Understanding educators' and learners' perceptions and experiences of their participation in Science Fairs/Expos: A South African case study

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By

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DECLARATION

I, the undersigned, hereby declare that the study on investigation of educators' and learners' perceptions and experiences of their participation in Science Expos is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.

Signature..... Date……

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ABSTRACT

The rationale behind Science Expos is to develop and empower learners to be able to identify problems and find solutions (Eskom Expo Project Guide Book, 2013). It is believed that involvement in Science Expos arouses learners' interest to pursue science related careers. But despite these ideals, there is still poor participation in Science Expos by educators and learners.

I conducted this case study in five schools in Grahamstown, Eastern Cape, South Africa. The purpose of this study was to understand educators' and learners' perceptions and experiences of their participation in Science Expos. The case study was designed within an interpretive paradigm. The data were generated, triangulated and validated by a variety of methods, namely, document analysis, interviews (semi-structured and focus group) and observations.

The main findings of the study were that learners who participate in Science Expos attend workshops organised by Scifest and SAEON office with the help of some of the educators and lecturers from Rhodes University. Learners' participation was influenced and assisted by the educators and peers with whom they were able to communicate and share their projects with. It emerged from the study that, as a result of participating in Science Expos, educators (teachers) and learners were exposed to a wide variety of scientific investigations and skills that are necessary for their classroom based-scientific investigations.

It also emerged from this study that educators and learners face the challenge of a lack of motivation; insufficient support from schools and parents; time constraints to support learners in their participation and a lack of knowledge among some educators on their learners' projects. Some learners are even discouraged from participating in Science Expos by their peers on the grounds that they have no chance of winning. Teachers therefore require continuous mentorship and capacity building in order to encourage their learners to partake.

DEDICATION

I dedicate this thesis to my parents, Augustinus Kahenge and Kristian Andreas who brought me to earth so that I would be able to carry out this study. I further dedicate this thesis to my special husband Daniel S. Amakali and my children Walter, Melk and Twapewa Wendy. Their patience, motivation and support have been amazing. Their staying at home in my absence I cannot forget. Special dedication goes to Martha Ndeshi Ipakwa who took care of the house, my husband and children in my absence.

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ACRONYMS AND ABBREVIATIONS

AAAS	American Association for the Advancement of Science
CAPS	Curriculum and Assessment Policy Statement
CD	Compact Discs
CoP	Community of Practice
DBE	Department of Basic Education
EHDC	Education Higher Degrees Committee
HDE	Higher Diploma in Education
IBSE	Inquiry-based science education
ISEF	Intel International Science and Engineering Fair
NRC	National Research Council
NSES	National Science Education Standards
NSTA	National Science Teacher Association
SAEON	South Africa Environmental Observation Network
SciFest	Science Festival
STDE	Senior Diploma in Education
ZPD	Zone of proximal development

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CHAPTER ONE: BACKGROUND OF THE STUDY

> *Science refers to a system of acquiring knowledge based on the scientific method, as well as to the organized body of knowledge gained through such research* (European Commission, 2007, p. 5)

1.1 Introduction

This chapter introduces my study, which investigated educators'[1] and learners' perceptions and experiences of their participation in Science Expos. In this chapter, I briefly outline the background of the study, present my problem statement, research goals and research questions and lastly give an outline of the various chapters.

1.2 Background of the study

Science has a long history in education and is considered a difficult subject globally, both at primary, secondary and tertiary levels (Czerniak & Lumpe, 1996).

The Department of Education, Directorate of Science and Technology and non-governmental organization, specifically Eskom in South Africa, came up with a possible way of motivating learners from both advantaged and disadvantaged schools by encouraging them to participate in Science Expos[2]. Blair (2003) defines Science Expos as a public exhibition of students' projects to recognize their work and to stimulate interest in science. A Science Expo is a co-extra curriculum activity (Eskom Expo Project Guide, 2013, p. 1) and it offers hands-on experience with scientific processes. In essence, the rationale for a Science Expo is to enhance science interest among learners and encourage them to pursue science related careers in the future.

[1] The educators in this study refer to Science Fairs/Expos coordinators and teachers.

[2] This includes both the Eskom Expo for Young Scientists and Science Fairs. At regional level it is referred to as Science Expo; while at National/International level it is called Science Fair. Up to 2011, this competition was called a National Science Fair and since 2012 it is called an International Science Fair. So, throughout this thesis I will use Science Expo.

In South Africa, Science Expo is called Eskom Expos for Young Scientists. The vision of Eskom Expos for Young Scientists is to inspire Young Scientists and researchers hence the mission is to develop Young Scientists who are able to identify a problem, analyze data, find solutions and effectively communicate findings (Eskom Expo Project guide, 2013).

In South Africa, Eskom Expo for Young Scientists is affiliated to the National Science and Technology forum and has links with Science Festival[3] (Scifest Africa), the annual Science Festival in Grahamstown. Internationally, Eskom Expo for Young Scientists is affiliated to the International Movement for Science and Technology activities, Society for Science and the Public and the Worldwide Young Researchers for the Environment (WYRE).

The South African, Department of Basic Education (DBE) Natural Science Curriculum Assessment Policy Statement (2011) aims to provide a foundation on which learners can build their understanding of science throughout their lives. It emphasizes the importance of scientific literacy (see Section 2.4) by focusing on the development and the use of science process skills in a variety of settings. Through scientific investigations, learners investigate relationships and solve problems in science, technology and environmental contexts (ibid, p. 22).

A scientific project, central to the engagement in Science Expos, is an investigation in which learners try to solve problems or answer questions that they have identified in their community (Eskom Expo Project Guide, 2012. p. 1). When learners do investigations, they follow methods that allow them to test ideas/solve a problem and come to a conclusion Essentially, science projects involve scientific processes such as experimenting, observing, estimating/predicting, recording, analyzing, interpreting, and measuring and conclusion (South African Curriculum and Assessment Policy Statement, DBE, 2011).

Scientific investigations are an essential aspect of learning science and its importance cannot be over emphasized. Learners gain an understanding of the nature of scientific problem solving as the pursuit of thoughtful knowledge (Kibirige & Hodi, 2013).

[3] Science Festival is an annual science activity where science experts showcase their innovations. The main venue is normally the Settlers Monument in Grahamstown and the Scifest office is responsible for organizing the Grahamstown Regional Science Expos.

One of the roles of science teachers is to motivate learners to participate in Science Expos and that cannot be underestimated. According to the Eskom Expo Project Guide (2013), the role of teachers in Science Expos is to organize learners at school to participate, provide the information about Science Expos, guide learners to prepare their projects and take them to Science Expos and even become judges at the exhibition of the science projects.

Eskom has been sponsoring and running Science Expos for over thirty years, and has been identifying the most innovative and talented science minds across South Africa's rural and urban areas (Science Expo Project Guide 2013).

As part of the solution to the global economic challenge, Eskom Expos play a significant role in developing the skills required in today's job market. Engaging learners in inquiry can provide powerful learning experiences where they not only learn about science content but also gain research skills.

Eskom as a sponsor of Science Expo hands out special awards to the top energy and energy efficient projects. They also recognize the best rural development school and the best projects done by girls. This is done with the aim to motivate the disadvantaged rural areas and in particular females to participate in Science Expos (Grahamstown Regional Expo Database, 2011 and 2012, Scifest Africa, 2013).

1.3 Grahamstown context

Grahamstown, although a small town, is a centre for education. The regional Science Expos are held at Rhodes University, in the Chemistry Department and schools in and around Grahamstown are encouraged to participate. Lecturers and students at Rhodes University assist learners from nearby schools to prepare their science projects. As an incentive to learners, bursaries to Rhodes University are awarded to the top five winners of the Science Expos.

There are 24 schools in the Grahamstown district, 21 of which are public schools and three are private schools. Twenty of these schools participated in the 2011 and 2012 Science Expos; and 11 of these schools were from township and rural areas. This indicates that

almost all of the schools in the Grahamstown district do participate in Science Expos including some township and rural schools. Therefore, I was fortunate to have the opportunity to study at Rhodes University in Grahamstown, Eastern Cape, South Africa as this has given me an opportunity to explore how teachers and learners in the Grahamstown district are motivated to participate in Science Expos.

Figure 1: South African map with an arrow pointing to where the study was done

http://www.lib.utexas.edu/maps/africa/safrica_provinces_95.jpg&imgrefurl

This study investigated five educators (three teachers and two Science Expo coordinators, one from Scifest and the other one from SAEON[4] office) and six learners. Four of the six learners participated in both Regional and International/National Science Fairs in 2013 and in previous years. The remaining two learners participated in Regional Science Fairs for the first time this year. Of the four learners with previous experience of Science Fairs, three were from township schools, while the other learner who had experience both at Regional and International Science Expos level was from a former Model C school.[5]

[4]An Expo coordinator from SAEON organizes Expo workshops for learners in and around Grahamstown and more especially for township and rural school learners. She motivates and assists them with their Expo projects.

[5]Former model C school refers to a school that was formerly meant for whites only.

1.4 Problem Statement

In this study I wanted to find out the perceptions and experiences of educators and learners of their participation in Science Expos, more specifically the experience of historically disadvantaged schools (township schools). This resonates with my work as an Education Officer (EO) for Natural Sciences and a Science Fair committee member in Namibia.

With the understanding I gathered from this study, I hope to improve the way we organize our Science Expos both in South Africa and Namibia.

In Namibia, Omusati Region, where I work, there are 275 schools of which only 9% participate in the Regional Science Expos. In 2012 after the event, the Science Fairs committee members conducted a seminar for teachers on information sharing about science projects. The teachers from schools, who had not participated in Science Expos in the past, did not attend this seminar.

This experience of low participation of schools and the negative attitude among teachers and learners triggered my interest to find out educators' and learners' perceptions and experience of their participation in Science Expos in Grahamstown. Grahamstown has been active in participation in Regional Expos and a large number of learners participate in International Science Expos. This forms the focus of my study. That is, I wanted to find out: What motivates or does not motivate educators and learners to participate in Science Expos. I lack a proper understanding of the factors, both positive and negative that might be at play in school participation in Science Expos so I wanted to explore some of these factors further.

One of my assumptions from the Namibian experience that could explain the low participation in Science Expos is that many teachers find it difficult to prepare their learners to carry out scientific investigations because they themselves were not well trained on scientific investigations and projects from the educational institutions where they studied. This seems to have an impact both on their science teaching and their engagement with Science Expos resulting in poor participation in these events. However, I have an open mind as to other possible factors that might inhibit teachers' and learners' involvement in Science

Expos. So, I looked forward to exploring these issues within the very active Science Expo culture of Grahamstown.

1.5 Potential value of my study

This study is qualitative and it focused on understanding educators' and learners' perceptions and experience of their participation in Science Expos. The information from the study may be useful to all educators and learners who have not been involved in Science Fairs/Expos before and for those who have participated; it may help them to improve their agency and interest.

I hope this study will provide useful insights to the Directorate of Science, Research and Technology and the Ministries/Department of Education both in Namibia and South Africa in organizing Science Expos or participation in Science Expos.

