... I don't know, I don't know.</i></p> |
| <p><i>Interviewer: So, why usiza to the science club?</i></p> | <p><i>Interviewer: So, why do you come to the science club?</i></p> |

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| <p>Learner: <i>Okay, at school I am struggling kwiMaths ne, so I thought it will help me.</i></p> | <p>Learner: <i>I am struggling in Maths so I thought it would help me.</i></p> |
| <p>Interviewer: <i>So, you not here for the science aspect of it?</i></p> <p>Learner: <i>I am here for it too, but...</i></p> | <p>Interviewer: <i>So, you not here for the science aspect of it?</i></p> <p>Learner: <i>I am here for it too, but...</i></p> |
| <p>Interviewer: <i>Njee just to pass?</i></p> <p>Learner: <i>Mh.mh</i></p> | <p>Interviewer: <i>Njee just to pass?</i></p> <p>Learner: <i>Mh.mh</i></p> |
| <p>Interviewer: <i>So, ayikuExcite(i) iscience wena ne?</i></p> <p>Learner: <i>It does, because I am learning a lot of things. Mh.mh.</i></p> | <p>Interviewer: <i>So, science does not excite you?</i></p> <p>Learner: <i>It does, because I am learning a lot of things. Mh.mh.</i></p> |
| <p>Interviewer: <i>So, you feel like the “lot of things” you are learning are enough for you now, you don’t, like ayikho lento yoba, infact I wanna pursue this, I wanna see uba inton-nton yenzeka xa kutheni, like I wanna do this naseHigh School naseUniversity and actually be like in that for the rest of my life – you don’t feel like that?</i></p> <p>Learner: <i>I do feel like that, but...</i></p> | <p>Interviewer: <i>So, you feel like the “lot of things” you are learning are enough for you now, you don’t, want to pursue science, like in High School and at University, and actually be like in that for the rest of my life – you don’t feel like that?</i></p> <p>Learner: <i>I do feel like that, but...</i></p> |

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| <p><i>Interviewer: But uthanda iLaw more?</i></p> <p><i>Learner: To be honest, I don't know what to do. Eh.eh.</i></p> | <p><i>Interviewer: But you just love law more?</i></p> <p><i>Learner: To be honest, I don't know what to do. Eh.eh.</i></p> |
| <p><i>Interviewer: Okay, iyakunceda iclub ke, like coming to the club - kuyakunceda?</i></p> <p><i>Learner: Mh.mh</i></p> | <p><i>Interviewer: Okay, is coming to the club helping?</i></p> <p><i>Learner: Mh.mh</i></p> |
| <p><i>Interviewer: Kanjani?</i></p> <p><i>Learner: Kakhulu because first time ndifika apha I wasn't sure ne, then I learnt somethings that I didn't know. Then kengoku, worse in science, then kengoku, ya iyandinceda. Then nakwimaths, I see my marks uba yah, they are better.</i></p> | <p><i>Interviewer: How?</i></p> <p><i>Learner: A lot because, when I got here, I learnt a lot of new things, particularly in science, so it helps. Even in Maths, I see my marks are better.</i></p> |
| <p><i>Interviewer: Ezescience zibetter?</i></p> <p><i>Learner: Mh.mh, I am getting level 7.</i></p> | <p><i>Interviewer: Are the science marks better?</i></p> <p><i>Learner: Mh.mh, I am getting level 7.</i></p> |

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| <p><i>Interviewer: So, do you think the experiments ozenzayo apha zescience ziyakunceda?</i></p> <p><i>Learner: Mhmh, ziyandineda because naseskolweni, if kuthethwa ngaleexperiment bendiyenze apha, I'll be the first one to answer the question.</i></p> | <p><i>Interviewer: So, do you think the experiments you doing here are helping?</i></p> <p><i>Learner: Yes, they help because if we are talking about an experiment I did here, at school, I'll be the first one to answer the question.</i></p> |
| <p><i>Interviewer: Because its something that you did and remember?</i></p> <p><i>Learner: Yah</i></p> | <p><i>Interviewer: Because its something that you did and remember?</i></p> <p><i>Learner: Yah</i></p> |
| <p><i>Interviewer: Uhm, do you remember the experiments and understand uba bekusenzeka ntoni kwiexperiment noba iApply(a) kanjani emsebenzini wakho weskolo, uyazilandela iexperiments uziunderstand(e) then uthi xa ufika eclassini ukwazi urelate(a) lento ifundiswa eclassini nalento ubuyenza kwiexperiment apha?</i></p> <p><i>Learner: Mh.mh.</i></p> | <p><i>Interviewer: Uhm, do you remember the experiments and understand and understand them, understanding how they relate to your school work?</i></p> <p><i>Learner: Mh.mh.</i></p> |
| <p><i>Interviewer: Okay, why do you think abanye abantwana do not come to the science club?</i></p> <p><i>Learner: I've asked them before, then bathi, bayonqena. And I was like, okay... Then I</i></p> | <p><i>Interviewer: Okay, why do you think other learners do not come to the science club?</i></p> <p><i>Learner: I've asked them before, then they said they were lazy. And I was like, okay... Then I</i></p> |

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| <p><i>invited ichomi yam, but namhlanje akazanga, because kuyabanda.</i></p> | <p><i>invited my friend, but she didn't come today because its cold.</i></p> |
| <p><i>Interviewer: Any yeyi, its freezing...</i></p> <p>Learner: Mh.mh</p> | <p><i>Interviewer: Any its freezing...</i></p> <p>Learner: Mh.mh</p> |
| <p><i>Interviewer: What do you think about science ke wenake, like how do you feel about it ke?</i></p> <p>Learner: Actually, iyawavula amehlo, mhmh... And for mna, I've learnt a lot kwiscience, for an example, namhlanje, lento yestrawberry, bendingayazi uba ineDNA istrawberry.</p> | <p><i>Interviewer: What do you think about science \, like how do you feel about it?</i></p> <p>Learner: Actually, it opens your eyes, mh.mh... I've learnt a lot in science, for an example, today, what we learnt about strawberries, I didn't know strawberries had DNA.</p> |
| <p><i>Interviewer: Okay, so now you get to learn things that you didn't...</i></p> <p>Learner: That li didn't know. Mh.mh</p> | <p><i>Interviewer: Okay, so now you get to learn things that you didn't...</i></p> <p>Learner: That li didn't know. Mh.mh</p> |
| <p><i>Interviewer: So, can you say that kind of like science?</i></p> <p>Learner: Mm.mh, I like it so much.</p> | <p><i>Interviewer: So, can you say that kind of like science?</i></p> <p>Learner: Mm.mh, I like it so much.</p> |
| <p><i>Interviewer: Do you enjoy it?</i></p> <p>Learner: Yah</p> | <p><i>Interviewer: Do you enjoy it?</i></p> <p>Learner: Yah</p> |

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| <p><i>Interviewer: Do you enjoy it because of the experiments or because of the content itself, because of ezizinto zenziwayo that you see or because of what you are taught, like what science is about?</i></p> <p><i>Learner: Because of what its about.</i></p> | <p><i>Interviewer: Do you enjoy it because of the experiments or because of the content itself, because of activities done that you see or because of what you are taught, like what science is about?</i></p> <p><i>Learner: Because of what I ts about.</i></p> |
| <p><i>Interviewer: Okay, so do you feel like science can be applied to real life situations, like you can take what you learn in class and then solve real problems?</i></p> <p><i>Learner: Ewe</i></p> | <p><i>Interviewer: Okay, so do you feel like science can be applied to real life situations, like you can take what you learn in class and then solve real problems?</i></p> <p><i>Learner: Ewe</i></p> |
| <p><i>Interviewer: Like what?</i></p> <p><i>Learner: For example, okay... Yeah, I don't know.</i></p> | <p><i>Interviewer: Like what?</i></p> <p><i>Learner: For example, okay... Yeah, I don't know.</i></p> |
| <p><i>Interviewer: Okay, do you think, how do I ask this, because I know that you know... Uhm,</i></p> <p><i>Learner: Ewe.</i></p> | <p><i>Interviewer: Okay, do you think, how do I ask this, because I know that you know... Uhm,</i></p> <p><i>Learner: Ewe.</i></p> |
| <p><i>Interviewer: Wena do you enjoy science lessons?</i></p> <p><i>Learner: I enjoy them kakhulu</i></p> | <p><i>Interviewer: Do you enjoy science lessons?</i></p> <p><i>Learner: I enjoy them a lot.</i></p> |

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| <p><i>Interviewer: Ezalapha okaye ezaseskowleni?</i></p> <p>Learner: Ezalapha ikakulu because ezaseskolweni, the don't last okokoko, yah.</p> | <p><i>Interviewer: Lessons here or at school?</i></p> <p>Learner: I enjoy the one's here more because the one's at school are inconsistent.</p> |
| <p><i>Interviewer: And then apha, whenever you here, there is a science lesson eyenzekayo ne?</i></p> <p>Learner: Mh.mh</p> | <p><i>Interviewer: But then there is always a lesson when you get here?</i></p> <p>Learner: Mh.mh</p> |
| <p><i>Interviewer: Okay, what uhm, okay... What problems do you experience wena, or do you have in learning science, mhlambi xa uhleli kokwenu, mhlambi xa ufundiswa eskowleni and mhlambi even here. Zintoni ezikbhidayo when it comes to learning science?</i></p> <p>Learner: Okay, from the teacher ne, ngaske acacise, uyacacisa ne, but ucacise ashiye half, akayi to what this thing or lonto is about. Yah, and then kengoku, I struggle to get something.</p> | <p><i>Interviewer: Okay, what uhm, okay... What problems do you experience, or do you have in learning science, at home studying, being taught at school and maybe even here. What challenges do you have when it comes to learning science?</i></p> <p>Learner: Okay, I wish the teacher would explain more, but she explains just half, she doesn't get to what this thing or whatever it is she's talking about, is about. Yah, and then so, I struggle to get something.</p> |
| <p><i>Interviewer: Because ukucacisa kwakhe kuyashota, akuphelelanga?</i></p> <p>Learner: Mh.mh</p> | <p><i>Interviewer: Because her explaining was not enough?</i></p> <p>Learner: Mh.mh</p> |

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| <p><i>Interviewer: Then xa ufika uyozi fundela kwitextbook, then it doesn't really make sense, because khangе uqale ucaciselwe kuqala?</i></p> <p><i>Learner: Mh.hm</i></p> | <p><i>Interviewer: Then the textbook didn't really make sense because it hadn't been explained?</i></p> <p><i>Learner: Mh.hm</i></p> |
| <p><i>Interviewer: I hear you. So, ungumntu ofunda more xa umntu ethetha nawe kuna xa uzfunde...?</i></p> <p><i>Learner: Ufunda...Mh.mh</i></p> | <p><i>Interviewer: I hear you. So, you learn more when listening rather than reading...?</i></p> <p><i>Learner: Reading...Mh.mh</i></p> |
| <p><i>Interviewer: Okay. So, would you like to be a scientist one day?</i></p> <p><i>Learner: Mh.mh</i></p> | <p><i>Interviewer: Okay. So, would you like to be a scientist one day?</i></p> <p><i>Learner: Mh.mh</i></p> |
| <p><i>Interviewer: Why?</i></p> <p><i>Learner: Because, kukho abantu abangayaziyo what science is for ne, so kengoku, I want to help them know what science is about. And I am sure many things I've done in science, so kengoku, yah, ndibancede.</i></p> | <p><i>Interviewer: Why?</i></p> <p><i>Learner: Because, there are people that do not know what science is for ne, so, I want to help them know what science is about. And I am sure many things I've done in science, so yah, to help them.</i></p> |

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| <p><i>Interviewer: So, there's no problem that you've identified apho uhala khona mhlambi oqondaba, in fact I want to solve such problems using science?</i></p> <p>Learner: Yet, no.</p> | <p><i>Interviewer: So, there's no problem that you've identified in your community, in fact I want to solve such problems using science?</i></p> <p>Learner: Yet, no.</p> |
| <p><i>Interviewer: So, do you think learning science ngokuba umane uyidibanisa with everyday life, umzekelo lanto yoba besikhe sayenza ivinegar nebleach, nebicarb sizireact(isa) ke sifundisa about acids and bases, indicators and neutralization reactions, using red cabbage and necarbon dioxide ublow ngokwakho, so do you feel like, lonto iyanceda kunoba sinokthatha, xa sikusa eRhodes ufikephaya usebenzise iNaOH neHCL nizidibanise nireact. So, which one do you think helps more ekufundeni nasekuunderstnadeni iscience?</i></p> <p>Learner: Yile yezinto endizaziyo because nyani, it helps ezi ndizaziyo then ndiyazi uba this is for this and this is for that.</p> | <p><i>Interviewer: So, do you think learning science by relating it to everyday life, for example the reactions that we did, and when we take you guys to Rhodes, and the experiments that you do there. So, which one do you think helps more in learning and understanding science?</i></p> <p>Learner: Its working with things I am familiar with because really, the things I know help because then I would know that, this is for this and this is for that.</p> |
| <p><i>Interviewer: So, iscience is not just pha eskowleni, pha eRhodes eLab, iscience isekhaya, umamakho xa epheka pha endlini... xa epainta... sincokola ngoku... because, sound waves?</i></p> | <p><i>Interviewer: So, science doess not just end at school or at Rhodes, science is at home, when your mom is cooking... when she is painting... us talking now... because, sound waves?</i></p> |