It may also inform the Natural Sciences curriculum developers to see how Science Expos could be incorporated into the curriculum in order to promote science learning through scientific investigations. It may have the potential to help with the motivation and training of educators and learners so that they can take scientific investigations seriously and hence participate in Science Expos.

The study might also provide some insights into what could be done with the successful Science Projects and successful learners after the Science Expos, in order to use these materials as resources for future learning and role models respectively. These could in essence inspire others and expose the benefits of participating in Science Expos. In addition, the study may be useful to those who would like to do further research in this field given that this area is under-researched (LaBanca, 2008).

1.6 Research Goal and Research Questions

This study was aimed at investigating science educators' and learners' perceptions and experience of their participation in Science Expos.

Main research question

What are science educators' and learners' perceptions and experience of their participation in Science Expos?

To answer the main question the following sub-questions were explored to guide my study.

- How do science educators and learners perceive participation in science Expos?
- What are the educators' and learners' experiences of participation in Science Expos?
- How are science educators and learners motivated to participate in Science Expos?
- What challenges do science educators and learners experience in participating in Science Expos?
- In what ways do science educators and learners deal with the challenges they are faced with in participating in Science Expos?
- How can science educators and learners improve participation in Science Expos?
- In what ways do science educators' and learners' experiences influence their understanding of scientific investigations?

1.7 Thesis outline

The study consists of seven chapters:

Chapter One is an overview of the study which presents the background and context, problem statement, significance of the study, methodology, research goal and research questions and a brief overview of the thesis chapters.

Chapter Two is a review of literature relevant to the study. The literature reviewed is in relation to participation of educators and learners in Science Expos as well as literature on scientific investigations. The chapter also describes the conceptual framework which informed this study.

Chapter Three presents the methodology. The chapter describes the research paradigm underpinning the study, research site, sampling procedures, data gathering techniques, as well as data analysis process, validity and ethical issues.

Chapters Four presents the educators' data gathered from the semi-structured interviews, observations and document analysis. Data are presented according to the identified categories in relation to the research questions.

Chapter Five presents the learners' data gathered from the focus group interviews and individual semi-structured interviews. The data presented in this chapter reflect respondents' own ideas.

Chapter Six discusses the research findings presented in Chapters four and five in relation to the literature and the conceptual framework discussed in Chapter Two. The discussion is done with reference to the educators' and learners' perceptions and experience of their participation in Science Expos.

Chapter Seven concludes with the findings of the study. The recommendations for practice emerging from the study are raised; limitations of the study and suggestions for further research are discussed.

1.8 Concluding remarks

In this chapter I have outlined the context and background of the study. The chapter further presents the problem statement; the significance of the study; research design; the goal and research questions of the study. It also offers a brief overview of the thesis chapters.

The next chapter presents the literature reviewed in this thesis in relation to educators' and learners' participation in Science Expos as well as relevant literature on scientific investigations.

CHAPTER TWO: LITERATURE REVIEW

> *Children should not be taught creationism, which is irrational, but neither should they be taught that scientific investigation is our only tool of thought. Imagination can also bring us close to the unknowable powers of the universe, of which we are a part....* (Jennings, 2006, p. 15)

2.1 Introduction

This chapter reviews the literature relating to participation in Science Expos as well as literature on scientific investigations. It seeks to analyse, in particular, educators' and learners' perceptions and experience of their participation in Science Expos. 'Educators' in this study refers to coordinators of Science Expos and science teachers. The literature I have explored in the area of Science Expos includes the following:

- The National Natural Sciences Curriculum;
- Science Expos and projects;
- Importance and motivations of Science Expos;
- Challenges in participating in Science Expos;
- Scientific investigations and scientific literacy; and
- Educators' and learners' experiences of Science Expos.

I conclude by presenting and discussing the conceptual framework of this study.

2.2 Contextual background: Scientific investigations in Natural Science Curriculum

This section presents a review of scientific investigation drawn from the Natural Sciences Curriculum, a National policy that guides teachers and learners in carrying out scientific investigations in their science classrooms. This is relevant to my study in that learners present projects that have involved scientific investigation at Science Expos.

The curriculum aims to produce learners who are able to "identify and solve problems and make decisions using critical and creative thinking; work effectively as individuals and with other learners as members of a team; collect, analyze, organize, critically evaluate and communicate information" (South Africa, Department of Basic Education, Natural Science

Curriculum and Assessment Policy Statement (CAPS), 2011, p. 5) as proposed by Jennings (2006, p. 15) in the epigraph above.

It maintains that there is a need to understand the history and relevance of some scientific discoveries through accessing relevant information from appropriate sources. Moreover, the curriculum indicates that learners should be able to investigate phenomena in Natural Sciences through handling equipment, making observations, recording information and measuring, interpreting, and designing/planning investigations.

The Namibian Ministry of Education Natural Sciences curriculum (2010) aims to develop a "lively, questioning, appreciative and creative intellect to enable learners to discuss issues rationally, to make careful observations and analysis, to think scientifically, to solve problems and apply the skills to tasks" (p. 2). The curriculum statement argues that science without positive values can be destructive, so learners should develop the knowledge, skills and attitudes to lead a healthy life by applying and generalizing scientific knowledge to everyday situations. Learners are to develop the cognitive skills of exploring, investigating, inquiring, recognizing, contextualizing, hypothesizing, interpreting, weighing up alternatives, analyzing, synthesizing, evaluating, thinking creatively and creating knowledge.

Thus, both the South African and Namibian Curricula support scientific investigation in which learners investigate and solve problems so as to contribute to a knowledge-based society. Duggan and Gott's observation about the UK science curriculum seems equally applicable here: what is needed, they say, is a "curriculum that explicitly addresses this sort of scientific knowledge in order to teach learners about evidence and provide them ample time to design experiments, collect, handle and interpret data as evidence in investigative work" (Duggan & Gott, 2000, p. 66).

The South Africa Department of Education and Eskom realize the need to motivate learners to pursue science in their future and to inspire Young Scientists (Science Expo for young scientist project guide, 2013) through having them participate in Science Expos.

2.3 Science Expos and Projects

This section discusses what Science Expos and Science Expo Projects are. It also discusses the rationale for Science Expos. According to Abernathy and Vineyard (2001), a Science Expo is an opportunity for learners to engage in activities to develop science content knowledge, process skills and interest. Blair (1996, p. 3) defines a Science Expo "as a public exhibition of the learners' projects to recognize their work and stimulate interest in science". Eskom Expo for Young Scientists is a South African Science Expo and is the "primary and only existing Science Fair for school learners, where they have an opportunity to present their own scientific investigations" (Eskom Expo Project Guide, 2013, p. 5). Large numbers of learners in South Africa take part annually in Science Expos sponsored by national electricity supplier Eskom (Taylor, 2011).

Woolnough (1994, p. 78) explains that the aim of Science Expos is to "improve and encourage scientists and non-scientists alike to understand and promote awareness of the importance of science and technology and the way that it affects all our lives". Blair (1996) states that the aim of Science Expos is to motivate learners to present projects show casing their independent scientific enquiry. Science Expos aim to promote science and technology literacy and are intended to encourage more youths to pursue careers in Science, Technology, Engineering and Mathematics. Similarly, the Eskom Expo Project Guide (2010) indicates that the aim of Science Expos is to motivate learners to develop interest in science so that they will pursue science-related careers in future. In addition, Shock (2011) states that the purpose of Science Expos is to bridge the gap between scientific achievement and the public's knowledge of such achievement.

Science Expos aim to "develop Young Scientists who are able to identify a problem, analyze information, find solutions and communicate findings effectively" (Eskom Expo Project Guide, 2013, p. 5). Science projects involve scientific processes such as experiment, observation, estimation/prediction, recording results, analysis, interpretation, and conclusion (Science Fairs project Guide, 2010; South Africa National Natural Sciences Curriculum and Assessment Policy Statement, 2011; Namibian National Curriculum, 2010). Learners should identify researchable questions, apply scientific methods to them to create a valid experiment, and then reflect on the meaning of the results.

Bunderson and Anderson (1996, p. 372) indicate that researchers have defined Science Expos as exhibiting "independent science research projects done individually or in small groups with some consultation from a teacher or mentor". According to LaBanca (2008, p. 198), teachers can encourage learners to become members of a community of scientific practice, seeking the expertise of professionals when developing their project ideas. Science Expo projects are independent education activities that include a range of skills, many of which learners have to teach themselves as they go along (Blair, 2003). Blair adds that Science Expo projects provide learners with hands-on experiences.

A Science Fair Project is an activity that integrates almost every skill or art learners have been taught (Science made simple, 2011). Learners can learn how to apply their existing abilities to new areas as well as learn many new skills. This means that a Science Fair Project can "involve reading, logical thinking, writing, grammar and spelling, math, statistics and data analysis, computer science and graphic art, as well as scientific methodology" (p. 1). Science made simple (2011) indicates that participating in Science Expos helps learners to develop confidence and competence and fosters a spirit of scientific inquiry. Moreover, learners can do important research and discover previously unknown facts (ibid).

There are different types of projects: mainly experimental investigations, innovation/ invention and research or study (Science Expo for Young Scientists Project Guide, 2013). It is up to learners to decide what type of project they want to carry out.

Learners can participate in Science Expos at various levels, such as Regional, National or International to present their projects for judging. Regionally, Science Expo judges are recruited from the local community where the Science Expos are taking place (SEC1 pers. com, 2013). In most cases judges are school teachers, university lecturers and students, and representatives from other organizations with an interest in Science Expos (e.g. the sponsors). The role of the judges during the Science Expos is to assess the projects, interview learners about their projects, make recommendations and score learners' presentations according to guidelines provided by the Science Expo organizers (Abernathy & Vineyard, 2001). After the presentations of the projects, successful learners receive a variety of prizes ranging from medals and trophies to bursaries or scholarships (Abernathy & Vineyard, 2001; Taylor,

2011). The awards are typically made to learners whose projects meet the Science Expo requirements regarding scientific investigation procedures.

In the following section, I will discuss literature pertaining to the scientific investigations and scientific literacy that are a central part of Science Expos.

2.4 Scientific investigations/inquiries and scientific literacy

This section discusses the scientific investigations or inquiries and scientific literacy which are essential in Science Expo projects.

2.4.1 Scientific investigations/inquiries

The projects that learners carry out to present during Science Expos are scientific investigations/inquiries[6] and have to follow scientific procedures, as indicated in the Science Expo for young scientist project guide and the National Natural Sciences curriculum. Watson and Wood-Robinson (1998, p. 84) observe that during the investigative work learners "make their own decisions either to work individually or in groups, [and] … are given directions on how the investigation is carried out".