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| <p>Learner: She's doing science... she's doing science... we are doing science. Mh.mh.</p> <p><i>Interviewer: So, what did you think nje of the experiments wena?</i></p> <p>Learner: Intoni?</p> | <p>Learner: She's doing science... she's doing science... we are doing science. Mh.mh.</p> <p><i>Interviewer: So, what did you think of the experiments?</i></p> <p>Learner: What?</p> |
| <p><i>Interviewer: Eza Experiments besizenza ucinga ntoni ngazo?What do you think about them? Ziright azikho right? Did you enjoy them, did you not? Or nje icomments orhalela undinika zona, mhlambi ngezaexperiments, mhlambi, ngoba iscience mayiyeke ufundiswa ngetextbook ngoku, makwenziwe iexperiments zodwa okanye mayenziwe netextbook nexepiriments, kuxutywe eziphi iexperiments, uyabo, like closing remarks orhalela ukuzithetha.</i></p> <p>Learner: Mmh. Okay, most of the time I get bored xa uthetha okokoko, I prefer uthethe and then kwenziwe lonto, and, mna ndingavuya if itextbooks zingayekwa because kancinci they not helping me, I prefer uthetha, yah.</p> | <p><i>Interviewer: What do you think about the experiments we did? Did you enjoy them, did you not? Or just any comments that you have, about the experiments? Or maybe you feel science should not be taught using the textbook, that we should only do experiments and which experiments, or we should use both, like any closing remarks that you have.</i></p> <p>Learner: Mmmh. Okay, most of the time I get bored when you are talking a lot, I prefer talking and then do something, and, I would be very happy if they stopped using textbooks because they not helping me, I prefer listening, yah.</p> |
| <p><i>Interviewer: So, do you think kuyanceda ukuphuma eclassini ungabiko kulasetting yaseskolweni, uze noba kulapha kwiscience because nalapha kuseseskolweni but siskolo esidifferent kunesiya saseskolweni? Do you</i></p> | <p><i>Interviewer: So, do you think being outside of the classroom setting and coming to a place like the science club, which is also a school, but different from a normal school helps? Do you prefer this school where you with other learners and us, or your normal school?</i></p> |

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| <p><i>prefer esi soba uphuma uzohlala with abanye abantwana and us?</i></p> <p>Learner: Mh.mh. Yah</p> | <p>Learner: Mh.mh. Yah</p> |
| <p><i>Interviewer: What do you like more about it?</i></p> <p>Learner: I am not afraid apha, like more than eclassini I am free apha, because if I have a problem, I know its going, izohlala kuwe and something like that.</p> | <p><i>Interviewer: What do you like more about it?</i></p> <p>Learner: I am not afraid here, like more than in class, I am free here, because if I have a problem, I know its going, it will stay with you and something like that.</p> |

Learner 7

| VERBATIM | TRANSLATED TO ENGLISH |
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| <p><i>Interviewer: So, ndicela ubuza kengoku, my first question for you is: Why do you come to Khanya Maths and Science Club?</i></p> <p>Learner: Uhm, Khanya Maths and Science has uhm, kind of what I need in the future. Because in my, uhm, in my career, I need iMaths and Science to be a doctor, so I want to improve those things, so I come here.</p> | <p><i>Interviewer: So, my first question for you is: Why do you come to Khanya Maths and Science Club?</i></p> <p>Learner: Uhm, Khanya Maths and Science has uhm, kind of what I need in the future. Because in my, uhm, in my career, I need Maths and Science to be a doctor, so I want to improve those things, so I come here.</p> |
| <p><i>Interviewer: So, you want to be a doctor, and you feel like in order to be a doctor you need to do well in Maths and Science?</i></p> | <p><i>Interviewer: So, you want to be a doctor, and you feel like in order to be a doctor you need to do well in Maths and Science?</i></p> |

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| <p>Learner: Yes.</p> | <p>Learner: Yes.</p> |
| <p><i>Interviewer: Okay, kengoku, iKhanya Maths and Science ikuncedisa uba uperform(e) kakuhle. Iyakuncedisa okanye ucingba fanele ibe iyakuncedisa?</i></p> <p>Learner: Iyanndincedisa yona, kakulu.</p> | <p><i>Interviewer: Is KMSC helping you perform well? Is it helping, or do you feel like it should help?</i></p> <p>Learner: It does help a lot.</p> |
| <p><i>Interviewer: Iyakuncedisa, how do you know, how do you see uba iyakuncedisa?</i></p> <p>Learner: Uhm, I, the chemicals first, I can remember the chemicals and, in the table,, I... iElements, I can remember them from 1-20. Then iMaths, indinceda kakulu yona kuba you have to count mass itable of elements, so indinceda kakulu apho. So, indinceda kakulu apho.</p> | <p><i>Interviewer: It help, how do you know, how do you see that it helps?</i></p> <p>Learner: Uhm, I can remember the chemicals and in the table of elements, I can remember them from 1-20. With Maths, it helps a lot, you have to count mass in the table of elements, so its helps a lot there.</p> |
| <p><i>Interviewer: Okay, so uhm, iExperiments ezi uzenzayo, because mna ke ndenza science more than iMaths so sizothetha ngescience ikakulu, more than the Maths aspect of Khanya Maths uyaqonda.</i></p> <p>Learner: Yes</p> | <p><i>Interviewer: Okay, so uhm, I am doing science moss, so we will be talking more about science than the maths aspect of the KMSC ne.</i></p> <p>Learner: Yes</p> |

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| <p><i>Interviewer: So iExperiements ezi besizenza apha, eziya zevinegar nebleach nesteel wool and all that we did, uva njani ngazo? Ucinga ntoni ngazo?</i></p> <p><i>Learner: Iye yandiinceda kakulu kuba ndizazi iAcids neBases, because ekuqaleni bendingayazi, then we had to use ifood elements from endlini, so its easy to separate, to have iacids on the side and to test nebases on the other side.</i></p> | <p><i>Interviewer: So, how do you feel about the experiments we did here, the ones with vinegar, bleach, steel wool and all that we did, what do you think about them?</i></p> <p><i>Learner: They helped a lot because I know acids and bases, because at the beginning I didn't know them, then we used food elements from home, so its easy to separate acids and bases and to test them.</i></p> |
| <p><i>Interviewer: Why? Because zizinto oziqhelileyo that you have from home okanye, do you feel like if beniswe elab nizenze iacids and bases niteach(wa) ngezinto zasela, like yeyiphi ofeel(a) ngathi ibetele for wena? Uba ufunde ngezinto onazo endlini noba uye elab ufunde ngezazinto, because ezaselab zimnandi ziykuvisa kamnandi ube excited and all that stuff, but yeyiphi ofeel(a)ngathi to understand iscience yakho betele?</i></p> <p><i>Learner: Ndiyabawela, ziyandinceda ezi ndiziqhelileyo, ndiske ndibawele nam ukuya elab, then ndiyojonga ezi ndingaziqhelanga so ndikwazi uyazi kengoku uba lena idibana njani, ewe.</i></p> | <p><i>Interviewer: Why? Because its things you used to, things you have at home? Do you feel like, if you had gone to the lab and be taught using stuff from lab, you'd feel different? Which one do you feel is better for you, using things from home or using things from the lab, because the lab is exciting and all, but which one helps you understand better?</i></p> <p><i>Learner: I would love to, the things I am used to help but I would love to go to the lab too and look at the stuff I am not used to, and be able to know how these things relate to each other.</i></p> |
| <p><i>Interviewer: Ndyakuva.Uhm, xa ucinga abanye abantwana kutheni bengazi kwiscience club?</i></p> | <p><i>Interviewer: I hear you. Uhm, why do you think others don't come to the science club?</i></p> |

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| <p><i>Learner: Maybe abanye abayazi ukuba ikhona ngoba kwecala ndikhe ndabuza, awufuna ukuya kwiKMSC, bathi abayazi bona so ndiyabadirect(a) apha kulendawo. Abanye abazi kuba bengaxelelwanga naseskolweni okanye abanye abazi kuba bengazoyekelwa kokwabo ukubabenze kanje.</i></p> | <p><i>Learner: Some don't know about it because I asked some, if they wanted to go to the KMSC, they said they didn't know and so I gave them directions to this place. Some don't come because they weren't told at school and some don't come because they know they wouldn't get permission from home.</i></p> |
| <p><i>Interviewer: So, its not a matter of abafuni ukuzi, its just that abayazi uba kukhona into enje and they can take advantage of it.</i></p> <p><i>Learner: Mh.mh</i></p> | <p><i>Interviewer: So, its not a matter of not wanting to come, its just that they don't know that there is something like this and take advantage of it.</i></p> <p><i>Learner: Mh.mh</i></p> |
| <p><i>Interviewer: So, wena wava kanjani?</i></p> <p><i>Learner: Ndiva kabhlungu kuba ezinye izkolo azixelelwa ngaleKMSC, so ndiske ndibawele mhlambi kuye umntu kwelacala pha kubo, then abaxelele ngeKMSC izobanceda kwintoni, then balwazi sibebaninzi apha kwiKMSC.</i></p> | <p><i>Interviewer: So, how did you hear about it?</i></p> <p><i>Learner: I don't feel good because other schools are not told about KMSC, so I would love to see someone going to the schools and then telling them about KMSC and how it will help them, so there can be a lot of us here at KMSC.</i></p> |
| <p><i>Interviewer: Uve ngobani wena?</i></p> <p><i>Learner: Ndava eskolweni. Kukhoomnye usisi waza apha kuthi wafika wasixelela, kwachoose(wa) kengoku ngobani abafuna ukuya, then after kutshuzwe la5, then kwalandela abanye, kwathwa ngoku</i></p> | <p><i>Interviewer: Who told you about it?</i></p> <p><i>Learner: At school. Some lady went to my school and told us, some of us who wanted to go were chosen. After the 5 was chosen, more went because we were told that it wasn't about number anymore, people could just go and do maths and science.</i></p> |

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| <p><i>akufunekanga kuziwe ngenumbers, umntu makazeazoyenza iscience nemaths.</i></p> | |
| <p><i>Interviewer: Abanye bahlala bangazi still?</i></p> <p>Learner: Mmmh.</p> | <p><i>Interviewer: And some still chose to not come?</i></p> <p>Learner: Yes.</p> |
| <p><i>Interviewer: Okay, so uziva nja, what... How do you feel about science in life? Ucinga ntoni xa kuthwa science? Is it exciting to you? Ayikho exciting? Iyakubhora mhlambi, okanye uyayithanda? Okanye because ke ukuze ube ngugqirha funeka uyenze iscience?</i></p> <p>Learner: Its exciting yona, ngoba kukho iacids bekufuneka sizijongile, then funeke siziexperience uba, inoba zenza ntoni, ziharmful okanye azikho harmful, so zitest(we) phambi kwethu, and nam ndiyabawela, imnandi ubukela into isenziwa, and nawe unikwe ichance yoba mawuyenze not uyibukela nje, ungayenzi.</p> | <p><i>Interviewer: Okay, how do you feel about science in life? What do you think when you hear 'science'?</i></p> <p>Learner: Its exciting, because there are acids that we need to look at, and then get a feeling of what they are for, whether they harmful/or not, so they are tested in front of us and I also would love to test them. Watching something being done in front of you is great, and then being given a chance to do it too.</p> |
| <p><i>Interviewer: But, ingenziwa lonto nakwi, zintoni ezinye isubjects ezikhoy, ezingeyo science? Mhlambi nakwiAccounting babaliswe imali, like ibalwe pha, nawe ubaliswe. Like, whats different about science kuwe, from ezinye isubjects, yintoni eyenza uba uyithande more iscience, ngaphezu kweaccounting nesocial science nehistory?</i></p> | <p><i>Interviewer: But that can be done in other subjects besides science, subjects like accounting, for an example, you can be given money to count and balance. What makes science different form other subjects, what makes you love it more than other subjects like accounting, social sciences and history?</i></p> |

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| <p><i>Learner: Iscience yone ne, ineacids phakathi, kwiaccounting we can ukubala imali, qha kwiscience kukhona iacids Phakathi, so idifference ininzi kuba imali ungakwazi uyibamba then ilentuza, iacid wukwazi uyibamba. So, you have to follow the rules uba funeka wenze ntoni nantoni nantoni. Kwimali awukwazi ufollow(isha) irules ngelinye ixesha kodwa uyakwazi uxelelwa iamount yale mali funeka ibeyile, then ungakwazi ubala ubale ifike pha, kodwa kwiscience, usebenzise iacid, ukhangele ukhangele, nikhangele ezinye imaterials eziyi conductor from iacid, so imnandi ngelohlobo kum.</i></p> | <p><i>Learner: Science has acids right. With accounting, we can count money with science, there are acids and bases, so the difference is that, you can touch money, but you can't touch acids. So, you have to follow the rules of what to do. With moany, you can't follow rules sometimes, but you told what amount it should be, then you count until you get to that. With science, you use acids, you test them and look for other materials that are conductors from acids, I enjoy it because of that.</i></p> |
| <p><i>Interviewer: Uyayithanda? Lik singatsho sithi uyayithanda wena iscience?</i></p> <p><i>Learner: Ewe</i></p> | <p><i>Interviewer: Do you love it? Could we say that, you love science?</i></p> <p><i>Learner: Ewe</i></p> |
| <p><i>Interviewer: Uyazibona usenza iscience in the future, uyazibona uhlala elab udibanisa izinto, usenza izinto?</i></p> <p><i>Learner: Andiziboni ndihlala elab, ndibadibanisa izinto ndisenza izinto.</i></p> | <p><i>Interviewer: Do you see yourself doing science for the rest of your life, being in the lab mixing stuff and making stuff?</i></p> <p><i>Learner: I don't see myself being in the lab, mixing things and making things.</i></p> |
| <p><i>Interviewer: Uzibona ungugqirha?</i></p> | <p><i>Interviewer: You see yourself as a doctor?</i></p> |

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| <p>Learner: Ewe</p> | <p>Learner: Yes.</p> |
| <p><i>Interviewer: But usebenzisa iscience xa ungugqirha at the end of the day</i></p> <p>Learner: Ewe ke.</p> | <p><i>Interviewer: But doctors use science at the end of the day...</i></p> <p>Learner: Well, yes.</p> |
| <p><i>Interviewer: Ndiyakuva. Xa ucinga iscience iyakwazi usetyenziswa to everyday life okanye iscience iphelela eskolweni, uba ufundiswe ngetextbook, then uhambe, mhlambi uyotesta isemi conductors like you said, neconductors or something is an acid or base, like we did. Xa ucinga siyakwazi uphuma from lento siyifundiswe eskolweni, then iscience ibe, sikwazi uyiapply(a) to everyday life, sibone uba infact ubomi esibuphilayo...</i></p> <p>Learner: Siyakwazi ngoba siyakwazi notesta istarch endlini. So uba, bakhona abanye abangasaziyo moss, then, ukwazi umxelela lena, mhlambi, ndenza umzekelo, itapile, linestarch, isonka sinestarch, ngeyiphi le, icheese, ayinayo istarch. So, uyakwazi uxelela umntu ngeyiphi into enestarch, ngeyiphi into engena starch.</p> | <p><i>Interviewer: I hear you. Do you think science can be used in real life or that it ends at school? Like being taught with the textbook and then going on to test conductors and semiconductors or acids and bases, like we did? Do you think we can use the information we get at school in real life?</i></p> <p>Learner: We can, because we can test the presence of starch at home. So, if, there are people who don't know this, o you can tell them, that a potato and bread, for an example, have starch in them and cheese doesn't. So, you can tell people about what has starch and what doesn't.</p> |
| <p><i>Interviewer: Lonto, yinto esiyazi ngoba sense iscience, siyakwazi utesta istarch ezambaneni sisebenzisa certain methods...</i></p> | <p><i>Interviewer: And that is something we know from doing science, that we can test for starch in potatoes using certain methods...</i></p> |

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| <p>Learner: Yes</p> | <p>Learner: Yes.</p> |
| <p><i>Interviewer: So, you feel like iyasebenzia in normal life. Uyifumene kanjani lento? Uyifundiswe, uzbonele?</i></p> <p>Learner: Ndazfundiswa, then ndazbonela. Then kwathwa uba masitesta kusetyenziswa iIoine. So sayitesta nathi sabona uba akho starch kwelicala, nakwezinye, sikhona istarch.</p> | <p><i>Interviewer: How did you get to know about this? Were you taught about it or did you discover it yourself?</i></p> <p>Learner: I was taught about it and then got to see it. We were told to test for starch using iodine, we tested and were able to see what has starch and what doesn't.</p> |
| <p><i>Interviewer: So kengoku, xa ulapha umzekelo, wenze iexperimentsokanye uye elab sometimes kweziwe iexperiments okanye wenze iexperiments eclassini, uyakwazi udibanisa these experiments that you doing with umsebenzi owunikwayo eclassini? Zidibane ubone uba, in fact yenza isense maan lanto bendiyifundisiwe, yenza isense bendikhe ndayenza Ekmsc, then uthathe loInformation, ujonge iproblem onayo, then ufune uslove(a) loproblem?</i></p> <p>Learner: Ew, ndyakwazi uzcompare(isha) zoy2 and into esiyenzayo esikolweni iyafana nalapha ngelhlobo siyenza ngalo. So kengoku, xa ndiyenza eskolweni okanye ndiyenza apha ayikho different, ndiyayiunderstanda uba bendikhe ndayenza lento apha, so ilula kum uyiUnderstanda worse xa ndiseiclassini.</p> | <p><i>Interviewer: So, when you do experiments here, at the lab or even at school, can you make connections between the experiments and your school work? Like find that it all makes sense together and then use that information to solve a problem?</i></p> <p>Learner: Yes, I can compare both of them and what we do at school is the same as what we are doing here at the club. So, when I do it at school or here, its not different, I understand that I did this here, so its easier for me to understand especially when at school.</p> |

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| <p><i>Interviewer: Uyazienjoya iscience lessons? Ubhonest, xa kume itishala phambi kwakho, ifundisa iscience, uyayienjoya lonto?</i></p> <p>Learner: Ewe, ndiyayienjoya.</p> | <p><i>Interviewer: Do you enjoy science lessons? Be honest, when your teacher is teaching, do you enjoy that?</i></p> <p>Learner: Yes, I enjoy that.</p> |
| <p><i>Interviewer: Why uyienjoya? Lendlela kwenziwa ngayo eskowleni, singekezi EKMSC, sisepha eclassini yakho, xa nifundiswa inatural sciences pha, uyayienjoya lonto?</i></p> <p>Interviewer: Andiyi enjoyi kakulu, kuba ezizinto bazithethayo, abazenzi phambi kwethu sikwazi nathi uba neproof uba inyaninile na lento ibhalwe apha iyenzeka. Iyandiconfuse(a) ngelinye ixehsa, bayakwazi ukuthi ewe iyenzeka, nangona ingenzeki, so ndibawela mna yenziwe phambi kwam, then ndikwazi uba kuzonkwenzeka ntoni.</p> | <p><i>Interviewer: Why? The way things are done at school, before we get to KMSC, we still in your class, do you enjoy how natural sciences is taught there?</i></p> <p>Learner: I don't enjoy it that much because they don't do what they are talking about, so we can get proof that what's written is true, it actually happens. I get confused sometimes, because they can say that it happens even when it doesn't, so I want to see it done in front of me so I can see what will happen.</p> |
| <p><i>Interviewer: So ucingba kungenziwa kanjani kengoku uba uyithande more? Ngoba zenziwe phambi kwakho ezizinto uzifundiswayo?</i></p> <p>Learner: Ewe.</p> | <p><i>Interviewer: What do you think can be done, so you can love it more? Do you want to see them done in front of you?</i></p> <p>Learner: Yes.</p> |
| <p><i>Interviewer: Like, if ufundiswa into efana noba, mhlambi kwiNatural science ufundiswe ngento engazukwazi uba neexperiment, but izokwazi ufundiswa eclassini, mhlambi into enje ngechlorophyll and things like that and</i></p> | <p><i>Interviewer: What if you taught something that doesn't really need an experiment, but can be taught in class? For an example, if you taught about chlorophyll and things like that, what do</i></p> |

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| <p><i>awuyifumani ichlorophyl, ucingba kungenziwa njani ufundiswa izinto ezinjalo? Niyoboniswa phandle imithi?</i></p> <p>Learner: <i>Ndingafuni siyoboniswa phandle, mhlambi kubekhona lomthi ne, then kuxelwe kengoku uba awuyiboni ichlorophyl kodwa ikhona. Then kwenzeka icycle yonke apha, yilento igreen, kwenzeka lonto, nangoku kwenzeka icycle, nantsi isunlight iza apha, then xa kunetha, kungena amanzi then iphinde ikhuphe icarbon dioxide.</i></p> | <p><i>you think can be done? Be taken outside and shown trees?</i></p> <p>Learner: <i>We could be taken outside. Say, we have this tree right, and then be told that, you can't see the chlorophyll but it is there. Then, the full cycle happens here, and the cycle is happening as we speak. This is sunlight, it comes here, when it rains, the water seeps into the tree, which then releases carbon dioxide.</i></p> |
| <p><i>Interviewer: Ioxxygen. Iphotosynthesis?</i></p> <p>Learner: <i>Iphotosynthesis.</i></p> | <p><i>Interviewer: Oxygen. Photosynthesis, right?</i></p> <p>Learner: <i>Yes, photosynthesis.</i></p> |
| <p><i>Interviewer: Ndiyakuva, niyeke uyifundiswa encwadini qha? Nikhutshwe phandle nizoybona?</i></p> <p>Learner: <i>Yes.</i></p> | <p><i>Interviewer: I hear you. You don't want to be taught using books all the time, you want to go out and see for yourself?</i></p> <p>Learner: <i>Yes.</i></p> |
| <p><i>Interviewer: Okay, sendizogqiba ne. Zithini oba nazo wena xa ufunda iscience, what problems do you experience xa ufunda iscience? Mhlambi iproblems zeunderstanding, mhlambi ayivakali ikude kakulu, mhlambi kuthethwa ngomthi that you can't see, things mhlambi ongakwazi</i></p> | <p><i>Interviewer: What problems do you have with learning science? Problems with understanding maybe, is it abstract maybe, is it that you cannot relate to some things, like being taught about sulfuric that you don't know and you've never seen?</i></p> |

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| <p><i>urelate nazo, mhlambi nifundiswa ngesulphuric acid uvele uqonde uba yinto isulfuric acid?</i></p> <p>Learner: <i>Uhm, kwiscience ne, kukho ezinye ielements abazibizayo then ndiske ndibenalanto yoba, I wonder injani, icolour yayo itheni, kwenzeka njani, ndiske ndibelost apho, ndiske ndibawele uyibona lento kuthethwa ngayo, qha ngelinye ixesha uskeungakwazi.</i></p> | <p>Learner: <i>Uhm, in science, there are some elements I don't know so I wonder what it looks like, its colour, how it works, I get lost there and want to see to see what they talking about but sometimes it doesn't happen.</i></p> |
| <p>Interviewer: <i>So, awunangxaki zoUnderstanda norelte(a) uyifundiswa eskowleni to ubomi bamanyani, like uba ufundiswa ngento, awunangxaki yokuyibona lento, like in real life, mhlambi engqondweni yakho before uyiboniswe lento, xa kutwa, umthi has ichlorophyl, awunangxaki yoqonda uba umthi unechlorophyl noba ungayibonanga, you can receive lento uyixelelwayo uba in fact umthi unechlorophl ngaphakathi.</i></p> <p>Learner: <i>Ewe</i></p> | <p>Interviewer: <i>You don't have any problem with understanding what you are taught at school? Like, when you are taught something, you have no problem seeing it in your mind before you see it in real life, when they say, a tree has chlorophyll, you can receive that even without seeing it?</i></p> <p>Learner: <i>Yes</i></p> |
| <p>Interviewer: <i>Why ufuna uba ngugqirha?</i></p> <p>Learner: <i>Kuba kwezinye indawo ne, ndiske ndifune uba, okau, ibetele lanto uyazi eliyenza lenza ntoni emzimbeni womntu. Then, ndiske ndibawele nam, mhlambi umntu unentliziyo ne, ukwazi umnceda umnike amayeza, wenze le naleya. Mhlambi umncede, ndenza</i></p> | <p>Interviewer: <i>Why do want to be a doctor?</i></p> <p>Learner: <i>Because in some places, I want to, okay, it would be nice to know what certain medication actually does in a human body. Then, I also would like to help people, for an example, people with heart problems, give them medicine and do this and that. Maybe</i></p> |