Scientific inquiries are activities through which learners develop knowledge and understanding of scientific ideas and the method that scientists use to study the natural world (National Research Council (NRC), 1996, p. 23). The National Science Education Standards (NSES), (2000) define inquiry as:

> First, inquiry refers to the abilities learners should develop to be able to design and conduct scientific investigations and to the understanding they should gain about the nature of scientific inquiry. Second, it refers to the teaching and learning strategies that enable scientific concepts to be mastered through investigations. In this way it draws the connections between learning to do science and learning about science. p. xv

LaBanca (2008, p. 9) asserts that open inquiry opportunities "vary from school to school" but typically provide experience for learners planning to present their projects to judges through

[6]Scientific investigation and enquiries are the same; they both have to do with problem solving using scientific methods. In this thesis I have used these two terms interchangeably because some authors use scientific investigations and some use scientific enquiries.

Science Expos. Learners have the opportunity to select their topic of interest, develop and execute it, often "working in conjunction experts in the field as mentors".

Jona and Adsit (2008, p. 5) expressed that scientific investigation has "strong educational value by engaging a student deeply in both the content and process of science and by providing a practical perspective and cognitive connection to the theoretical materials presented in a classroom setting". Furthermore, some teachers agree that exposure to scientific investigations is an important part of learning science (ibid). In fact, scientific investigations have to do with solving problems by using a set of scientific procedures such as identifying a problem, test the hypothesis, interpret the results, and then conclusion (Watson & Wood-Robinson, 1998). According to Hackling (2005), scientific investigations are an essential aspect of learning science. When learners are engaged in scientific investigations, they provide powerful learning experiences whereby students not only learn about science content but also gain research skills. Mathews (1994, p. 146) asserts that "inquiry training gives the children a plan of operation that helps them to discover fundamental factors of physical change through their own initiative and control, not to depend on teachers' clarifications". That is, learners learn to arrive at hypotheses and test them through carrying out experiments and then interpret the results.

Thomson (2012) explored how to do scientific investigations and how they could make learners think like scientists. Thomson (2012) states that scientific investigations involve more than just experiments but rather consider several ideas, experiments are often inappropriate and only show part of the picture. Examples of hints for scientific investigations explored by Thomson are:

- The question being investigated should be connected to scientific concepts and methods;
- Provide opportunities for students to connect their knowledge; experiences and interest with the subject;
- Encourage ideas to flow freely; and
- Learners to articulate their first draft thinking and revisit the ideas and think critically about others ideas. (p. 1)

According to Abernathy and Vineyard (2001), if learners follow the scientific method as they carry out their Science Expo projects, it would help them to understand science concepts. Johnston (1996, p. 31) describes science in terms of the scientific process such as: "investigation and finding out". Johnston (1996) posits that scientific skills build up during the scientific process and it is important that learners develop scientific concepts, knowledge, research skills and attitudes that they can use in everyday life.

Scientists use scientific processes when they observe phenomena and ask questions about what they observe. Learners gain an understanding of the nature of scientific problem solving as the pursuit of thoughtful knowledge (Magnusson & Palincsar, 1995). Therefore, researchers of elementary science reform emphasize the importance of involving learners in scientific inquiry (Driver, Osoko, Leach, Mortimer & Scott, 1994).

Duggan and Gott (2000, p. 65) point out that "industry requires employees to have sets of skills of doing science, communication skills and management skills". Additionally, the industry supports the use of science skills that encompass the ability to generate one's own ideas, hypotheses, design and conduct investigations. In their study of skills needed by industries Duggan and Gott (2000) found out that people have some understanding of facts, theories and concepts of science but their knowledge was narrow.

The European Commission Community Research (2007, p. 3) indicates the "reversal of school science-teaching pedagogy from mainly deductive to inquiry-based methods" to increase interest in science. Inquiry-based science education (IBSE) has positive effects at both primary and secondary levels of schooling in "increasing learners' interest and attainments level". It was also noted that IBSE stimulates teachers' motivation. Furthermore, IBSE is more likely to "encourage relationships between the stakeholders of both formal and informal educations" (ibid, p. 3) such as Science Expos. As teachers play a major role in the renewal of science education this would give them an opportunity to improve the quality of their teaching and support their motivation. An emphasis of IBSE is on training teachers in order for them to develop networks for support and to strengthen their scientific inquiry skills.

2.4.2 Scientific literacy

Avargil, Herscovitz and Dori (2012) urge that "science education has two major goals: to develop learners' scientific literacy and their higher order thinking skills". These goals can be achieved through "learning science in context as well as learning science concepts and processes through dealing with real world problems and adapting scientific articles context based learning related to real world problems promotes scientific literacy" (p. 207).

Matthews (1994) defines scientific literacy as:

> The ability to recognize formulae and give correct definitions, to a more expansive or liberal definition which includes understanding of concepts and some degree of understanding about the nature of science and its historical and social dimensions. p. 36

In addition, Duggan and Gott (2000) define scientific literacy as:

> Being able to combine science knowledge with the ability to draw evidence based conclusions, in order to understand and help make decisions about the natural world and the changes made to it through human activity. p. 65

To ensure the scientific literacy of all science learners, curricula should be changed to "minimize the content covered and pay more attention to the connections among science and present the scientific endeavour that strongly influences human thought and action; to foster scientific ways of thinking" (American Association for Advancement of Science (AAAS), 1989. p. 5).

Moreover, AAAS (1985) emphasizes:

> Basic science literacy, coupled with scientific ways of knowing namely; making conclusions based on observations, experiment and analysis provides citizens with skills needed for rational debate and decision-making based on scientific knowledge. Without this preparation, the nation is left with the need to make decisions affecting the direction of their societies on the basis of personal or historical experiences and beliefs, self-interest and the outlook for a better world are not promising (p. 3).

Roth and Lee (2003, p. 265) argue that to make scientific literacy available to all poses a threat to the control of scientific expertise in everyday affairs. Good education for science literacy allows every learner to be actively involved in exploring in the same way that

scientists do. For people to gain knowledge that is necessary for scientific literacy, "they should understand, interpret, and evaluate information and make conclusions based on scientific research" (Korpan, et al., 1997, p. 521).

Duggan and Gott (2000, p. 68) suggest that in the future UK science curriculum, "scientific literacy is seen as enabling a passive understanding of science-based issues" rather than being seen as empowering future citizen to actively participate in science. Webb and Mayaba's (2010) study on the effect of a scientific literacy strategy which focuses on reading, writing, talking and doing science argue that as "scientists read, write and discuss their ideas to develop and defend their claims and argument, learners need to be able to read, write and talk about their science at higher level to develop meaningful understandings" (p. 35).

Webb and Mayaba (2010) found that learners who participated in district-wide combined kit based and science writing programmes scored higher in science than those who did not participate as scientific literacy requires proficiency in science language and thinking. Oral presentations, using for example, PowerPoint presentations have become a primary communication mode for learners engaging in open-inquiry. The "opportunity to regularly present their work to teachers and classmates builds spoken communication skills and assists students in polishing and strengthening their thought and findings before formal presentations" at Science Fairs/Expos (LaBanca, 2008, p. 198).

Yore and Treagust (2006) emphasize the basic sense of scientific literacy that counts for the development of strategies that can provide teachers with ideas and techniques to encourage learners to develop questions; plan and carry out investigations in their classrooms and present their findings. Literacy is necessary to improve reading and writing and to learn science through scaffolding writing, reading, argumentation and critical thinking.

According to Webb and Mayaba (2010), science teachers may encounter some obstacles in promoting scientific literacy whereby there are probably issues in terms of reading techniques if learners are second-language speakers. Teachers need to be competent to promote discussions among learners and ensure that there are materials available for learners to promote reading and research to extend their way of learning. Participating in Science Expos

enables learners and teachers to interact with other teachers and learners from different schools and share materials that they do not have at their schools.

2.5 Participation in Science Expos

This section discusses the importance/benefits of participating in Science Expos and the factors that motivate/enable or constrain participation in Science Expos. The section also unpacks the educators' and learners' perceptions and experience of participating in Science Expos highlighting both the positive and negative aspects.

2.5. 1 What motivates learners and teachers to participate in Science Expos?

In his study, Taylor (2011, p. 67) explores the extraordinary motivation of a group of township learners who participated in Science Expos. The data from his study revealed that learners participated because they saw "Science Expos as giving them a chance of success and conceptualized in terms of present or future goals as measured against a criterion or relative to others". Taylor (2011) further states that in some schools, learners do their investigative science projects through science clubs with the assistance of the student teachers from the university. Learners who participate in Science Expo find that it enables them to:

> Increase critical-thinking skills; apply thinking skills across content areas; increase effective communication skills; ask better and more varied questions; demand more evidence to support the claims of others; become better writers; increase their interest in science; boost their self-confidence; improve their social skills; and become successful learners (Taylor, 2011, p. 67).

Grote's (1995, p. 276) study on teachers' opinions on Science Fairs and projects revealed that some of the participants found that there was a "fear of a negative effect on motivation because of awards, that connecting awards to specific goal can increase both achievement and intrinsic motivation". Furthermore, Grote indicates that the National Science Teacher Association's (NSTA) position statement on Science Expos says "emphasis should be placed on the learning experience rather than on competition" (p. 277). The incentive to attend the Expos in the hope of winning awards and scholarships affects the number of learners who do independent research projects and it might be possible that learners do not participate in Science Expos because of their the fair's competitive nature.

In contrast, Dionne, Reis, Trudel, Guillet, Kleine and Hancianu (2012) urge that in spite of the competitiveness of Science Expos, learners who have participated know that learning is the major benefit. Woolnough (1994) highlights that most learners like competitions because it adds extra spice and fun to Science Fairs/Expos. In addition, those who compete believe that they do have opportunities to succeed and that has a positive effect on motivation. Lending support to this argument, Czerniak and Lumpe (1996, p. 355) posit that "competition can be an effective motivation in Science Fairs".

Taylor (2011) hopes that competition can play a role in increasing the interest of many learners to participate in Science Expos. This was highlighted when the Minister of Science and Technology in South Africa addressed the 2007 Science Fairs/Expos finals saying that, "science competitions contribute towards achieving the two goals of Youth into Science Strategy namely the promotion of science and technology literacy; and encouraging more youth to pursue career in science "(p. 68).

Wilson, Sheila and Carol (2004) assert that encouraging learners to do Science Expo projects that reflect their own interests can increase their interaction in science classrooms. Jona and Adsit (2008, p. 16) urge that effective instruction in any academic discipline should cultivate an interest in the subject and motivate learners to continue learning more about the subject.

Rock (2011) indicates that many Science Centres in the United States of America are involved in providing professional development and support for teachers on the incorporation of inquiry-based learning and real-life experiences. The Centres help teachers to develop an understanding of science and discover creative, flexible strategies to involve their learners in science learning. Inquiry-based teacher training helps to move them beyond a book-based approach. In addition, teachers' participation in professional development changes their teaching style as they have a deeper understanding of inquiry. Rock emphasized that "Science Centers can help teachers to improve their own understandings of science and discover creative, flexible strategies to engage learners in science learning" (Rock, 2011, p. 3).

Woolnough (1994) states that the role of teachers in Science Expo projects is to create a supportive environment, take learners into new areas in which they might learn fruitfully,

provide the training in knowledge and skills which can be used throughout their own investigations. Thus, educators should find ways of encouraging learners, and to reward and support all learners to develop their science literacy skills (Abernathy & Vineyard, 2001).