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| <p><i>umzekelo abenecut, umncede apho, then umtunge wazi umzimba wakhe kukho ntoni, then uxele uba akayibandage(i) esiscar, uzabaneInfection, umntu owenza olohlobo.</i></p> | <p><i>help them, for example, a person that has a cut, help them, suture the cut knowing what is inside their body, and then be able to tell them to cover the scar, lest they get an infection.</i></p> |
| <p><i>Interviewer: Okay, kuwe, is it more about ndifuna unceda abantu okanye ndinomdla woba umzimba womntu usebenza kanjanI?</i></p> <p><i>Learner: Ndinomdla woba umzimba womntu usebenza njani and ndiyabawela nonceda abantu.</i></p> | <p><i>Interviewer: Okay, is it more about helping people or about understanding how the human body works?</i></p> <p><i>Learner: I am interested in how the human body works and I also would like to help people.</i></p> |
| <p><i>Interviewer: Do you think learning science by relating it to everyday life helps? Xa sifunda iscience, umzekelo the experiments that we did, do you think that, that helps your learning of science, or do you think that ipointless?</i></p> <p><i>Learner: Iyandinceda kakulu ngoba bendingayazi nam ezisubstances sizisebenzisileyo yibase neacid. So, nam ndiye ndothuka xa kutshintsha icolours, nam ndaybona. Bendingazcingelanga ezinye uba ziacids, so nam ndabona kengoku uba lena yiacid, lena yibase.</i></p> | <p><i>Interviewer: Do you think learning science by relating it to everyday life helps? When learning science, the experiments that we did, for an example, do you think that, that helps your learning of science, or do you think that its pointless?</i></p> <p><i>Learner: It helps a lot because I didn't know that these substances that we used were acids and bases. So, I was shocked when I saw colours changes. I didn't think that some were acids, so I also got to see that what were acids and what were bases.</i></p> |
| <p><i>Interviewer: Okay, then wayifunda icontent uba kutheni kutshintsha icolours and things like that.</i></p> | <p><i>Interviewer: Okay, then did you learn the content, like understand why colours change, and things like that.</i></p> |

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| Learner: Yes. | Learner: Yes. |
| <p><i>Interviewer: So iyakuncedisa ukufunda iscience ngezinto iziqhelileyo?</i></p> <p>Learner: Iyandincedisa izinto endiziqhelilyo ngoba iIndicator xa itshintsha ne, then ibegreen okanye ibe purple, iyaxela kengoku uba lena yibase lena yiacid. So, indinceda kakulu noba ndikwazi usebenzisa iindicators.</p> | <p><i>Interviewer: Is learning science using things you are used to helping you?</i></p> <p>Learner: Learning with things I am used to is helping, because when the indicator changes colour, when its it becomes green or purple, its indicating that, this is an acid and this is a base. So, it helps me learn how to use to use indicators.</p> |
| <p><i>Interviewer: In your own opinion, iscience club eyenza iexperiments ezinezinto zasemakhaya, okanye if uza kwisience club, ingase ufike wenze ntoni kwisience club?</i></p> <p>Learner: Ndibawela ndifike ndenze iexperiments, mhlambi not ngefood items esizifumana endlini, mhlambi ngeacids nyaninyani zaselab.</p> | <p><i>Interviewer: In your own opinion, what would you like to do at a science club?</i></p> <p>Learner: I would love to do experiments, not with food items from home, maybe with real acids from the lab.</p> |
| <p><i>Interviewer: Okay, so wena, uorefer(a) usebenzisa ezi zaselab kunoba usebenzise ezi uziziqhelileyo zakokwenu?</i></p> <p>Learner: Yes.</p> | <p><i>Interviewer: Okay, so you prefer using lab stuff instead of the ones that you are used to?</i></p> <p>Learner: Yes.</p> |

Learner 8

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| <p><i>Interviewer: What do you want to do when umdala?</i></p> <p><i>Learner: What do I wanna do? Okay. Like, I want to be a doctor ne, but my problem is that, I enjoy maths, I enjoy maths to be honest, I really do, Ii understand it, and science is also fun ne. Then being a doctor for one is helping people, not just that, I just... I just don't like seeing people opened, but yet I want to help them, you understand. So, its like a 50/50 situation. Yeah, and like, being a doctor for me, like, I feel like it will open more opportunities, I am not only getting, like to be a doctor but at the same time, I am also getting a medical certificate on which I can move to different fields so that's my main reason I'm choosing that career.</i></p> | <p><i>Interviewer: What do you want to do when you grow up?</i></p> <p><i>Learner: What do I wanna do? Okay. Like, I want to be a doctor ne, but my problem is that, I enjoy maths, I enjoy maths to be honest, I really do, Ii understand it, and science is also fun ne. Then being a doctor for one is helping people, not just that, I just... I just don't like seeing people opened, but yet I want to help them, you understand. So, its like a 50/50 situation. Yeah, and like, being a doctor for me, like, I feel like it will open more opportunities, I am not only getting, like to be a doctor but at the same time, I am also getting a medical certificate on which I can move to different fields so that's my main reason I'm choosing that career.</i></p> |
| <p><i>Interviewer: Is there anyone that inspired that?</i></p> <p><i>Learner: Yes, my dad. My dad is like my number 1 role model guys. So, like, like I've noticed people saying like I adore my Dad more, but I've never really noticed that until like, 3 months ago when my friends told me, girl why you always speaking about your Dad, like that, its always your dad, your dad, seriously guys, I didn't even notice. That's how much I appreciate him. But then, oh, as soon as we in the same room, its like all hell breaks loose. Its that kind of feeling.</i></p> | <p><i>Interviewer: Is there anyone that inspired that?</i></p> <p><i>Learner: Yes, my dad. My dad is like my number 1 role model guys. So, like, like I've noticed people saying like I adore my Dad more, but I've never really noticed that until like, 3 months ago when my friends told me, girl why you always speaking about your Dad, like that, its always your dad, your dad, seriously guys, I didn't even notice. That's how much I appreciate him. But then, oh, as soon as we in the same room, its like all hell breaks loose. Its that kind of feeling.</i></p> |

Interviewer: So, what happens when you in the same room? Do you speak? Do you... Uhm, how does hell break lose?

Learner: Yeah, we do speak ne, we do speak. But then, there will be that, lets say we are having a proper conversation ne, and then there will be this time when he is like, we all tired and he is like, "Mihlali, kondenzele ikofu," and Mihlali is like, "nyani, seriously? I mean, iphelile iswekile," and he is like, "nope, I bought it yesterday," and I am like, okay what to do next, what to do? "amanzi amkile." Then athi, "naziya i5L," and I am like ah this guy, can't you understand, I don't want to doo it. Yeah, but he is also that type of person of which you can, he's very strict on education, so that's where. So, he's like, "uyabona, I see all your friends are taking maths lit, uyoyohlala estratweni ke uba uzothatha imaths lit." Yooh guys, and like, hes got these files, like huge stack of files, sp he's like, "ah soze usokole, naziya zihleli zikulindile, noba andikho, ndzokthengela idata mntanam kakuhle nje," and I am like, oh my goodness, and then I have to do pure maths and pure maths comes with science, and in the end, I have to understand and actually try to like science. That's where I try to comb... to mix the two to get them to bond yabo, because if I don't like science and I like Maths, then igs gonna clash because in science you need maths and in maths, you need science.

Interviewer: So, what happens when you in the same room? Do you speak? Do you... Uhm, how does hell break lose?

Learner: Yeah, we do speak ne, we do speak. But then, there will be that, lets say we are having a proper conversation ne, and then there will be this time when he is like, we all tired and he is like, "Mihlali, kondenzele ikofu," and Mihlali is like, "nyani, seriously? I mean, iphelile iswekile," and he is like, "nope, I bought it yesterday," and I am like, okay what to do next, what to do? "amanzi amkile." Then athi, "naziya i5L," and I am like ah this guy, can't you understand, I don't want to doo it. Yeah, but he is also that type of person of which you can, he's very strict on education, so that's where. So, he's like, "uyabona, I see all your friends are taking maths lit, uyoyohlala estratweni ke uba uzothatha imaths lit." Yooh guys, and like, hes got these files, like huge stack of files, sp he's like, "ah soze usokole, naziya zihleli zikulindile, noba andikho, ndzokthengela idata mntanam kakuhle nje," and I am like, oh my goodness, and then I have to do pure maths and pure maths comes with science, and in the end, I have to understand and actually try to like science. That's where I try to comb... to mix the two to get them to bond yabo, because if I don't like science and I like Maths, then igs gonna clash because in science you need maths and in maths, you need science.

Interviewer: So, you don't really like science, you like maths??

Learner: Yeah I like maths, but science, no I love science ne, its fascinating, but then when it comes to writing it out I am like, whoo, okay, like I mean, asikwazi ukwenza IVN maan guys ndiniexplainele uba okay, this is what we did, because me and writing, I am more of a talkative person because I will write something down ne, but I will write it to a specific limit because I don't know how to get it on a pen and paper, but as soon as I start talking, then you see, then it gets too deep and I am like, okay, today I learnt that, ethanol is this type of substance okay, and it does this and this. But, if I were to talk, I would be like, okay guys ethanol, my goodness ethanol. Yeah, so, that's the type of person I am.

Interviewer: Why do you come to the club?

Learner: It helps me, lets just start there, it helped me a lot, especially last term, I mean my marks improved drastically, in maths I got a level 7 and in science I also got a level 7. So, it helps me, it helps me. The thing is, it's the small things that actually help me ne. And then, the other reason is that, yah, I actually get woken up and they like, not this Saturday, this Saturday you've got this commitment and you have to stick to it. So, my parents are like, if you can't teach yourself to commit to something now, its going to be very hard to coming to something later on in life. So, they

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are like, Mhlali... especially this morning, oh my God, ITS FREEZING!!!! And my mom is like, mh.mh, and they all sitting in bed, I am the only one that has to get up ne. Mhlali vuka, vuka umise ipapa... And I am like yima ne, ndzovuka ne, but ipapa yenziwa nguwe. And she's like, as long as uvukile mntanam. And I get up like, I don't want want to get up but I have no choice, I don't feel like making porridge this morning, and yeah so, that all that happened.

are like,... especially this morning, oh my God, ITS FREEZING!!!! And my mom is like, mh.mh, and they all sitting in bed, I am the only one that has to get up ne. wake up and make pap... And I am like wait ne, I will wake up ne, but you make the pap. And she's like, as long as you are up, my child. And I get up like, I don't want to get up but I have no choice, I don't feel like making porridge this morning, and yeah so, that all that happened.

Interviewer: What do you think is the one thing that helps you in the science club?

Interviewer: What do you think is the one thing that helps you in the science club?

Learner: The one thing that helps me... Its actually getting to practise maths. Its very sitting... Because at home I'm the eldest and the only girl and then there is three brothers that come after me. So, it's a challenge I'd say, getting to study. But now you get to a place where you study but you don't really feel like you studying. You know that, okay, right now I am doing maths. But maths, if you were to sit in class, you'd be like, ha guys, hai maan uzivile iindaba zayizolo? Uyayibona, benikxelele, utshilo nyani but then here you like, okay guys, I don't know you, I don't know you, I don't know you, I know you we don't really talk, so the only thing you can focus on is the maths that you have to do.

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Interviewer: So, do you feel like the experiments we were doing with the science part were helping?

Learner: Yeah, they really did. Because, uhm, you don't, like at my school, its not really something we do often, doing experiments. So, its kind of seeing things blow up and seeing the reactions of this to this, because its very easy to read from a textbook but when you see it, you like, okay, I remember I remember she put this green liquid, what's this green liquid, ah it was called uhm, g- something something, So, I remember with, how can I say it? My memory comes with pictures or sounds. So, if I remember hearing a boom, then I can say, what did she do before that boom, so that's how I remember.

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Interviewer: Okay, why do you think other learners do not come to the club?

Learner: 1. Its peer pressure. Like seriously, like like, people can say, guys this weekend... especially around my group. A person can say, guys lets do this, and then I'm like, but I've got a thing from 9-11. Then they like, okay ngohalf I and they like, okay we can make half 1. Then some people take it as, as being, let me put in a quotation marks, a "nerd." So, in the type of circle we're in right now, being a nerd is like being a nerd is like being a loser, but yet they don't understand that, its not all about learning, you can learn in a fun way, but

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people just don't want to because they think that, uzandihlisela ilantuza, ireputation, bazathini abantu... mna ndibonwe elibrary ngomgqibelo? Hayi, soze sikwai, uyabo, zinto ezinjalo. Ichom zam ziyaphuma uyabo, but they don't understand uba ichom zona ziyakwazi ufika zifunde emakwabo, they don't have the same challenges abanazo bona, and stuff like that.

people just don't want to because they think that, they can't be seen at the library on a Saturday because that would hurt their street crd. My friends go out ne, but they don't understand some friends can study at home they don't have the same challenges as them and stuff like that.

Interviewer What do you think about science? What comes to your mind when we say science?

Learner: Evolution, like, science, in me, like I just, it just popped into my brain that science isn't just life science science, like physical science, but social science. Because, the whole concept of technological evolution comes from the theory of human evolution. So, its like taking, like as they said, I am not sure if it was like before, as they said, its like the little ideas, that give out great uhm... whats this word, oh izpuhumo. Results, yes. So, its like... Wait, what was the question?

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Interviewer: What do you think about science?

Oh yah... Its nice, its evolution, its transforming but yet, like, for me, they took science a bit too far. YAH. Because now people are like, guys we've got global warming, and then like, 20 years ago, you didn't even think about global warming, you were thinking of making things easier, yet now you've got to find new ways of stopping global warming while causing global warming which is just, a headache guys. Because they like, guys we should save fuel, yet people are so concerned of the rand going down because of the oil that needs fuel. So, I am like, guys, this thing is crashing so we gotta find something. Yes, people nowadays are like, but if I work, then no one is gonna recognize me, so why do good when I can do bad and people will know that I did bad, yet when I do good at the same time, I am like boom I am famous, yet you didn't do nothing. You still in square 1. So we stuck.

Interviewer: What do you think can be done then about these problems?

Learner: What I think can be done, like right now, I don't wanna lie, I don't know. Because we could be like, guys, lets lets lets stop the oil pollution, yet, Volkswagen or Mercedes is inventing a new car that's going to need that oil. We can say, guys lets stop greenhouse gases, yet at the end of the day, you are the one going to the stores and buying those substances that ccause greenhouse gases. So,

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| <p><i>it should be a 50/50 uyabo. Because if we tell ourselves, guys, then we've got this national bike day and only one day in a year. What is one day going to change in 364 days left of that year? Because, during the 364, that one person said, I am gonna ride a bike today, tomorrow they still going into their car. I am going to uh, stop cutting down trees this week, the next week, you cutting even more down. So, I think we should just start with ourselves, just start ngementality yethu, kuthi uba, if I don't do this, then this is gonna happen. Lets start with educating each other, because if you are not educated and people are like, stop cutting trees, why should I stop cutting trees, I mean, it makes no sense, we need trees, why should I stop cutting them, uyabo. Its basically that.</i></p> | <p><i>should be a 50/50. Because if we tell ourselves, guys, then we've got this national bike day and only one day in a year. What is one day going to change in 364 days left of that year? Because, during the 364, that one person said, I am gonna ride a bike today, tomorrow they still going into their car. I am going to uh, stop cutting down trees this week, the next week, you cutting even more down. So, I think we should just start with ourselves, just start our mentality that,, if I don't do this, then this is gonna happen. Lets start with educating each other, because if you are not educated and people are like, stop cutting trees, why should I stop cutting trees, I mean, it makes no sense, we need trees, why should I stop cutting them, Its basically that.</i></p> |
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| <p><i>Interviewer: Don't you think then, we can develop scientists, or we become scientists that think about solutions to these problems? Like people who will solve our problems without creating more problems? Like alternative fuel or alternatives to cutting trees?</i></p> | <p><i>Interviewer: Don't you think then, we can develop scientists, or we become scientists that think about solutions to these problems? Like people who will solve our problems without creating more problems? Like alternative fuel or alternatives to cutting trees?</i></p> |
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| <p><i>Learner: Yeah, that could help ne. But, into endiyibonileyo is that, that could help ne... But how are you going to teach these young children or people that come after us? Because, as we can see, like, umntu akhale ukuthi ubana, abantwana eskolweni, abafundi, or abafuni funda, yet you not trying to understand what they going through. So, you, akafuni ufunda lomntana, have you asked, kutheni ungafuni ufunda? Like umntana... you don't ask those type of</i></p> | <p><i>Learner: Yeah, that could help ne. But, what I've seen that could help ne... But how are you going to teach these young children or people that come after us? Because, as we can see, like, learners don't want to work/study, yet you not trying to understand what they going through. So, you say, this child does not want to learn, , have you asked, why don't you want to learn? Like children... you don't ask those type of questions. I really hate when Ma'am says that: why are you like this?? like you don't</i></p> |
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questions. I really hate when uMa'am athi ubana, kutheni ujena? like you don't ask it in front of the class, like uyamthatha umntu and go into a quiet place and then be like, do you mind explaining your situation... ungathi ubana, uyabo, umhlaze umntu uthi ubana, unjena eclassini, sithi imarks zakho. Then, in that person's mind its an encouragement ukuthi uba, hai uyandidelela moss, why should I do any better, uyabo, that's basically what you are saying to that person. So, yeah, it could work on teaching younger minds, ne. I know they say, "you can't teach old dogs new tricks," but can you teach them to do their old tricks in a better way? Its like saying, I teach you, you teach me, if they teach me, we teach us, so it's a boom situation.

ask it in front of the class, like you take a person and go into a quiet place and then be like, do you mind explaining your situation... you don't embarrass a person by telling the whole class about their performance.. Then, in that person's mind its an encouragement that, they c moss, why should I do any better, that's basically what you are saying to that person. So, yeah, it could work on teaching younger minds, ne. I know they say, "you can't teach old dogs new tricks," but can you teach them to do their old tricks in a better way? Its like saying, I teach you, you teach me, if they teach me, we teach us, so it's a boom situation.

Interviewer: Do you feel like your learning process is affected a lot by the person/people who teaches you?

Interviewer: Do you feel like your learning process is affected a lot by the person/people who teaches you?

Learner: Like, a lot. Like there are moments where you look around the class and everyone, and like, you come out as like the 3rd cleverest person in your class and everyone is like, guys you're so smart, I mean how do you do it, ukubone? There are questions like that, and then, you get this person who... you're humble at third ne, but you get this number 1 who is cocky and then you like, how do you do it and hes like, just get out of my face. Then, to you, you like, fine, if he doesn't wanna share, I don't wanna learn. If he doesn't wanna do this, I'm not gonna do that uyabo. So, its... whats mainly important is changing imentality

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| <p><i>yabantu, although, I don't know how to, it would be a good idea to atleast try and change people's mentality.</i></p> | <p><i>although, I don't know how to, it would be a good idea to at least try and change people's mentality.</i></p> |
| <p><i>Interviewer: So, do you think science can be applied to real life situations?</i></p> <p><i>Learner: Science can be applied into real life. You just have to put it into a concept of real life. Because most of the experiments we see are extreme uyabo. Its stuff, but you can just say, ukubone the reaction of bicarb and vinegar, that's science, thats already an experiment on itself uyabo. So, it can be very much applied, ukubone, how to put out fires without spending a R150 on a fire extinguisher, uyabo. It is possible. It is.</i></p> | <p><i>Interviewer: So, do you think science can be applied to real life situations?</i></p> <p><i>Learner: Science can be applied into real life. You just have to put it into a concept of real life. Because most of the experiments we see are extreme. Its stuff, but you can just say, the reaction of bicarb and vinegar, that's science, that's already an experiment on itself. So, it can be very much applied, how to put out fires without spending a R150 on a fire extinguisher, It is possible. It is.</i></p> |
| <p><i>Interviewer: Do you enjoy science lessons? At school? The one's that we have here?</i></p> <p><i>Learner: Mh.mh. Yah. Mh.mh.</i></p> | <p><i>Interviewer: Do you enjoy science lessons? At school? The one's that we have here?</i></p> <p><i>Learner: Mh.mh. Yah. Mh.mh.</i></p> |
| <p><i>Interviewer: Why do you think you enjoy them? Is it how its taught, is it science itself?</i></p> <p><i>Learner: Yeah, I mean its science itself. Because between here and school is a very long uyabo way, because at school you are taught, the teacher will be like, the chemical reaction of this and this is equal to this, write it down in your books. And you like, okay, I get it, but here you like, you see that, if you actually add</i></p> | <p><i>Interviewer: Why do you think you enjoy them? Is it how its taught, is it science itself?</i></p> <p><i>Learner: Yeah, I mean its science itself. Because between here and school is a very long way, because at school you are taught, the teacher will be like, the chemical reaction of this and this is equal to this, write it down in your books. And you like, okay, I get it, but here you like, you see that, if you actually add</i></p> |

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| <p><i>this, it will actually equal to this, so its two different ways ne, as long as they add them to one, its very nice. Kodwa, eskolweni bekuthwe, like eskolweni, the reaction, bektwe there will be a fire ne, and then you actually do it in real life and you like okay, there is no fire here. In a way it intrigues imind yakho, your're like, why is there no fire guys, like, did they do it wrong or did I understand wrong. So, it actually, in a way, it motivates you to wanna learn more, about science, yeah.</i></p> | <p><i>this, it will actually equal to this, so its two different ways ne, as long as they add them to one, its very nice. But this is what they said at school,, like, the reaction, they said there will be a fire ne, and then you actually do it in real life and you like okay, there is no fire here. In a way it intrigues your mind, you're like, why is there no fire guys, like, did they do it wrong or did I understand wrong. So, it actually, in a way, it motivates you to want to learn more, about science, yeah</i></p> |
| <p><i>Interviewer: So you are able to take what you get here and mix it up with what you get from school to get a basic understanding of the concept you are taught at school? Then ke think about ways to apply it to your own life...</i></p> <p><i>Learner: mmmmh</i></p> | <p><i>Interviewer: So you are able to take what you get here and mix it up with what you get from school to get a basic understanding of the concept you are taught at school? Then ke think about ways to apply it to your own life...</i></p> <p><i>Learner: mmmmh</i></p> |
| <p><i>Interviewer: What problems do you have with learning science?</i></p> <p><i>Learner: Remembering. Because, you... the big words guys, there's... the language... there's.... Oesophagus is really easy ne, like the pronunciation. I'm very bad at spelling, like andikwazi uspella guys tjo, me and spelling are just not friends. So I am just like, oesophagus, okay, how can I remember this word? Oeso-pho-gus. It sounds weird guys, that's like the back of an ostrich. So you like, oesophagus – trachea, trachea-oesophagus,</i></p> | <p><i>Interviewer: What problems do you have with learning science?</i></p> <p><i>Learner: Remembering. Because, you... the big words guys, there's... the language... there's.... Oesophagus is really easy ne, like the pronunciation. I'm very bad at spelling, like I can't spell, me and spelling are just not friends. So I am just like, oesophagus, okay, how can I remember this word? Oeso-pho-gus. It sounds weird guys, that's like the back of an ostrich. So you like, oesophagus – trachea, trachea-oesophagus, this is here and</i></p> |

this is here and oesophagus is this. So, for me, I find the pronunciation easier, not the spelling. You can put oesophagus in front of me and I'll be like, whats this word guys? But then if you say it, I'm like, guys this is the oesophagus, its in your neck uyabo, its one of the pipes, and you're like whats the other one, and I am like, trachea, and I'm okay, now I know what oesophagus is, but if you were to write it down, I'm like, which one is which kengok, oeso - what now? Tra-what? So, reading them and saying them are two different things to me.

oesophagus is this. So, for me, I find the pronunciation easier, not the spelling. You can put oesophagus in front of me and I'll be like, whats this word guys? But then if you say it, I'm like, guys this is the oesophagus, its in your neck, its one of the pipes, and you're like what's the other one, and I am like, trachea, and I'm okay, now I know what oesophagus is, but if you were to write it down, I'm like, which one is which oeso - what now? Tra-what? So, reading them and saying them are two different things to me.

Interviewer: So, would you like to be a scientist? Why/not?

Interviewer: So, would you like to be a scientist? Why/not?

Learner: No. I just... I wouldn't prefer doing experiments by myself, I don't like to find out, I like to be taught, I am that type of person. So, if you say, what happens if this and this and this are mixed together? I am like, I really don't care, but if you tell me, that this happens, I am like, okay, lets see how it happens, you see.

Learner: No. I just... I wouldn't prefer doing experiments by myself, I don't like to find out, I like to be taught, I am that type of person. So, if you say, what happens if this and this and this are mixed together? I am like, I really don't care, but if you tell me, that this happens, I am like, okay, lets see how it happens, you see.

Interviewer: So, it doesn't excite you like that?

Interviewer: So, it doesn't excite you like that?

Learner: No, I want to you tell me, if you add this and this, it will make a bomb. I'll be like, you lie!!! And then, I will want to do it. But if you ask me, what does this and this give? I'm like...

Learner: No, I want to you tell me, if you add this and this, it will make a bomb. I'll be like, you lie!!! And then, I will want to do it. But if you ask me, what does this and this give? I'm like...

Interviewer: So, do you think learning science by relating it to everyday life helps? Do you think there would've been a difference if we used things we normally get at a lab for the experiments? Like, if we used sulfuric acid instead of vinegar, sodium hydroxide instead of bleach, magnesium strip instead of steel wool?

Learner: It would've made a difference. Like, a big one. Because you are like, okay yah maan, yes ndiyayikumbula ibicarb, ibicarb yilanto iblue ekhabathini ne, ne bleach. So ezizinto zezizinto, like bleach is what now? Because if you say sulfuric acid, I am like, yeah, I know its in science, but I really don't know what it is. But if you tell me, its bleach, I am like, oh its bleach, sulphuric acid you can go away now. So, you take bleach and you take vinegar, and tell me its potassium, I'm like, I'd rather write you in an exam so you gotta go. Yeah, so its easier using things that you know because you like, okay, I know this won't hurt me, but what is sulphuric acid? Although, its in front of you don't know what it is.

Interviewer: So, do you think learning science by relating it to everyday life helps? Do you think there would've been a difference if we used things we normally get at a lab for the experiments? Like, if we used sulfuric acid instead of vinegar, sodium hydroxide instead of bleach, magnesium strip instead of steel wool?

Learner: It would've made a difference. Like, a big one. Because you are like, okay yah maan, yes I remember bicarb, bicarb is that blue stuff in our cupboard ne, ne bleach. So like bleach is what now? Because if you say sulfuric acid, I am like, yeah, I know its in science, but I really don't know what it is. But if you tell me, its bleach, I am like, oh its bleach, sulphuric acid you can go away now. So, you take bleach and you take vinegar, and tell me its potassium, I'm like, I'd rather write you in an exam so you gotta go. Yeah, so its easier using things that you know because you like, okay, I know this won't hurt me, but what is sulphuric acid? Although, its in front of you don't know what it is.