Dionne, et al. (2012) conducted a survey on what mediates learners' decisions to enrol in Science Expos, and found out that they participate because of a:

> High sense of self-efficacy and personal accomplishment that can be achieved through inquiry-based activities, passionate about science learning, science learning value, performance goal, achievement goal, teaching and learning strategies and learning environment plays a role (p. 671).

They further explain self-efficacy as individual perception of one's own competencies to learn in a given situation. Learning strategy refers to the learners' behaviour and thinking involved in learning. Learning value refers to learners being able to perceive the value of problem solving. Performance goal is the competition that learners do and can be seen while achievement goal is the learners' satisfaction when expanding their competence in what they are doing. Furthermore parental support increases learners' motivation to participate.

The Science Guide for British Columbia (2007) emphasizes that parents can support Science Fairs in many ways such as volunteering to be part of the organizing; committee; mentor/coach students; purchase or build boards for the students; assist during the Fair; be a VIP at the Fair and take photographs at the Fair. For the parents to be able to support their children, they were informed about science fairs and why they are important, and they were provided with a guidelines rubric on what to do (p. 20). When parents help their children in their learning, it creates a positive relationship between them and the school.

When children engage with science during childhood while playing it influences their interest in science (Jarrett & Bulumuz, 2009). Joyce and Fareng's (1999) study investigated the background of pre-service teachers on Science Expos and indicated that at the age of nine, the teachers had already decided whether they liked science or not. They confirmed that their early age science experience in school and outside school played a role in motivating them to pursue science as a career.

According to LaBanca (2008), learners' success was contributed to by achievement and positive school adjustment comes from the support and guidance of parents. Learners perform well and have positive attitude in Science Expos if parents are aware, knowledgeable and involved (Anthony & Walshaw, 2007). When learners improve, the school improves also and ultimately the entire community benefits.

Hence, inviting community groups to Science Fairs greatly enhances the Fairs by creating a diverse science experience for learners. In addition, involving local groups and sponsors contributes more to the community participation in the event. "Parents' roles were often involved in the mechanical process of editing work, helping with the layout of posters or listening to talks" (LaBanca, 2008, p. 166).

2.5.2 Benefits of participating in Science Expos

There are always questions around, why it is important to participate in Science Expos? And what benefits do teachers and learners gain from their participation?

According to the Eskom Expo Project Guide (2013, p. 2), learners' participation in Science Expos, increases their "awareness of the wonder of science", adds to their knowledge and learners are afforded opportunities to explore entrepreneurial possibilities. Jones (1991) asserts that Science Expos help to develop learners' interest in science outside the traditional classroom setting, build self-confidence and increase motivation to take up science.

Furthermore, the British Science Fair Guide (2007, p. 74) emphasizes that learners are enabled to apply the processes of science (scientific methods) and to; "develop organizational and project management skills; apply problem solving techniques; develop and apply skills in research". Laws (1996) argues that learners use scientific knowledge and understanding to make predictions in their science projects.

In their study of teachers' attitudes towards participating in Science Expos, Bunderson and Anderson (1996, p. 372) indicate that "it encourages creativity, provides opportunity for independent research, increases student interest in science, offers student opportunities to explore individual interests by choosing their own projects". They thus suggest that Science

Expos can be a useful tool to engage parents with their children's school experiences but their support with Science Expo projects should be considered and informed.

Furthermore, Bunderson and Anderson (1996) indicated that guidelines about the amount of money learners have available to spend on their projects should be provided as some learners feel that they cannot participate because of the cost of project resources. Taylor's (2011) findings from his research found that some learners had sub-standard projects because of lack of resources such as apparatus, computers and reference books and when learners tried to go to the library to get information, they were asked if they had library cards since students from wealthier backgrounds had more impressive projects.

Czerniak and Lumpe's (1996) study of predictors of participation in Science Fairs shows that many science educators believe that:

> Participation in Science Fairs helps students develop basic skills, develop the attitudes and knowledge that will help them be comfortable and successful in an ever changing scientific/technological society, design an experiment that will attempt to solve or investigate a problem, discover a topic of their own interest and provide the first step to the ladder to success (p. 355).

They found that participants indicated the advantages of participating in Science Expos included providing an opportunity to learn things, receiving awards, improving their grade, have good experiences, impacting on their academic records, improving presentation skills and meeting new people. Moreover, the scores student received from the Science Expo projects are used in science classrooms for assessment purposes.

Olson (1985) posits that participating in Science Expos influences learners in science career choice. Similarly, Blair (1996) mentions that the benefits learners get from the Science Expos are scholarships and tuition grants, networking with the best minds in science and also gaining exposure to the scientific community. In addition, Dionne et al. (2012) assert that the investment of time, money and effort in participating in Science Expos are seen as valuable opportunities for learners to upgrade their knowledge and refine their skills in a scientific way.

2.5.3 Challenges of participating in Science Expos

Roth (1995) revealed that the "out-of-school problems" (p. 27) that learners try to solve are complex and are often ill-structured. The out-of-school problems refer to problems that are not conceived in the science classroom but are there in the societies/communities. They do not give most of the information needed and learners have to make a selection about the information to use as a solution. These can be constrained by the cost of resources that are involved in solving the problem, the effort needed to do the projects and time to deal with it.

Some students are not interested in participating in Science Expos possibly because being involved every year can become boring especially if they do not win. Also learners grow older and may want to participate in other extracurricular activities and social endeavours such as sports (Abernathy & Vineyard, 2001; Dionne et al., 2012).

According to Grote (1995, p. 276), "poor quality of judging during Science Expos discourages talented students from pursuing a scientific career". In Grote's (1995) study on teachers' views concerning Science Expos and projects, he found that there was a concern that was necessary to have a scientist mentor to make science projects valuable because teachers cannot give adequate guidance to learners in their science projects.

Saul (2005) asserts that learners get disappointed when they try and work diligently to set up their experiments and the results are unexpected or the materials do not work properly. Therefore, learners may get discouraged and want to stop participating for fear that their investigations would not have valid information to share during the Science Expos.

In their study, Bunderson and Anderson (1996, p. 372) found that the pre-service teachers were not supporting the competitions associated with Science Expos. Pre-service teachers were not happy with the judges and judging procedures, saying it put too much pressure on the learners and that "Science Expo projects made too many students hate science" (p. 373). Moreover, projects in Science Expos "should not be judged, they should be graded on completion of the projects" (p. 376). Some of the teachers felt that Science Expos did not make science exciting and interesting but caused stress and an increased work load.

Participants indicated that teachers wanted to participate but there was a limited of number of projects to be entered for Science Expos.

Czerniak and Lumpe (1996) said that the participants in their study listed the disadvantages of Science Expos as being a waste of time as one has to work on projects during weekends; it is hard work; being nervous to present to a group of people; affecting grades and there is a possibility of failure.

2.6 Science educators' and learners' views concerning Science Expos and science projects

This section discusses the literature pertaining to the educators' and learners' views on their involvement in Science Expos and projects.

2.6.1 Science educators' views

Bigelow (2011) highlights that teachers were invited for the professional development workshop and were expected to conduct a research project and present it to the rest of the group. During the workshop teachers had the same feeling as the learners in terms of being reluctant to do the work asking: why do they have to do projects rather than do their lesson plans? They found it difficult to select topics. Teachers were supported in coming up with the project topics and after many complaints teachers got involved and afterwards most of them agreed that it was an outstanding experience. The complaints stemmed from the fact that some teachers had never been involved in Science Expos and some had never conducted a research project before.

He thus suggests that to make Science Expos a meaningful experience there should be:

- Modeling and long term preparation with learners;
- Training for teachers and judges;
- Recognize that not all research is experimental,
- Differentiate between projects completed in a laboratory and those completed at home or school; and
- Identifying the role of parents and provide opportunities for teamwork.

Grote (1995) did his study on teachers' opinions on science projects and Science Expos. Half of the teachers who took part in his study had done science projects while they were students in secondary schools and they felt that science projects were "valuable but judging them in a Science Expo setting is counterproductive" and judges need to be trained or certified although most thought the quality of judging at science fairs was good. Some of the participants indicated that Science Expo "had no value in modern school programs" (p. 1). However, they commented on Science Expos that they "promote interest and enthusiasm about science, give learners experiences in communication skills, teach learners about scientific methods, give them opportunity to interact with other learners who are interested in science and learn about the research of other student " (Grote, 1995, p. 1). According to Taylor (2011) the learners' conceptions of participating in Regional Science Expo indicated that judges expected "substantial effort, some originality, good presentations and something that can convince people" (p. 74).

Bunderson and Anderson's (1996) study on Pre-service Elementary teachers' attitudes towards their past experiences of Science Expos indicated that Science Expos were beneficial and "most learners were satisfied with the support they got on their projects even if it was not that much" (p. 372).

Some teachers indicated that they were required to be involved in Science Expos and had received incentives, while some indicated that they chose whether to participate or not but learners should get rewarded for their participation. Moreover, they indicated that by participating in Science Expos they felt a "sense of accomplishment, like the feeling associated with learning new concepts, sharing knowledge and working on science research projects with their parents and liked the competition nature of Science Fairs" (p. 372).

In his study on how pre-service teachers reproduced the discourse and practices of theoretical scientific methods, Windschitl (2004) found that the pre-service teachers had little experience with scientific inquiry so pre-service teachers needed to be engaged in scientific investigations in order to mentor their own learners through inquiry, "they must feel some intellectual and methodological competencies, gained not only from reading and hypothetical discussion but through firsthand experience and reflection on that experience" (p. 486).

2.6.2 Learners' views

In Taylor's (2011) study of township learners' conceptions of Science Expos, participants indicated that their projects did not win because they did not prepare their science projects on time so were not up to standard. Learners also participated in Science Expos because they saw it as "giving them a chance of success, conceptualized in terms of present or future goal as measured against a criterion or relative to other learners" (Taylor, 2011, p. 67). However, their experiences left them with a sense of failure since their projects were often substandard.

The failure was caused in part by lack of access to resources and assistance from parents. Furthermore, learners indicated that the judges were not fair when judging their projects. Learners saw little connection with their classroom experiences of science. Looking at Science Expos through the eyes of the group of learners from a disadvantaged background, Taylor surmised they were not an effective means for encouraging learners from disadvantaged background into careers in science.