The volunteers' interviews.

VOLUNTEER 1

Interviewer: Okay, uhm, so... What are you studying and why?

Volunteer: I am doing a 3rd BSc degree in Microbiology and Biochemistry. What I really wanted to do was Microbiology, because I am interested in understanding the small stuff that we cannot see with the naked but need microscopes to even be able to see, but because I need two majors, I took biochemistry. I chose biochemistry because it goes well with Microbiology in that it helps with the understanding of the chemistry aspect of the microbes that I want to study.

Interviewer: Where are you taking this in the near future? What do you want to do with microbiology?

Volunteer: I wanna go up to master's level, and just continue with research.

Interviewer: So you don't wanna go into industry?

Volunteer: Well, I can spend some time in research (maybe 2 years) after my master's degree and then move into industry eventually and flourish there.

Interviewer: Okay, so why are you a volunteer?

Volunteer: I am a volunteer because, I feel like I didn't get the opportunity myself of people I can relate to, who are around age as me, who I can relate and talk to, and understand about what's happening at University, the career I want to go into, which is in the sciences. When I was in high school, you only got like, old teachers who would actually just get in, teach and leave, sometimes not even sure about what they are teaching. So, you are getting relevant people who just did what you are doing now, so they have more understanding of the times compared to the ones who have been doing this for so long.

Interviewer: So, you chose a science club because? Why not Home of Joy for an example?

Volunteer: I chose a science club because of my love for science. Yeah, yeah. I think also wanting to make more impact on science because at Home of Joy, I would engage with the kids yes, but it wouldn't be related to what I am studying, or where I want to work in. So, it is better if I integrate towards science, which is like still making a difference but still on the career I am doing.

Interviewer: Have you always felt this love for science?

Volunteer: Not really, I think my love for science developed when I actually got to university. I think back then, I was just doing science because they said it was in demand and there was money in it. But then as I get into university and got more into practicals, like more engaged because I am more engaged, I have to do more practicals on it, that's when I started to actually enjoy this thing, when I do more

practicals, but back then I really wanted to go into entrepreneurship and business, but then when I got here, I started to develop the love for science.

Interviewer: So, do you feel like, with way science is thought in High School, our attitude is somehow killed?

Volunteer: Yes, I do. I feel like yah, it's really killed because in high school, you basically narrow minded, it's almost like they put blinkers on you using the textbook. You not more exposed into research done by other people. Here at university, they will say, here is a topic, you have to go and do research about it yourself and you are more engaged with practicals, you know every week, whatever topic we are doing, I have a practical about it, so you can understand as see what they are talking about, rather than having to sit in class and be told of a theory and its basic steps. Science is more of being practical rather than being stuck in a classroom, so high school is more of being stuck in a classroom than being out there and experiencing, using a microscope to understand bacteria or mixing chemicals. So that's how its killed in high school. Even the teachers that we have are not enthusiastic like the lecturers that we have because most lecturers that we have are people that are actually in the field they are teaching about and are doing the work so they are enthusiastic and when teaching they are like, 'uh, I am doing research on it, and I have a textbook on it,' so they are enthusiastic. But in high school, we get teachers who are not even interested on the topic they are teaching, and they are just pushing the topic.

Interviewer: Wow, so do you feel like there is something that can be done to try and influence a positive attitude on learners in high school?

Volunteer: I think there is a lot that can be done, for learners, especially on a young age because kids at a young age are actually more into touching, than sitting and listening to you. They are more energetic and having them to go out there and giving them use small microscopes to actually go around and look for small stuff, mix chemicals, small chemicals, builds in them the excitement of chemistry or the excitement of science than actually having to sit and read that photosynthesis is like this from a textbook. When you still young, you into the thing of having to be out there running around rather than actually stuck in one place. Even the attitude of teachers can actually be changed. I feel like if teachers can be given more of equipment and more platforms to not just be teachers of science but actually implementers of science, just like university lecturers. Lecturers at university have offices which have small labs in them where they are doing research in, so why is it that teachers are not afforded the opportunities to practise their own research? Some of them, you could find out that, at the time they got into teaching, they were so passionate and enthusiastic about science but as the time went by, the enthusiasm went down, why? Because they are not into doing sciences, but are more into textbooks reciting the same thing, sitting down and not actually involved even in publishing small papers that might not make much difference but, generating new knowledge, so that by the time they go into class, they are enthusiastic about it. I think that's how we can revitalize science in schools.

Interviewer: Wow, okay. So, what do you think is the role of science clubs in working on the attitudes than learners have towards science, not necessarily their understanding but their attitudes on riding on the fact that, you do well on whatever you feel positive about?

Volunteer: I think science clubs actually improves the attitudes of learners towards science because, as I said, in schools, they don't have people that they can actually relate to, they do not have people who are still fresh and energetic about science, they only have like teachers who are just there. So now, when they actually gonna get students who are fresh, who are almost the same age as them, and when you get there as a volunteer, you get there with enthusiasm of "I know more and trying to explain to them the exciting things that you know, so even in them, you putting that exciting of, " when I get into university, I will study this, I will know this and know this," so as a volunteer you are still fresh and you are still exposed to a lot of new scientific stuff that has been discovered and so you give them that inspiration of, "I want to do this, I want to do this," and also you come with knowledge of things of things that they are still doing but at a different level compared to them, so you revitalize science for them. I think the involvement of science clubs can actually help their attitude more than a lot if you have volunteers that are actually enthusiastic themselves about science and doing small experiments about it. Science clubs, we get there, do experiments and they get wowed thinking oh, this is this and that and especially experiments that are so small and simple, where you mix this and that and they get all energetic about it. So, it put that spark again of like science rather killing it by just sitting in the desk the whole day at 2 ring the bell, leave, come back and submit an assignment.

Interviewer: So, what do you think can be done in science clubs to give it a different fell compared to the classroom setting, give them that relatability of science in their lives, make it more interesting?

Volunteer: I think one thing we can do, in my experience, as I said I started liking it when I got to varsity, science is more of being involved, like I am not a tux person, being in an office, its not me, its actually being there, getting your hands dirty, being with gloves and working with chemicals. That's what I feel like science will get you because if look back into the science Einstein and them practised, those people spent a lot of their time doing trial and error in the labs, that's how they got enthusiastic about it, not actually bearing to only spend few hours or one hour in the but most of your hours you are spending it in books, why? Because it actually kills you because you jut gonna read something that you will cram and memorize which is actually not learning as opposed to doing something physically and experiencing it because it stays on your mind as an experience. So if science clubs, has experiments for all topics that they have in their curriculums, experiments that explain the concepts in class and how to go about them like mitosis, or acids and bases, they have some kind of an experiment that is gonna explain that this is an acid, an acid looks like this, do this, it tastes this, because it will an experience to them that uh science is like around me every day, and they will get the curiosity of hai maan, how did

that happen? And then try to explain it. That is how Einstein and explained a lot of the stuff because they were so involved to the point that they were actually curious about stuff happening around them. And then when you look at something, you can actually discover something by just looking at it because you have that curiosity, but then today's science is actually killing that curiosity, because it is giving you a textbook rather than experience and working. I feel like science clubs should have more experiments on topics in curriculum, so the learners can gain more understanding and more experience, and then it can also help with some kind of a revision on what they did in class, go through it before the experiment is done. Another thing I think would be helpful is having some kind of a reward or recognition for those that come, because you don't wanna just come to this thing and then you are not getting any reward for it, maybe awards or certificate that I've completed this or after you've found something, managed to get 100% on an experiment you did on your own, get a reward on finishing – some kind of motivation so that even the learners pick up their game on the next experiment or piece of work because they also want the recognition so that can work also in science clubs. Yah, I think that's it. More experiments because I feel like others go to science clubs thinking that its experiments, we gonna do experiments and then when we get there and we talking most of the time, they are like wow, I am coming from class, from a talking teacher only to come to someone else who is also talking, so more engagement from them also, asking them questions, having them present, so they can feel like a part of something rather than just seat and listen, like I am contributing. Having debates on like ethical issues on stem cells or ethical issues on whatever, about what they believe is true, whether gravity is true, like having to engage, they are actually getting experience in other stuff that are not necessarily science like presentation, of which science also needs to be communicated. So, when they get to actually speak these terms themselves and not only listen to just the teacher saying these bug words, which don't make any sense to the learner. So it's better if they also use these words and start getting used them, being able to argue using those big words able to support their claims using those bug words also bring to them that thing of being scientific so when they get to university, and they hear methods and hypothesis, it's a norm to them because they have been using these words, not only get surprised in grade 11/12 and now university and all of that. It doesn't get more difficult but easier because they have been using these terms.

Interviewer: Do you know about indigenous knowledge?

Volunteer: I can't say there is much I know about it, I don't wanna lie there is none that I can say I know of some indigenous knowledge. The only knowledge I have is the one that's in the textbook, and the one in the experiments that they do so of IK, I don't.

Interviewer: But do you know of the concept of IK?

Volunteer: Oh yah, yah, yah I do understand the concept. Its like the knowledge about stuff but Indigenous like the one that has been passed from generations, so that's my understanding of the concept.

Interviewer: So, do you think that using IK can have an influence on the attitude learners have towards science?

Volunteer: I think it will definitely work because like when you see something that you see everyday at home and its in a reaction happening in front of you, you relate more to it than something obviously new to you, because then I would first have to understand what you bringing to me before I understand the reaction, I fist wanna know what this is and where it comes from, so that I have more understanding about it and then I still have to understand the process, so its better if I understand what you working with already so that I can now understand the process, so yes if they can use experiments that they see at home everyday and I feel like it will also pump them into trying to understand stuff that, they can even get home and start explaining and sharing their science, like explaining what vinegar is and what it can be used for, so it actually pumps them into getting into this science mood and I feel like it will open their mind and help them discover and explain stuff that we didn't know and processes happening to them because they will start looking at everything as a process or everything as a chemical reaction so then new stuff are discovered because everything they see is just scientific to them so that thing will open them up to discovering things that we don't know now. So, I think it will actually help them a lot, it will help them relate more with the experiments happening because they can see things that they see everyday and then also open more curiosity on them to seeing everything scientific and trying to explain everything.

Interviewer: So, would you then say that IK experiments used with the conventional experiments would work on the attitudes or using IK alone would work best?

Volunteer: I feel like if we can use IK more, so that we can use IK relate back to the conventional experiments, for an example use vinegar as an acid and then explain that even sulphuric acid is an acid because it share the properties of vinegar, than actually making them do an experiment with sulphuric acid that they know nothing about and then tell them that its just like vinegar, they will then think, why didn't we use vinegar straight, something I can even be able to use at home, than using a big thing sulphuric acid. This will even help when they are writing exams, because they will remember vinegar, remember it's the same as sulphuric acid and then know that sulphuric acid could be ideal for the situation/question. So, using more of the stuff they relate to is best than actually using the conventional ones or linking. You can link them by actually first using IK and then relate it back to the conventional ones.

Interviewer: Do you think there could be any significant shift in the attitude if the science clubs are used with experiments that have IK integrated? Or do you feel like they should be separated?

Volunteer: I feel like they would do a more positive impact if the science clubs do these experiments which are IK because I will first introduce IK in schools and actually bring more excitement. In schools, they teach theory but when they go to science clubs, they stuff that they can relate to so that they are not lost both in class and also at the science club, but at the science club they will relate to the work, see the stuff done with the volunteers and the concept done in class would now make sense because of the science club because at the science club they are doing IK experiment with things they see every day at home so I feel like it would be so great if science clubs used more IK rather than text book information which is difficult because now they will feel stuck in class and then stuck again in science clubs doing experiments that I don't understand, as much as it is experiments, it is useless if I still do not understand the experiment I am doing so its better if I am doing the experiment and I understand the experiment itself so that I can link it with the theory I got in class. I feel like these science clubs will make more difference in understanding the concept and influence a positive result on the student because the learner understands the content more because of the experiments with IK that they are doing. Now, the science clubs could even be some kind of an initiator so much that, we even in university can see that IK actually makes a difference rather than the conventional one because you can now have a person who does research and say that IK was initiated by science clubs around the country and lets see the results of it and if they see the result then even decolonisation of education can actually happen because of the positive results in high school science clubs introducing IK and now we see that they is position and now we say that, now the curriculum used in high schools and universities have to change because now people in SA can relate more learning in IK rather than in conventional way so its some kind of an initiator on actually understand the impact IK can have on the learning system in general. I feel like the impact won't only be in science clubs only, it can even be broad and actually infiltrate university where by now you are getting. Yes the university has to be more advanced because we are generating new knowledge and all but if we are coming from the school which pumped you with IK, it will so easier for you when you get out and see reactions and seeing stuff happening for you to question them and for you to be curious about then and now university will actually generate more knowledge so the more the curriculum will actually be decolonized if we can actually get IK from the start of high school, I feel like it will have more impact used in high school clubs in experiments.

VOLUNTEER 2

Interviewer: Okay, uhm, so... What are you studying and why?

Volunteer: Uhm... Currently I am studying computer science, biochemistry and chemistry. I want to go into bioinformatics or maybe computational chemistry. I am still not sure, I mean there's so many choices, but yeah, I believe there's something better that science and technology together can do with the future of medicine and everything, yeah.

Interviewer: Okay, so you wanna go into medicine eventually?

Volunteer: Yes, more of the health field with my, if its bioinformatics or if it's the computational chemistry but yeah.

Interviewer: Are you going into industry of research?

Volunteer: I'm thinking... Research, yeah.

Interviewer: And why is that?

Volunteer: Uhm, I believe in pushing the boundaries of knowledge, I should say. I believe research gives you that, I believe industry is more about application, but yeah, yeah, that's what I wanna do.

Interviewer: You want to create your own knowledge?

Volunteer: Mm.mh

Interviewer: I hear you. Okay so, why are you a volunteer?

Volunteer: Uhm, I don't know, its just something that has been inherent in me, from a very young age I've been volunteering, but then there was a system in my school, where they made us do a 150 hours in order to graduate high school, we had to do like a 150 hours of community service, and it was, it was, it was horrible, we had so much work to do but we had to do community service as well, so you know like, you can't, you can't really pass if you don't pass community service, no matter how many distinctions you get, so like in that experience kinda, as dreadful and horrible and excruciating as it was, it was one of the best times that I had, I actually realised that its actually great to actually you know, do something for someone, to volunteer your time not because you have it, but because you want to – yeah.

Interviewer: Wow okay, so why a science club?

Volunteer: Uhm... I like science, it's a given. But, uhm... I feel like not necessary a science club, for me its a science and maths club, if I should be precise, I like both science and maths. But, I think the essence of it was, I... when I went, when I first went into it, I didn't want anyone to struggle with maths because I know (giggle), I know what it's like to struggle. I remember the time I actually failed maths in like, in like high school and it was like the worst period of my life, not because I wasn't learning anything because I didn't understand. So, if like, if somebody can be there to just open up that window so that you can see things, its not that these things are hard, its not that these things are undoable, its just that we need guidance on what to do, yeah.

Interviewer: So, I happen to know that you were doing Mary waters high school science club last year and now you are doing Khanya maths and science club. Do you feel like there are any differences between the learners you had last year and the learners that you have now? Or between the science clubs generally?

Volunteer: Uhm... I mean, there is more, I don't know. The learners themselves in terms of, you know, a learner being a learner and they still the same, but uhm... the science club at Mary waters, I thought the learners weren't very consistent so we had to fill in a lot of gaps as well, during their time. Here, it's a lot more, it's not perfect at all, there is a bit of consistency with the large mass of the people or students, so it's a lot better to sort of develop their knowledge as we go along, yeah.

Interviewer: So, there is that build-up of knowledge as they go.

Volunteer: Yeah.

Interviewer: Okay so, do you feel like science can be applied to real – life? Also with regards to where you wanna take your career?

Volunteer: Definitely, definitely. Uhm... it's what we've been doing all along (giggle). Oh yah, I certainly believe that, I mean look at stuff like 3D printing and how just take a bunch of cells and then we multiply them and make them that. You know, it's very applicable in so many little things that all life around us is made up of science. I mean to say that, is it applicable, of course it's applicable, it's such a general question...

Interviewer: You know, not everyone thinks that science is relevant to everyday life.

Volunteer: True, but I mean, we wouldn't, we wouldn't be. The air we breathe is science, the very fat that we have the air we breathe made by plants is science, you know the food we eat is science, for us to have a metabolism, for you to wake up in the morning, for you to have hormones, for you to want to cry, that's science you know, everything is science.

Interviewer: Sure. So, have you always liked science? Always wanted to be in the sciences?

Volunteer: Uhm... I'm not sure. I've always been a curious person, that's for sure. But, as uh, for always sciences, I'm not sure because I've been a pretty confused kid, uhm and I landed my hands on many different things, but I tended really to go more towards science because I really found it to be more fascinating. I mean there was more to know with science I felt than with anything else. Not that there isn't much to know with other things, but I felt like, with science you can basically manipulate anything to be what you want it to be, that's creativity in itself.

Interviewer: When did you start moving towards science?

Volunteer: I think somewhere in like grade 9, yeah. Grade 9, grade 10, somewhere there.

Interviewer: Was there anything that happened? Any person involved?

Volunteer: Mmmmh, it could've been chemistry. I really liked, I really liked the reactions that we did. They were so fun, uhm... Actually, it was a very simple reaction of metals reacting with water, where I think we put sodium on the water and that thing just blew there, I was so fascinated, I was like "you

can do this,” I was so excited, I was like, what more can you do – you know. So yeah, it was really great.

Interviewer: Okay, so, did you do anything else to try and nature your attitude to develop it into what it is today, besides doing science at school?

Volunteer: Yes, uhm... I mean with uhm... I mean I did, I did, A lot of the stuff that I did were, I guess I did an independent, what do we call it? Analysis myself. It was sort of like a miniature experiment but to me it was so big. I was studying like, uhm the effects of essential oils on throat lozenges and whether they make them effective, uhm... and whether their different active compounds, you know like limonene and the stuff that you have in peppermint makes it you know, one is better than the other, why the other one is preferable and what are the side effects and everything. So yeah.

Interviewer: Did you do that on your own? Like developed the project yourself?

Volunteer: Yah, yah.

Interviewer: Was it for something like science expo?

Volunteer: Noooo, it was more for like, it was more like, the school gives you liberty to do whatever you want. You can choose from any subject, from Sesotho to Maths to anything, but I chose chemistry, I was like, I want to investigate this – and you come up with your own topic. You find methods, you find what to do, and you know, yeah.

Interviewer: And that is an opportunity that your school gave you guys. Do you feel like there are any problems in how Maths and science are taught at school? Or like, there is anything that can be done to make sure the teaching of maths and science influences a positive attitude in learners towards science?

Volunteer: Uhm... Yeah, uhm, it's great that we teach, and we have tot teach science, but I believe in more of letting them (learners) explore on their own. Like, give them the knowledge that they have and then let them use that, apply it to something else that they have passion in, or something that they like, because I know, my, my, my love for chemistry really developed from that, applying the tings that I liked. I remember there was another time where we had to do experiments and you also had to come up with your own experiments at that time, and so I was testing the effectiveness of different bleaches, and so I tested the thiosulfate blah blah blah stuff, I don't wanna go into it. But I did like my titrations and oxidations reactions and looked at why the other one is a lot thicker and all of those things. I mean, they didn't just teach science to say yeah guys, know that atoms react together to form molecules, and then this is what you gonna have on the test and then goodbye. No, it was like okay, so this is what you have, and then, what are you gonna do with it? You know, let them have that chance to want to do something with it.

Interviewer: I hear you. Okay, so, with that in mind, what role do you think science clubs play in influences a positive attitude on learners? Do you even think they play any role?

Volunteer: Uhm... They do, they do indeed play a role because sometimes I, there are different curriculums and different modes of teaching in schools, and so a lot of time (maybe I'm being a lot of presumptuous) but yah, I feel like in a lot schools, they don't really get that much exploration, like doing science for fun, its always a lot of science for tests, for the exam. Its never science of, oh yeah, I just wanna find out if this flower has this compound you know, its never really like, the science club gives you that curiosity, you are more aware of a lot things that you wouldn't have been in class. And so, with that then, you can actually apply it in class. Really a lot of the stuff that you learn outside is more applicable inside than the stuff that take inside to apply outside. Yeah.

Interviewer: So, my work is about IK you know, trying to integrate IK into everything that they do in class so that they know that the knowledge they already have is not really outside whatever it is that they are doing, so they can take what they are doing and apply it in solving the problems we have outside. So, I wanna know what you think about IK generally?

Volunteer: Uhm, you might have to explain the concept for me, because uhm, its taking, if I understand it because I don't want to misinterpret it in any way, uhm... its taking common compounds or whatever that you have in the household and do experiments with that?

Interviewer: Its taking what you already know, not necessarily compounds, it can be in any discipline, from chemistry to maths or whatever, all the knowledge that you already have and bring it to class and apply it to try and understand the concepts now given in class. For an example, with what we doing of taking households substances, things that they already know, some that they already know their uses, but they don't know that they are acids and bases sometimes, so we take that to show them that what you know about these substances is okay, but on top of that, these are acids and bases and this is how you would check that they are, help them generate knowledge on them and then build their understanding of concepts in their curriculum.

Volunteer: True, I think that its very important because I feel like we go through all of life, think that we know things but we don't actually know stuff. So, I mean, taking what you know and adding, its like what we know is sort of like a skeleton and when you bring a lot of aspects and say that this is this, put a lot of flesh into that and make a complete human if that makes sense, but yeah. I believe it really helps a lot because you actually know what to do, you can actually branch out into so many things from that, from food to physics, to mechanics to anything, so it really really helps, it goes a long way.

Interviewer: So, in working with their attitudes rather than their understanding, knowing that attitude influences understanding, do you feel like if you had an opportunity to use the knowledge that you had, given the chance to use indigenous knowledge that you have before doing the

concepts you did at school, do you feel like that would've made a difference on how you felt about science then or even how you feel about science now?

Volunteer: I think it might've given me more understanding if I should say, because, I mean learning about something in theory is great, I mean you tryna understand and wrap your head around it. But if you do it first, so its theory plus practical at the same time even though the theory hasn't been set into you know, something legit yet. So I feel like if I had to do stuff before, like do a practical before, it would actually help me question that okay, so what is this - you get more inquisitive, you get mote engaged if I can say and so when you get to the theory part of it you actually have questions to ask and you have things to say about it and you have things to investigate more on.

Interviewer: So, you feel like experiments are an integral part of our learning? Especially in the sciences?

Volunteer: Yes, I believe, maybe it's me, but I believe, we learn by seeing, we interact more with what's around us – even outside the sciences. We interact more with what's around us really, from seeing to touching, from smelling and everything. That's learning, its not so much putting stuff in your head, that's the learning. For an example I you were to differentiate the smell of an orange from a lemon and you, you smell those two and when somebody says D-limonene and L-limonene, you like HUH, but when you smell them, you like oh, that's why they are different. It's not really applicable when you think they are isomers and they have mirror images, you like, mmmh, what mirror image are you talking about but when you actually have them, and you smell them, and you see them, it actually makes more sense. Yeah.

Interviewer: Do you feel like they can be any significant shift on the attitude learners have towards science when science clubs, experiments and IK are used together rather than using them individually?

Volunteer: I feel like the integration is the way because knowledge is not about having dots but its about connecting the dots, so if you can bring all those together, you can literally have them making maps of science and you know, making the world into something completely different and them getting to do science and loving it and doing things for themselves and going into fields that no one even thought of.

VOLUNTEER 3

Interviewer: Okay, uhm, so... What are you studying?

Volunteer: I am doing a 3rd year BSc degree majoring in Entomology, Mandarin and I am also doing Microbiology.

Interviewer: Could you please just run me through your science experience from school to now and how all that has shaped the attitude you have towards science now.