The Intel International Science and Engineering Fair (ISEF), is a leading science competition and one of Pakistan's efforts to improve science literacy (Intel, 2007, p. 2). One of the top learners in Intel indicated that "I really like people who want to help others and make a difference in the world" when that learner was asked how the Intel program influenced her life, she responded;

> I have started observing things more carefully and trying to understand how they actually work. Now I know how to write a proper research paper. My observation skills have definitely improved and I try to find out about more new things around me. I am more confident and have learned never to give up. (p.2)

ISEF is striving to prepare learners with the required skills to thrive in the knowledge economy by improving teaching and learning of sciences. Tave Verhoef, a winner of the Eskom International Science Fair for Young Scientists 2012 explained her experience as "indescribable" since she had "double wow" (p. 1) that she could not believe that she won. She actually mentioned that she never imagined her simple research project could get her so far and help her to make new friends and learn new things. Furthermore, she stated that when

she started preparing her research project, it was not all about the prizes but instead, it was about learning new things and broadening her horizons. Therefore, she learned that:

> Never underestimate your abilities and that hard work really pays off, after many hours of doing and redoing my project I doubted if it was going to be worth it and the answer is 49 million times yes, the lasting friendships I have made, the things I have learnt and the new experiences I have are what I will treasure most from this astounding Expo. (Intel, 2012, p. 1)

2.7. Conceptual Framework

Since the focus of this study was on understanding educators' and learners' perceptions and experiences of their participation in Science Expos, I found it appropriate to use Lave and Wenger's (1991) theory of Community of Practice (CoP) in conjunction with Vygosky's (1978) Zone of Proximal of Development (ZPD) as my conceptual framework. I now discuss each of these below.

2.7.1 Community of Practice (CoP)

Learners who participate in Science Expos do learn how to solve problems through participation in their Science Expos projects. Handley, Sturdy, Fincham and Clark (2006) define participation as not only the action of taking part but also the relationships and connections to others in the community. Therefore, through that process of participation learners have an opportunity to share information, knowledge, experiences and understand who they are and in which community of practice (CoP) they belong (Goos, 2004; Lave & Wenger, 1991).

Lave and Wenger (1991, p. 2) define a CoP "as a group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly". They posit that a CoP has three main elements: the domain of knowledge which defines the issue(s) (the Science Expos); the community of people who care about the domain of knowledge (educators and learners) and a shared practice being developed to make the domain of knowledge effective (the aims, structure and support system to participate in Science Expos).

According to Ardichvilli, Page and Wentling (2003), members are motivated to become active participants in a community of practice when they view knowledge as meant for the public good, a moral obligation and as a community interest. Sharing knowledge is critical to success in a community of practice. In addition, LaBanca (2008) asserts that when students participate in extended open inquiry learning experiences, they imagine the role of the scientist and become practicing members of the scientific community. It is from the scaffolding (Vygotsky, 1978), peripheral legitimate participation (Lave & Wenger, 1991), apprenticeship and enculturation (Hodson & Hodson, 1998) that educators and learners are able to describe their perceptions and experiences and identify what enables and/or constrains them in their participation.

The notion of a community of practice is relevant in this study – since learners working on their Science Expo projects typically get support from their teachers and peers as they are acculturated into science (Hodson & Hodson, 1998). Furthermore, if science is a matter of enculturation into the beliefs, practices of community of scientists, then learners need assistance and encouragement from educators or peer learners or any other expert in the science field. So, novices learn to think, argue, act and interact in a knowledgeable way with people (educators and peers) who are experts in something (science projects) and by preparing the project together as legitimate peripheral participants (Lave & Wenger, 1991).

2.7.2 Vygotsky's Zone of Proximal Development

According to Vygotsky (1978, pp. 85-86), the ZPD is "the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable learners". The Vygotskian theory thus views teachers as important in navigating learners in the ZPD through scaffolding, apprenticeship and enculturation (Hodson & Hodson, 1998).

Teachers play a role in scaffolding (Vygotsky, 1978; Goos, 2004) learners when preparing their science projects. Here a teacher is the expert who is guides, assists and scaffolds learners on how to use scientific methods when working on their projects. As learners interact with other learners and educators through discussions and collaboration, they are moving

from one level to another level of the ZPD. As increasing participation occurs in the community of practice in that novices are scaffolded to solve problems beyond their unassisted efforts, then the expert can gradually withdraw and the novice becomes knowledgeable and is able to work independently. Hackling (2005, p. 18) highlights that "students need additional guidance and support to help them write a question for investigation or plan the design of the investigation". Through scaffolding, teachers take learners from a low level of the zone of proximal development (ZPD) to a knowledgeable level.

2.8. Concluding remarks

In this chapter I discussed the literature which informed my study. In the discussions I presented what other scholars have researched and published about participation in Science Expos and scientific investigations.

The chapter also covered literature on scientific investigations and scientific literacy; the importance/benefit of Science Expos; motivators and challenges in participating in Science Expos; educators' and learners' view of Science Expos and the conceptual framework of a community of practice. In the next chapter I discuss the methodology underpinning the study.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

> *Qualitative case study is an approach that is used to dig deep to get a complete understanding of the phenomenon one is studying. In qualitative research; we collect numerous forms of data and examine them from various angles to construct a rich and meaningful picture of complex, multifaceted situation.* (Leedy & Ormrod, 2010, p. 135)

3.1 Introductions

In this chapter, I explain the route I took in planning and gathering data concerning the educators' and learners' perceptions and experiences of their participation in Science Expos using learners from township schools and former Model C[7] schools in Grahamstown, South Africa.

I include a discussion of my research orientation; research objectives; research methods; research site and participants; data gathering procedures (instruments and methods). The data analysis process includes trustworthiness; reliability and validity; ethical considerations and limitations are also outlined.

3.2 Research Orientation

In an attempt to develop an understanding of educators' and learners' perceptions and experiences of their participation in Science Expos, I decided to use a qualitative case study located within the interpretive paradigm. The interpretive paradigm aims at understanding the subjective world of human experiences and it is concerned with the individual's actions or interpretation during a certain process (Cohen, Manion & Morrison, 2010).

McMillan and Schumacher (2010) assert that a research paradigm is a framework that guides how research should be conducted, based on people's epistemological and ontological world views. Furthermore, Babbie and Mouton (2001, p. 559) define epistemology, "as the theory of knowledge i.e. how things can be known, while ontology as a theory of the essence of

[7] Township schools are those schools which are historical disadvantaged in black area, whereas former Model C schools are those schools that were white only schools in town.

things, their true nature, the philosophical understanding of what aspects of human existence are available to study". McMillan and Schumacher (2010) contend that a research paradigm aims at providing specification on the plan for general empirical evidence that will be used in answering the research question(s). In addition, Bassey (1999) describes a paradigm as,

> A network of coherent ideas about the nature of the world and the function of researchers which, adhered to by a group of researchers, conditions the pattern of their thinking and underpins their research actions. (p. 42)

An interpretive paradigm is informed by qualitative research. According to Campbell (2011, p. 2), qualitative research has the following strengths: a) "It takes context into account; b) It allows for taking into account participants' categories of meaning - it is about people's personal experience- more adapted to needs of the people studied; and c) It allows in-depth study". In the context of this study, by using a qualitative research I wanted to understand the educators' and learners' perceptions and experience of their participation in Science Expos.

Interpretation enables the researcher to "gain new insight about a phenomenon, develop new concepts or theoretical perspectives about the phenomenon, and discover the problems that exist within the phenomenon" (Leedy & Ormrod, 2010, p. 136). Merriam (2002, p. 5) states that "researchers undertake a qualitative study because there is a lack of theory or an existing theory fails to adequately explain a phenomenon".

3.3 Research goal and questions

In order to address the main goal of this study a number of specific research questions are posed below. Care was taken to ensure that research questions were "clearly formulated, intellectually worthwhile, researchable and were used as a means to move from broad research to specific research" (Mason, 2002, p. 19).

Research questions

Main question

What are educators' and learners' perceptions and experiences of their participation in Science Expos?

To answer this main question the following sub-questions were explored:

- How do science educators and learners perceive participation in Science Expos?
- What are the educators' and learners' experiences of participation in Science Expos?
- How are science educators and learners motivated to participate in Science Expos?
- What challenges do science educators and learners experience in participating in Science Expos?
- In what ways do science educators and learners deal with the challenges they are faced with in participating in Science Expos?
- How can science educators and learners improve participation in Science Expos?
- In what ways do science educators' and learners' experiences on their participation in Science Expos influence their understanding of scientific investigations?

To answer the above questions, I used the following approaches:

The first, second and third research sub-questions in this study were addressed by interviewing educators and learners; observing Science Expos, the way learners were judged and analyzing documents, for example, learners' journals.

To answer the fourth to seventh research sub-questions, I interviewed educators and learners, observed learners' workshops and also analyzed documents.

Semi-structured interviews were conducted out for educators and learners who participated in the National/International Science Expos. The focus group interviews concentrated on learners who participated in previous years at Regional level and those who participated for the first time in Science Expos. All the interviews were audio recorded and transcribed verbatim. The observations were also video and audio recorded.

3.4 Research Methods: Case study and Sample

3.4.1 A case study

This method is an approach used in "educational research to gather data which were used as a basis for inference and interpretation, for explanation and prediction" (Cohen, et al., 2007, p. 47). To achieve my research goal I carried out a qualitative case study. According to Wellington (2000, p. 90), a case study is a "detailed examination of one setting, or one single subject, or one single depository of documents, or one potential event". My study examined one single setting, that is, educators' and learner's participation in Science Expos in Grahamstown, in particular, from township and former Model C schools. Furthermore, Merriam (2002, p. 8) defines a case study as "an intensive description and analysis of a phenomenon or social unit such as an individual, group, institution, or community".

However, one of the disadvantages of a case study is that it cannot be generalized, but I chose a case study because of its depth and manageability as proposed by (Merriam & Connie, 2002). Furthermore, a case study allows the researcher to examine a particular issue in a great deal of depth (Rule & John, 2011; Denzin & Lincoln, 2000), rather than looking at multiple instances superficially. Its status of in-depth analysis enables the researcher to obtain thick and rich descriptive data from the subjects which could lead to layered descriptions (Cohen, et al., 2011). It is recognized that this requires a careful selection of research participants.

Baxter and Jack (2008, p. 544) define a qualitative case study as "an approach to research that facilitates exploration of phenomenon within its context using a variety of data sources". As I have used an interpretive case study the data sets have been generated through the use of different methods. Denscombe (2007) asserts that case study research allows for data validation through triangulation. Blanche, Durrheim and Painter (2006, p. 287) assert that triangulation "entails collecting data in as many different ways and from as many diverse sources". A case study is suitable for this particular study because it can provide rich data sets (Hamilton & Connie, 2011). The case was the educators' and learners' participation in Science Expos and my unit of analysis was their perceptions and experiences in participating in Science Expos.

3.4.2 Research site and Sampling

Sampling refers to the process of defining the population on which the research will focus as Mertens (2005, p. 69) states "the sampling process is a method used to select a given number of people (sample) from a population". Sampling decisions must be "taken early in the planning of research as factors such as expenses, time, and accessibility frequently might prevent the researchers from gaining information from the whole population" (Cohen, et al., 2011, p. 143).

For this study, purposive sampling was used to identify participants (Cohen, et al., 2011). According to Cohen, et al. (2011), purposive sampling is often, but by no means exclusively, a feature of qualitative research: researchers hand-pick the cases to be included in the sample on the basis of their judgments of their typicality or possession of a particular characteristic being sought.