Volunteer: Okay, uhm, in grade 8, I had taken, obviously I did physics and chemistry and all the other science subjects and my chemistry teacher was dreadful. She was one of the worst teachers I have ever met. Uhm... I am gonna be really honest with you, she actually abused me, and I ended up leaving the school. I left the school, and then in grade 9, I started at a new school but because of the impact that she had on me, I ended up, at the end of grade 9, I ended up dropping chemistry and physics. The same teacher was associated with Mathematics, so I, because of the impact that she had on me, it was so negative, I ended up dropping mathematics as well, to maths lit. When I left high school, I ended up just having maths lit and the biological sciences as my science, uhm... after high school I then went and did a mathematics course through master maths and uhm, that's how I then got mathematics qualification, you know, added to my matric certificate. I found it better, I learnt mathematics much easier when I learnt from the computer programme because I could do it at my own pace, I didn't feel, I wasn't made to feel like I was stupid or lacking anything because I could do it over and over again, until I got and working at my own pace really, really helped. Through that, I ended up achieving actually quite high marks in maths which I never thought I was capable of being that because she made me believe that I wasn't capable of, you know, grasping science and mathematics. So, that was good, I was glad that I had the opportunity to take the master maths after high school. And then when I came to Rhodes, I originally has signed up for a BSS until I met Mrs Sewry after my first year and she said that my marks were good enough, that I could convert to a BSc, and she believed that I could do science because that's what I was drawn to, I wanted to study zoology and entomology and all that stuff. Then she dropped the bomb on me, that I would have to do chemistry, and I was like oh my Goodness, in my head now I was having all these flashbacks and it was, it was a bit hectic, uhm, but I actually found towards the end of the year, I started to enjoy chemistry towards the end of the year and it was very difficult to reach that point, I won't lie, because of the emotional draw backs, uhm, and because of that, I just managed by 2% to not pass it, but it was okay because it worked out and I ended up joining Mrs Sewry in chemistry 1R. The way she handled it was so much better, uhm, I now had some of my friends who'd chemistry, maths, physics and stuff in high school, and I ended having a better grasp on some of the concepts than even they did, because what she would do, she would go through the foundations first and then she would build up on them from there so she would basically introduce us to a topic and then she base it to everyday life which definitely helped me because it no longer became an abstract thing you know, uhm, I could now see it in action every day, which I really, really liked, and that's how it helped me learn about chemistry because, you know when you think about chemistry and science, sometimes it can be a bit separate from your life, its something that's over there right, but she integrated it into every day. You know when she starts with thermodynamics and uhm, kinetics and all these things, she would give us an example and one of the ones that always sticks with me is when she explains a

glass of water with ice in it, you know energy going in and out of a system, I ended up using that example on the science club when we were doing endothermic and exothermic reactions. Yes, I ended up using that and I actually received higher chemistry marks than my friends who had done chemistry in high school and I then started to just learn about it a lot better because she put it in such a way that, you know when certain teachers just give you work sheets and worksheets and worksheets and they believe that the more you do, the better you will get, she didn't do it like that, she was on, work smart and not harder, that if you explain it well and understand the concept and you do that sort of thing, it just works and so she didn't overload us with work. And you know, if we ever had a question or something we could always go chat with her, she would always help, she was always very friendly and open about science, science is something that's always around and its not something that is kind of put up here (pointing up), something that is science. So yeah, then I did my first year of chemistry here and now I am just continuing with the maths and science and also participating in the KMSC and I am finding that is actually really nice because, not only am I kind of working with the learners there, but I also get to kind of, I like the demonstrations because I also kind of learn from them and, you know, it's the kind of education that I wish I had, instead of what I had.

Interviewer: So, do you feel like the way that we taught, uhm, contributes a lot to, or influences our attitudes a lot?

Volunteer: Definitely, the way maths and science is taught in schools is, I think, essential to how a person carries on or continues with, uhm, that subject later in life. And that is where you build your associations, and so when you are a kid, you don't really notice it at first but you are slowly building up this database of association, what you associate with maths and what you associate with science, and I would describe mine as negative and its because the teachers went about it in a way that was either incredibly strict or, I think there was just some part of them that was, probably mean people, mean spirited people, but then I associated the subject with them instead of the course content and that is a big problem. Not much help is offered as well, I didn't receive any help, even if I asked for extra lessons, I received very little or, it wasn't a positive subject. You know if you got something wrong, uhm, we were disciplined quite harshly you know, it was never like, ehh, this where you went wrong, let me show you the process or lets find it together, lets see where we could improve this, there was none of that, it was like, you know, red, you didn't get it and you never gonna get it. I found that, I learnt maths at a slower pace than the other students in class with me, and that, often the teacher, would just be like, oh you don't get it, its fine I'm just gonna move on now and she would move on regardless, even if I asked for help, so eventually I actually just stopped asking because, I felt it was pointless, because it just became like a constant thing and then the teacher would do thing where if I asked, she would be like, urgh, again, and I would just like stop.

Interviewer: That doesn't make sense though, kante, what is learning? What's entailed in the learning process?

Volunteer: I think people just trapped into a routine, so the job becomes a, you know, she's there everyday so she becomes insensitive to the fact that, children are learning it for the first time.

Interviewer: But isn't that supposed to make you feel, because I have here for a long time, I understand there could be varieties and different learning extremes in a classroom and like overtime learn to be able to attend to each and every learner's need?

Volunteer: Or, even call the parent to say that, I see so and so is struggling, let us work something together. There was very little of that. And that's, I think, why I enjoyed doing the master maths programme because, again like I said, I was leaning from a computer and I found, that removing the social side of it, with the teacher, I all of a sudden became a lot more receptive to it because there was no, oh my god I am gonna get something wrong and I would get punished for it. I think what happened is, that teachers do those things where if you get something wrong, it's the end of the world, and so, there is this fear, even the students that I worked with at Khanya, you could see that they are so scared of getting something wrong and it's sad because, there shouldn't be scared of being wrong. You know in science, where you do experiments, its not gonna work, first, second or even third time and you got to learn why and also don't become disheartened because you got it wrong once and now you are feeling horrible about it, feeling like you gonna get punished. If you continue to get something wrong, you gonna end up just dropping it because, you, know, just, you're continuously failing, there's none of that drive to push through, and I think that's the bad thing, we get towards this fear of getting things wrong and this, OMG exams are coming up and how am I going to pass this. Maths and science are so much bigger than those things, maths and science are so much bigger than you getting something wrong, like an equation or an exam wrong, so what actually?

Interviewer: Don't you think the way that science is taught, I mean the curriculum itself requires them to cram and produce what they are given rather learning the concepts taught and using them to solve our problems?

Volunteer: When I did chem 1, I found that the course was so, the were just cramming information into us so much that I didn't have enough time to digest the concept and it became how much can I know or like parrot, if you know what I mean, instead of actually knowing something, and I just felt like I was drowning at some point in first year because the pace was too fast and there was just too much of it. If they kept the same course but stripped it down to some of the basics, the basic concepts, I think it would be more manageable, but it wasn't. But that's what then Mrs Sewry does. She strips it down to little things, you gotta start somewhere first, and that definitely helps because once you've got your foundation down, its good from there and I think that's what the problem is with like the entry level chemistry and stuff because it's just too much and heavy because there isn't emphasis on the core and

fundamental issues first, and like take away all the frills and other things around it first, because it was just too much. Most of my friends when I spoke to them, they were struggling with the same thing, they didn't have time to actually process what we were being taught.

Interviewer: Based on your learning experiences at master maths compared to a classroom setting with a teacher and all, do you think we could learn better if we eliminated the social aspect of learning, or do you think it depends on the teacher at a particular school or even your peers at the space you are in?

Volunteer: I think it depends on the person, but for me, my personal experience, removing the teacher from the equation helped me a lot. I was also on my own pace, I didn't have to work at the pace of the class, erm, that also removed a lot of the pressure and by removing that pressure, I felt more comfortable and at ease about learning the stuff because I didn't feel, you know when you are in high school and you are in school, you are influenced by how your friends or people around you react and if they react negatively because you just not getting something, or you know, if you have to ask another question or you get it wrong again, the negative reactions, you eventually stop wanting to learn, or wanting to get it right or wanting, you just detach yourself from the thing and you just continue to kind of scape by and your attitude towards the things is just, and that's when you kind of, go out of school. If I didn't have the maths and science opportunity because you know, I said to myself I want to this, I don't think what they said was hm, really me, I think I can do this. If I didn't have that opportunity or that drive, I probably would've with this, I hate maths and I don't wanna do it, I'll never be able to do it.

Interviewer: So then, what do you think of science clubs, why are you a volunteer and why a science club specifically?

Volunteer: Uhm, so I heard Mrs Sewry talking about the maths and science club in my first year And I felt like at that point, I still had like this thing pf gosh, I don't know anything, I wouldn't be able to help somebody if they were stuck on something. Err, but last year after going through it and, I thought my, marks were pretty decent, erm, I passed it nicely, I felt like oh this is actually cool, I actually enjoyed this now and erm, I've been in and around Grahamstown since 2016 and I really like it here and I've been through all the protests and I've been through all this stuff and uhm, I've helped a couple of people in the library, you know, they didn't know how to use a computer or something rather. I was like, it would be nice to be more active in the community because you know I am part of a community even though I am a student, erm, even though this might be a transitory phase of my life, I am still part of a community and it would be if I could work with it more and just be an active member. SO, I wanted to do the maths and science because Mrs Sewry spoke about it so much and she was always like, help us, and I was like okay, let me just do this. She is so enthusiastic about it and I really like that and I also wanted to have this thing, I had such a negative experience in school, if somebody made it a little bit enjoyable for me or had my back a little bit or just gave me a little bit of confidence, I think it would've

made a bit of an impact, it would've really changed something so, if I could do that little something, if we doing some equation and they feel a little more confident in themselves, that would be worth it, you know and I think that's what I really like as well, with working at the club.

Interviewer: So, you do then think science clubs have a positive influence on learner attitudes?

Volunteer; Yes, definitely, at the beginning of the year when I started there, there were some of the regular kids and uhm, when they would start out, they wouldn't really wanna participate if you know what I am saying, they were cool with letting the stuff happen, but they wouldn't wanna take part, again it was like this fear, and I know because when we gave them stuff to write down on the sheets, they were actually scared to be wrong and they not writing anything wrong, and they not being marked on it. When I said to one, its okay if you don't get something, and its not what was given, we not marking it and if you get something wrong, its okay as long as you learn something, I want you to have fun. The one experiment where, it kind of sunk in a bit, where they had fun, it was so great, and they remembered it the next week after and I was like, Yes! Yes! You know the experiment where you had micro chem kits and vials, I said c'mon interact with it and see what happens and why do you think its changing colour? And they actually started to enjoy the experiments and that was so nice, and they remembered it after that, so it was worth it, just take the pressure off, science is not something that's up here (pointing up), just bring it down. I think people think science is for really smart people and boring, which is sad actually, because it can really be just fun. You know your exothermic endothermic reaction thing, when the kids came back, I said to them, when we were tryna discuss the concept of exothermic endothermic, I said, so you've just gone and had snack right, you've put sugar and other stuff in your body, are you feeling warmer now, yah, do you know that there is a reaction happening in your body now and they were like, what???? It was like mid blowing, see its not something that happens in front of them, its happening in their bodies as well and that's what was so nice, like you can relate back to the biological thing, science is not just something that happens with other things, put two solutions together, its everywhere, that was cool and this one kid was like, its like I was speaking some weird stuff.

Interviewer: Okay uhm, you touched a bit on experiments and their reactions, what can be done in the science clubs to make sure the learners do not have the same experience and they actually learn?

Volunteer: Honestly homework cripples' learners, homework is not a good thing. I au paired for this one little girl for a while and I would drive her to and from school and these other things and I would ask her every day, like how was your day and how much homework do you have, and she would spend like the moment she got home until 8 pm doing homework, in primary school level. I don't think she had a good association with school, because I don't think she thought of it as a part of learning, she was just like uh, I've got homework, its boring, its something that you do, they no longer engage, the do it because they pressured to, because when they don't do it they get punished, or in trouble. They don't

learn from it, so what I like about the maths and science club, if I had a tutor, when I was younger, that I would see no and again and work with consistently, that would've been awesome because they got to know me, my learning pace and where my strengths and weaknesses were at because, the two kids that I was working with, I noticed that the one kid didn't really have a good foundation in just simple things you know, the geometrical shapes and angles and so what I did was like, okay, today we gonna make a cheat sheet. So, what I did was like, I made a cheat sheet at home and I made one with them. So, I didn't just make one and photocopy it because I don't think they would've engaged. So, I would talk about the rule and ask them what they thought about the rule and then link it back to other things and they actually ended up having fun and the week after that they remembered the stuff. And they could take the cheat sheet home, and they got all the rules and stuff with them and its there so if they do some homework or whatever, and if they are struggling they could look up some rules. So, that also helped, to integrate the concepts into one simple kind of, like a cheat sheet and then being able to refer to that, really helped them. We did broach the subject, I remember one meeting that we had as a group for the science club, some of the students brought up, should we do homework and some of them were like yes lets do homework, lets send the kids with homework and I was one of the few who said, I don't think that's a good idea, they've already got so much homework from school, adding to that would just make it so much worse and if they do have a bad association with homework, they gonna get a bad association with the club because they will feel no, they gonna give me more homework and ultimately with science and maths and then if we take away that element of, yeah sure they had fun, but they are scared of getting more homework, they are not gonna come. So, if they come and the only thing that they got from it was that they had fun, when the things change colours, that's fine, honestly, that's fine because next time if one thing changes colour in class or they interact with science and indicators comes up, they'll remember it fondly instead of.

Interviewer: Okay, so experiments then also play a role in their attitudes. What are your feelings about local knowledge or IK – like we did with the experiments. Bringing in things that they are familiar with? Having them come with what they know and building on to what they know to help them understand their concepts.

Volunteer: I like that. Again, I really like those experiments because what it did, is that it showed them that science is everywhere and, obviously they enjoyed the demonstrations and stuff that they were given when the chemistry department brings all of this fancy acids and stuff, but all of this equipment arrives in special beakers and special containers, its now separate. Science is something that happens over there at the university in a special Lab and your experiments were like, oh, I use this stuff at home, I drink this stuff, I eat this stuff, and this is actually what it's doing. Science is so much closer to them, it's easier to work with and by doing that it breaks down that fear of science because you now are comfortable with it because its something that you work with every day, in a smaller way its not something special that scientists do, we actually working with it on a smaller scale and its not that bad

and that's what's really nice about it. I even learnt that for myself which is something that is, no we do this, actually every day and it's cool and, this is actually what the bases are doing, and this is actually what the acids are doing, yeah, it makes sense.