I thus purposively identified four township schools from Grahamstown East which are mixed sex schools and one former Model C school. The schools were chosen based on the fact that, in those schools the science teachers and learners have in the past successfully presented projects at Science Expos. That is, according to Lave and Wenger (1991), these schools have been striving to move from the peripheral to 'full' participation (see Section 2.8.1). On the other hand, one of the schools was chosen based on the fact that it had learners who were participating for the first time in the Science Expos in 2013. It could be argued that these particular learners were in the process of moving from the marginal to the peripheral.
My sample size consisted of three science teachers and six learners, two learners from the same school and one each from the other four selected schools. Of the three teachers who were involved in this study; two had participated in various ways in Science Fairs/Expos in previous years, while one teacher participated for the first time in 2013.

I focused on group interviews with two learners who had participated in previous years and two learners who participated for the first time in a Science Expo. I also had an individual semi- structured interview with two other learners who had been to the Regional and National/International Science Expos.

The intended value of including both educators and learners in this study was to get the experiences, perceptions, frustrations and achievements from both perspectives. It was also essential verify the claims of each as to what was being done. Also, prior research into teacher attitudes and beliefs has often shown that their theories of what their students do or believe can be wrong or needs further elaboration that could only be obtained from the students themselves (Burderson & Anderson, 1996).

As an attempt to establish a rapport with my research participants and clarify my thinking about how to conduct my research, I made contact with the Science Expo office to do their contextual profile and obtain their documents in relation to Science Expos. I interviewed a former science teacher who, despite having taught at a historically disadvantaged school in the past, has been involved in Science Expos and had attended workshops conducted to motivate learners from Grahamstown East (township) schools to participate in Science Expos. I interviewed the Science Expo coordinator (SEC2) (codes used) and someone from the South Africa Environmental Organization Network (SAEON) who had organized the workshops for township learners. These interviews were done as I was piloting instruments for the contextual profiling for my study.

3.5 Data gathering tools

Data gathering tools refer to the research instruments used to gather the required data. Interviews, document analysis and observation are regarded as major data gathering tools to be used in a case study method (Cohen, et al., 2011; Johnson & Christensen, 2004; Leedy & Ormrod, 2010). Regardless of what kind of data is to be collected, the qualitative study takes a great deal of time, where a researcher records data accurately and systematically by using audiotapes, photographs and field notes.

For this study, document analysis, semi-structured interviews and observation were used as data gathering techniques. I used three different data gathering techniques to ensure adequate coverage and address of the research questions and research goal. With the permission of participants, I used an audio and video recorder to capture data.

3.5.1 Document Analysis

Document analysis was the first data gathering technique I used in my study. I started by analyzing documents, focusing on official documents (Johnson & Christensen, 2004), namely, the Science Expo database of learners' participation in Science Expos (including learners' reflections (journals)).

Documents are reliable sources of data that do not change. Thus, document analysis helped me to understand the existing potential for teachers' and learners' perceptions and experience of their participation in Science Expos and to verify the phenomenon through records. It also helped me to formulate questions for the interviews.

3.5.2 Interviews

Focus group interview

A focus group interview is one of the data gathering tools I used in this study. According to Johnson and Christensen (2004, p. 85), a focus group is a "type of group interview in which the moderator leads a discussion with a small group of individuals (for example, students, teachers) to examine in detail how the group members think and feel about a certain topic". Campbell (2011) further defines focus group interview as follows:

> A focus group can be defined as an in-depth qualitative interview or organized discussion held with a small number of carefully selected individuals brought together to discuss a particular topic, so a researcher can gain information about their view and experiences of a topic. (p. 10)

Focus group interviews are known to have a distinguishing feature which is "the use of group interactions to discuss data, produce and provide insights that would not be available in a single interview situation" (O'Hanlon, 2003, p. 78).

In this study, I conducted two focus group interviews (with two learners in each group) who had participated before; and two with learners who participated for the first time in Science Expos and those who participated at National/International Science Expos. These learners came from three different schools and were doing different grades. I was aware of what I considered to be the main disadvantages of a focus group interview in that one respondent

may dominate the interview; the circumstances where the researcher has to aim a series of follow-up questions at one specific member of the group and the problem of coding the responses of group interviews (Cohen, et al., 2011).

Nonetheless, I chose a focus group interview based on its usefulness listed below: "a) When time is limited, b) People feel more comfortable talking in a group than alone, c) Interaction among participants may be more informative than individually conducted interviews; d) The researcher would like assistance from other people in interpreting what was observed" (Leedy & Ormrod, 2010, p. 148).

Campbell (2011, p. 10) also provides some advantages of focus group interviews a) It provides a wide range of information in a short time, b) It can be used as a starting point to construct an interview schedule, c) It can provide an initial exposure to the behaviors the researcher is about to observe, d) It does not require a complex sample; and e) It may benefit participants as it can be the opportunity to be involved in the decision making processes.

A focus group interview has been guided by standardized open-ended questions (see Appendix B1). Standardized open-ended questions are types of interview questions whereby the exact wording and the sequence of questions are determined in advance in respect of follow-up questions. All the interviewees are asked the same basic questions in the same order (Cohen, et al., 2011; Johnson & Christensen, 2004).

Despite little flexibility in relating the interview to particular individuals and circumstances and standardized wording of questions that may constrain and limit naturalness and relevance of questions and answers, I chose standardized open-ended questions because:

a) Respondents answer the questions, thus increasing compatibility of responses b) Data are complete for each person on the topics addressed in the interview; and c) They facilitate organization and analysis of the data (Cohen, et al., 2011, p. 413).

Although the respondents answer the same questions this does not imply that I would not probe respondents' answers for individual understanding. In addition, Campbell (2011, p.10) points out that "focus group interviews can be used as 'a stand point' for considering probing questions in individual interviews". During the focus group interview I conducted, learners

did not dominate each other; instead they respected others' views as they were told to respect each other's ideas during their Science Expo workshops.

Semi-structured interviews (Individual interview)

Individual interviews are a type of interviews whereby the researcher engages selected participants individually on a one-on-one basis (Johnson & Christensen, 2004). I conducted individual interviews with five educators (see Section 1.1) and two learners. Johnson and Christensen (2004, p. 183) state that qualitative interviews are used to obtain in-depth information about a participant's thoughts, beliefs, knowledge, reasoning, motivation and feelings about the topic. Therefore, the interview "is the main road to multiple realities" (Stake, 1995, p. 64). As in the focus group interviews, the same open-ended questions were used to guide the individual interviews.

According to Leedy and Ormrod (2010), individual interviews are believed to have the ability to yield a great deal of useful information because the researcher can ask questions related to some concerns. Among those are:

> Facts; peoples' beliefs and perceptions about facts; feelings; present and past behaviours; standards for behaviours (i.e., what people think should be done in certain situations); and conscious reason for actions or feelings (e.g., why people think that engaging in a particular behaviour is desirable or undesirable). (p. 148)

Despite the perceived weaknesses of interview as a method, some being the requirements of staff time, a quiet area to conduct them and special equipment to record and transcribe them, Durrance and Fisher (2005, p. 1) mention three of the interview's strengths as being: a) Personal contact with participants might elicit richer and more detailed responses; b) Individual interviews provide an excellent opportunity to probe and explore questions; and c) Participants do not need to be able to read or write to respond.

I chose individual interviews as one of my data gathering tools because I believe their strength outweigh their weaknesses. I interviewed five educators to get their insights on their participation in Science Expos. It was difficult to get some of the participants for the follow-up interviews; I thus had to e-mail those follow-up interview questions to them. It was very effective since the participants emailed their responses back promptly. Although it was not

possible to ask follow-up questions, I gave the transcripts to the participants for member checking, but there were some delays in receiving the transcripts back.

3.5.3 Observation and Fields Notes

To complement data from the interviews and document analysis, I used a naturalistic, non-participant observation method as my third data gathering technique. According to Punch (2005),

> In naturalistic observation, observers neither manipulate nor stimulate the behaviour of those whom they are observing, in contrast to some other data gathering techniques. The situation being observed is not contrived for research purposes. This is pure or direct or non-participant observation in contrast with participant observation. (p. 179)

I understand observation as a data gathering method based on close monitoring of facts and practices of the target groups without attempting to change them. Cohen, et al. (2011) assert, "quality observations are more than just looking, they state it is looking (often systematically) and noting systematically people, events, behaviours, setting, artifacts, routines and so on" (p. 456).

I also attended workshops for learners to motivate them to participate in Science Fairs/Expos. During this process, they were scaffolded while doing their projects. The two teachers whom I identified have been involved in the learners' workshops organized by SEC2. When I observed the Expo workshops for learners I did not have an observation schedule, but tracked what was emerging from the workshops using field notes. I video- and tape-recorded some workshop sessions, and transcribed and analysed the recordings. I developed themes to guide me in presenting what emerged from the workshops.

Moreover, I conducted an observation during the period of my visit to Science Expo exhibitions which was held in July 2013 and observed the learners' projects (in particular the learners' projects involved in this study). I observed that the learners' projects resembled the academic research projects. It was a learning experience for me to observe learners freely presenting their projects to the Science Expos judges.

I took some field notes during all these sessions and conducted some informal interviews where possible. During my observation I did not use an observation schedule, instead I only noted every observable cue relating to my study phenomenon. Leedy and Ormrod (2010, p. 147) state that "observations in a qualitative study are intentionally unstructured and free-flowing. The researcher shifts from one thing to the other as new and potentially significant objects and events present themselves". I used an audio recorder and video tape to record what took place and what was observed so that I would not forget the important details. My focus was mainly on the judges and learners' interviews and projects.

The following table shows how data were gathered and the purpose of gathering these data.

Table 1: Shows the tools, methods and the purpose for the gathering of information

Stage	**Method used to gather data**	**Data gathered**	**Purpose**
Stage 1	Document analysis of curriculum documents. Document analysis of Science Expos documents and a contextual profile of the Science Expo offices. In addition to this, I also interviewed one of the Science Expo coordinators.	What the curriculum documents say about scientific investigations? Information on the participation of science teachers and learners in Science Expos. What strategies used to motivate science teachers and learners to take part in Science Expos?	To get some insight about scientific investigations and to contextualize the study. To find out information on science teachers' and learners' participation as well as the strategies used to motivate them to participate in Science Expos. The contextual profile had provided the necessary context and background for the main study.
Stage 2 PILOT	I piloted my research questions to a former school science teacher whose learners had participated in Science Expos in the past as well as research questions for Science Expos coordinators to SEC2 from South Africa Environmental Organization Networks (SAEON) who has been involved with motivating township learners to	Educators' and learners' perception of Science Expos; Enablers and/or constraints for participation in Science Expos.	To pilot test my data gathering tools so that I could improve them.

	participate in Science Expos. I had also conducted two focus group interviews (with two learners in each group) who participated in the Regional and National Science Expos.		
Stage 3	I interviewed three teachers and six learners from the five schools involved in this study.	Educators' and learners' perception and experiences of the participation in Science Expos. How they are/not involved and what support system do they get? Whether participation in Science Expos influences their understanding of scientific investigations or not.	To get some insights on educators' and learners' perceptions and experience of the participation in Science Expos.
Stage 4	Attend and observe teachers' and learners' workshops on Science Expos. Observe exhibition of learners' science projects during the July Science Expo.	How are teachers and learners motivated? Quality of science projects and learners' projects as they were assessed.	How were teachers and learners being motivated? Quality of science projects and learners' projects assessed.
Stage 5	Transcribing the audio and video recorded data, gave the transcripts to the participants for member checking.	I got information from interview and observation. Participants verified the transcripts.	For data analysis.

3.6. Data analysis

I consider data analysis as the step in research methodology for preparing gathered data for presentation and discussion. Cohen, et al. (2011) state that:

> Qualitative data analysis involves organizing, accounting for and explaining the data; in short, making sense of data in terms of the participants' definitions of the situation, noting patterns, themes, categories and regularities (p. 537).

According to O'Leary (2004), analyzing is moving from raw data to meaningful understanding of the data. Data analysis is thus the "process of making sense of and finding meaning in the data, interpreting what has been seen and what has been said" (Gay, Mills & Airasian, 2006, p. 205).

Qualitative analysis is a systematic process of coding, categorizing and interpreting data to provide explanations of a single phenomenon of interest. In this study, I used a thematic analysis as proposed by Brand and Glasson (2004) and data was analysed to provide insights on educators' and learners' perceptions and experience of their participation in Science Expos. Data sets were colour-coded and organised into categories to develop emerging themes (Brand & Glasson, 2004).

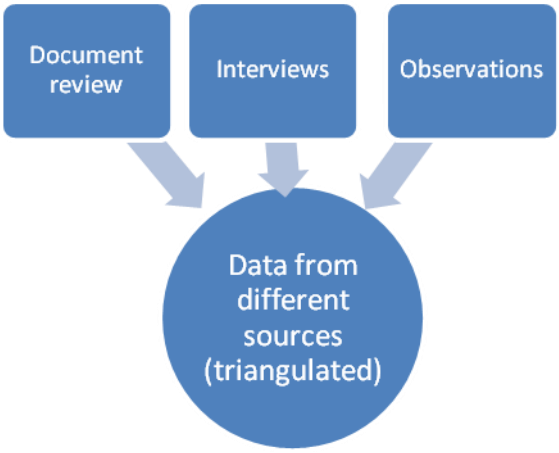
According to Cohen, et al. (2007, p. 462), "early analysis reduces the problem of data overload by selecting out the significant features for future focus". My data analysis therefore contained an on-going process until all the data gathered from the three instruments were analyzed. According to Brand and Glasson (2004), on-going data analysis enables researchers to extrapolate meaning from the narratives told by research participants.

Inductive analysis was thus applied in this study, which according to Danermark, Ekstrom, Jakobsen and Karlson (2002) typically consists of identifying similarities in a number of observations. Patton (2002, p. 41) describes inductive analysis as the investigation of data to discover patterns and themes, resulting in a creative synthesis. Through the use of inductive analysis, categories and patterns emerged from the data, rather than being imposed on them prior to the gathering process (Davies, 2007).

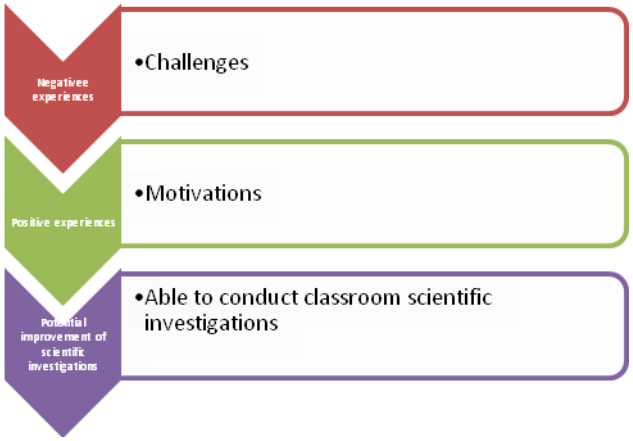
During the process of analysing the data, I also looked for trends, similarities and contradictions. I distinguished less important data from significant data by highlighting them with different colours (coding). For example, I used the colour green for positive perceptions, experiences and enablers, red for negative perceptions, experiences and constraints, and a pink for potential improvements in scientific investigations and so on. I then grouped together similar categories emerging from the different data sets, identified links between the categories and then constructed themes.

Merriam (2001, p. 164) posits that "coding is nothing more than assigning some sort of short-hand designation to various aspects of your data so that you can easily retrieve specific pieces of the data". Lending support to this position, Leedy and Ormrod (2010, p. 138) also indicate that the identification of patterns as a process when data and their interpretations are scrutinized for underlying themes and other patterns characterizes the case more broadly than a single piece of information can reveal. By triangulating the three sources of data gathering techniques, I was able to present a rich picture of data about the phenomenon under study for validity purposes and to address my unit of analysis in my study which was primarily on the participation of educators and learners in Science Expos.

Figure 2: Model of how data were analysed designed by Kahenge (2013) (Researcher)



Colour coding of data and development of categories



I came up with the model in figure two which shows how I analysed the data from different data gathering techniques through triangulation and how I colour coded the data. Negative experiences I considered as challenges were colour coded red. The positive experiences were considered as motivations and were colour coded green. The knowledge and skills (learning) that emerged as they carried out Science Expos projects were colour coded purple.

The model presents the data in broader categories only; the subthemes are presented in Chapter six.

3.7 Validity and trustworthiness

I employed multiple strategies to ensure and enhance validity and reliability of data (Merriam, 2009). Gray (2004) explains that validity is ensured if the research instrument measures what it is intended to measure. Cohen, et al. (2007, p. 133) assert that "validity is an important key to effective research". To them, if a piece of research is invalid then it is worthless. Merriam (2009, p. 229) defines reliability as "problematic in the social sciences simply because human behaviour is never static".

To ensure validity, I piloted the standardized open-ended questions to the former science teacher whose learners have participated in Science Expos in the past. Furthermore, my supervisors checked my data gathering tools. To enhance validity, the information was further triangulated by comparing codes across the data sets generated by all three data gathering techniques, before themes were developed.

Triangulation is defined by Golafshani (2003, p. 603) as a "strategy for improving validity and reliability of research or evaluation of findings". While considering the collecting of relevant data for validity, Denscombe (2007) asserts that case study research allows for data validation through triangulation. Blanche, et al. (2006, p. 287) urge that triangulation "entails collecting data in as many different ways and from as many diverse sources".

In this study, I also employed member checking to verify the accuracy of responses from participants. I therefore gave my interview transcripts and summaries of discussions back to the research participants (including learners) so that they could verify their responses as recommended by Maxwell (2008, p. 244). There were some delays in the transcripts being returned to me.

According to Cohen, et al. (2007, p. 136), "member checking is when the respondent validates, to assess intentionality, to correct factual errors, to offer respondents the opportunity to add further information or to put information on record; to provide summaries and to check the adequacy of analysis. Validity is defined by Hansen (no date) as the degree to which data provides relevant information about the research situation being explored. In

conducting the focus group and individual semi-structured interviews and observation, I also considered ethical issues in educational research. I used an audio recorder with the permission of participants. This was done to ensure that all data were captured.

3.8 Ethical considerations

Ethical protocol can be referred to as the parameters of ethics within which researchers bind themselves when conducting research. I sought permission to carry out my research study, in writing from the Science Festival office (SciFest Africa), the Science Expo coordinator from SAEON, the schools, and the three science teachers and from the learners' parents since they were still minors when I did this research.

I then prepared consent letters for participants I interviewed (see Appendices A1- A4). In the consent letters, participants' confidentiality and anonymity was guaranteed, as their participation was voluntary participation and they had the right to withdraw from the research at any given time (Blanche, et al., 2006). However, it is recognised that it is impossible to maintain anonymity during focus group interviews.

I outlined the ethical issues to everybody at the beginning of every interview and reiterated the point of confidentiality and anonymity at the end of every interview. Denscombe (2007) posits that people should not be forced or coerced into helping or participating in research. The research commenced upon the approval of the research proposal by the Education Higher Degrees Committee (EHDC) of Rhodes University.

3.9 Limitations of the study

Being a case study of four township schools and one former Model C school in Grahamstown, South Africa, the results of this study cannot be generalized; however, it has provided some insights on the perceptions and experiences of teachers and learners on their participation in Science Expos.

3.10 Concluding remarks

In this chapter I outlined the research orientation and highlighted the methodology that informed this study. I also described how data were gathered, analysed and triangulated. Lastly, this chapter provides the steps I took regarding the validity, ethical consideration and limitation the study. In the next chapter I present the data that was generated from the educators involved with Science Expos in Grahamstown.

CHAPTER 4: DATA PRESENTATION (EDUCATORS)

> *The role of the teacher is that of a mentor. Eskom Expo for Young Scientists depends on teachers to distribute information about Expo to students… Simply through their encouragement and support, enthusiastic teachers can inspire their student to great achievements* (Eskom Expo for Young Scientist Project Guide Book, p. 6).

4.1 Introduction

The aim of this study was to investigate educators' and learners' perceptions and experience of their participation in Science Expos in Grahamstown, South Africa to enhance best practice in Namibia. As highlighted in Chapter one, 'educator' refers to both the Science Expo coordinators and school teachers. Educators in this study are thus involved in Science Expos in various ways, for example, as coordinators, mentors and judges.

In this chapter, I therefore present data from Science Expos coordinators and from school teachers respectively. The data presented in this chapter were derived from individual semi-structured interviews. The chapter starts with Science Expos coordinators' codes and profiles and then I present the data according to the themes identified as shown below.

4.2 Science Expos coordinators' codes and profile

The code and participants' profile gives readers an understanding of data sources. The Science Expos coordinators codes are as follows: Science Expos coordinator one (SEC1), Science Expos coordinator two (SEC2) and semi-structured interviews conducted (SSI4 and SSI5).

SEC1's profile

SEC1 first experienced Science Expos while she was a student at university. In 2002, she started work as a Science Expo coordinator in Grahamstown, and is still in that post.

SEC2's profile

SEC2 has a BEd degree in Environmental Education. She works for the South African Environmental Observation Network (SAEON). She had never had an opportunity to participate in Science Fairs/Expos while she was at school. SEC2 is responsible for organizing workshops to encourage and motivate learners to participate in Science Expos. She mostly works with learners from township schools in Grahamstown as SAEON noticed the poor participation among the township learners so they initiated a project conducting workshops, excursions and camps.

4.3 Coordinators' perceptions and experience of Science Expos

The data sets are divided into the following categories in line with the research questions:

- Perceptions about Science Expos;
- Experiences on participating in Science Expos;
- Motivation of teachers and learners to participate in Science Expos;
- Educators' and learners' enablers in their participation in Science Expos;
- Challenges of participating in Science Expos;
- Science Expos Judges;
- The quality of learners' projects;
- Successful projects and successful learners; and
- Learners' participation and potential to pursue science related subjects.

4.3 .1 Perceptions about Science Expos

The coordinators were asked about their perceptions and experience of their participation in Science Expos and they had varied views. For instance, SEC1 explained that there are two main objectives of Science Expos. The first objective is to teach learners scientific methods since it is difficult for them to learn scientific methods at school, "*lots of our government schools especially in the peri-urban and the rural areas are not actually provided with laboratories, they do not have the resources*" (SEC1, SSI5, 19 April 2013). She further mentioned that lack of resources contributed to science being taught theoretically in most schools.

The second objective was to encourage learners to pursue science related careers and get involved in research and innovation. SEC2 indicated that Science Expos are further intended to arouse an interest in science in learners. Furthermore, she said Science Expos are a way of trying to understand the interests of the young people at school through the projects that they do.

4. 3. 2 Experiences on participating in Science Expos

SEC1 explained that she was introduced to the Eskom Expos for Young Scientists while she was in Grade 5, and she saw her brother who was in grade 8 at the time participating in Science Expos. So she had been involved in Science Expos from an early age until the present when she joined the Grahamstown Regional Science Expos as a coordinator in 2002. Through motivating teachers and learners she noticed poor attendance among teachers and learners; she said "*We did not have very good attendance from the former model-C schools*" (SEC1, SSI5, 19 April 2013).

She further indicated that there were some schools where teachers made decisions whether learners should participate or not, saying that "*no, we will not be entering the Expo because her learners were not ready or maybe the teachers do not want extra work*" (SEC1, SSI5, 19 April 2013).

SEC2 said she likes and enjoys Science Expos. She noticed from the previous years that only a few learners from the disadvantaged schools participated compared to those from the private and former Model C schools. This prompted her to motivate learners from the disadvantaged schools to participate. She stated "*they are kind of like having fear of trying it or lack confidence, yet it is meant for everybody*" (SEC2, SSI4, 05 March 2013).

4. 4 Motivations of teachers and learners to participate in Science Expos

At first SEC1 used to motivate teachers and then teachers would in turn inspire their learners to participate in Science Expos. Later on she realised that even though some teachers attended the workshop they did not disseminate the information.SEC1 said:

> We motivated them by showing how the Eskom Expo teaches scientific methods, that were actually really the teaching aid for them in the classroom and the other thing Eskom Expo has been very well linked into the old OBE curriculum and now the new curriculum where learners are required to have projects (SEC1, SSI5, 19 April 2013).

In response to this challenge, this year SEC1 started conducting combined teachers' and learners' workshops in order to pass the information directly to the learners. She said that she worked with schools in town, peri-urban as well as in rural areas. The attendance of former Model C schools was poor comparing to the township schools. She further stated that the urban school might know what they are doing, but the rules and guidelines change every year. She indicated "*We still have a situation where teachers are not motivated or they are just not interested, we invited all 26 schools to these workshops and at one there were two schools*" (SEC1, SSI5, 19 April 2013).

When asked who was supposed to motivate teachers, she responded that, "*I do not think it is the job of SciFest to motivate teachers, teachers are not motivated because it is an extra thing, they do not get paid enough or they do not have the resources they need or simply because they do not have the work ethic*" (SEC1, SSI5, 19 April 2013).

SEC1 indicated that as a way of motivating learners, during Regional Science Expos they award five to ten bursaries for the winners to enrol at university to study science. Successful learners also receive books to inspire them to read more about science. There was also an

opportunity for learners to meet with other learners from different schools. The successful learners progressed after the Regional Science Expos to Pretoria for the National/International Science Expos.

SEC2 from SAEON who conducts workshops for learners from township schools said some teachers who are motivated tell their learners to come and participate. She further said:

> Some teachers are still battling, but sometimes I do not blame some educators for not showing interest, because there is much happening in Grahamstown, we are trying to do outreach to schools and hence some of the projects fall apart and we leave teachers and schools with expectations and you do not fulfil anything hence they lose interest because there is too much happening (SEC2, SSI4, 05 March 2013).

Moreover, she emphasized that:

> We like working directly with learners but not putting aside educators but it is better if we get like more engagement with learners than with educators so we feel more comfortable and we know that information went to the right people.

The educators (coordinators) were asked how they ensure that Science Expos are not perceived as just as mere competitions. SEC1 explained that when Science Expo started there was no competition, they focused on the benefit of the Eskom Expo rather than the prizes and competition factors, looking at the fact that learners learned scientific methods that exposed them to different careers. That was their big focus during the workshops and they tried not to make it all about the competition but kept the prizes small.

> There are bursaries which are up for grabs and other prizes, we do not offer massive prizes like computers etcetera it's real, … the big focus on us when we are doing preparation before the Expos is to explain to learners as to why it's so important to take part in the Expos (SEC1, SSI5, 19 April 2013).

In answering how they would ensure that learners do not perceive Science Expos as mere competition, SEC2 indicated that their organisation aims to introduce and motivate learners from as early as Grade 7 so that when they are in Grade 10 onwards they would become interested in the sciences.

> When they are going to choose their subject choices in grade 10, we have introduced them at the very young age; they will be able to make appropriate decisions (SEC2, SSI4, 05 March 2013).

SEC2 further stated that in every competition there should be winners who have to be awarded, sometimes it also motivates some of the learners that next time "*I will work twelve times harder than what I did this year*". This has been evidenced by the fact that although some learners did not win anything they still entered every year. It could be argued that for these learners the interest in science is a catalyst.

SEC2 conducted workshops with learners at their individual schools and combined learners from schools that had a few learners who would like to participate. The workshops conducted at individual schools were for the schools that had more than ten learners who wanted to participate.

4.5 Educators' and learners' enablers in their participation in Science Expos

When the two educators were asked what enabled teachers and learners to participate in Science Expos, they all indicated that the workshops that they conducted were the contributing factor "*this year there is a big different in terms of going through what is required for the project to be entered into Eskom Expo*" (SEC1, SSI5, 19 April 2013).

SEC1 further stated that the "*availability of their office to help people, if learners say I really need help with research, I do not have internet access, I do not know how to write the bibliography*". She also indicated that the role of mentors in assisting learners with their projects should not be underestimated, as learners were attached to academics at Rhodes University or teachers who were specialists in their project fields. The other thing is "*we do not expect the projects to be typed up, they can be hand written as long as they are neat*" (SEC1, SSI5, 19 April 2013).

4.6 Challenges of participating in Science Expos

The educators were asked about personal and observed challenges they experienced in participating in Science Expos. SEC1 and SEC2 explained that they found it difficult to motivate teachers as often some of them see the Science Expos as an additional responsibility on top of their school work that they have to do. SEC2 said, "*Sometimes they see it as a burden or as extra work for them*" (SEC2, SSI4, 05 March 2013). Furthermore, SEC2 indicated that some educators made little effort to get help.

On a positive note, they also mentioned that learners used to be shy and did not have much confidence at the Regional Science Expos final. Yet, when they managed to go to the Nationals/Internationals and came back they were completely changed in terms of growth and self-confidence.

SC1 emphasised that what constrains teachers and learners was the level of motivation and resources, "*it is very hard for the teachers to help learners to do research if themselves they do not have access to internet*" (SEC1, SSI5, 05 March 2013). Lack of resources was a constraint since learners have to buy boards and papers because these are the basic requirements for Science Fairs/Expos. She also indicated that distance from township or rural schools to the library and places where they can get access to the internet were also a contributing factor.

SEC2 further stated that some learners could not come up with ideas for their projects. As a result, some of them withdrew from participating in Science Expos.

4. 7 Science Expos Judges

SEC1 was asked how their office recruits judges for the Science Expos, she answered that they tried to take young academics and postgraduate students from Rhodes University as role models so that they could talk to young learners about their projects. The rationale for this approach was the assumption that learners would not feel threatened.

They also selected teachers from local schools and coupled them with the academics. Teachers were chosen because they stayed with the learners throughout the process of carrying out their projects. She also indicated that they looked at industries around Grahamstown, librarians and people who have marketing background and moderators who have worked with Eskom Expos for a long time. She further explained that most of the educators (teachers) become judges and judged projects from other schools which had potential to be a learning experience. Teachers who have judged for a long time also go on to judge at National/International Science Expos.

When she was asked if judges were knowledgeable about learners' projects she explained that:

> We classify the projects into different categories and then look for judges who are familiar with those categories, we were very careful to match the judges to the actual projects which are entered in the Expos and make sure judges have a scientific background (SEC1, SSI5, 19 April 2013).

So the SciFest office classifies the projects into categories in order to identify appropriate judges for the categories available.

SEC2 stated that the SAEON office where she works was not really involved in the judging but they encouraged learners through conducting workshops. During the Science Expos they looked at the successful projects that related to water and these projects are subsequently sponsored by their office.

4.8 The quality of learners' projects

The coordinators were asked about the quality of the learners' projects, SEC1 indicated that they noticed a big gap between disadvantaged schools and former Model C schools which could be attributed to the availability of resources at their schools.

> You find learners from disadvantaged schools have two references because it is what they managed to get and depending on the amount of time allocated to them on the computer while Model C schools have ten references and ten academic papers (SEC1, SSI5, 19 April 2013).

However, she said that with the introduction of mentors they have seen an improvement in the quality of projects from the disadvantaged schools. The mentors take learners through scientific methods, the research process and spell-check their projects. All these factors have increased the quality of the projects over the last three years.

4.9 Successful projects and successful learners

The coordinators were asked what they did with the successful project and successful learners after the Science Expos and also what they thought should be done with such projects.

4. 9.1 Successful projects

SEC1 indicated that they encouraged learners to continue with their projects "*we look at the impact of that research they have done and take it further and the project really lasts longer*" (SEC1, SSI5, 19 March 2013). SEC1 further indicated that they took the projects from the Eskom Expo and displayed them during the Science Festivals so that learners could learn from them. Also, the learners who were successful in the past Science Expos talk to other learners about the whole process of doing the projects and Eskom Expo. SEC1 also mentioned that this year "*we will have representatives from the Technology Innovation Agency coming to our Expo to come and have a look, to see if there will be any of the innovations that can be taken further in the market place*" (SEC1, SSI5, 19 March 2013).

SEC2 indicated that,

> We were thinking of calling upon those who have been to Expos and they went to National Expos to bring their winning projects and then to present to these new learners that will be entering the Expos (SEC2, SSI4, 05 March 2013).

She said together with other educators they planned to do that this year and this was done in one of the workshops conducted outside of Grahamstown.

4.9.2 Successful learners

SEC1 indicated that once successful learners are identified from the Eskom Expo they get exposed to the scientists in different organisation during Science Festival. Successful learners were encouraged to continue with their projects and keep on improving their projects. "*That is the way we do to measure their growth to see how they are going*" (SEC1, SSI5, 19 April 2013). She explained that most learners start participating in Science Fairs/Expos while they are in Grade 8 so that by the time they were in Grade11 they could win bursaries. This was realised through close monitoring of learners' progress in their projects.

SEC2 suggested that since the bursaries are normally only for the top five winners and that none among the top five few learners came from disadvantaged schools, there was a need for more people or organisations to sponsor more bursaries to add to the five bursaries that Rhodes University sponsors so that learners from disadvantaged schools could benefit.

4.10 Learners' participation and potential to pursue science related subjects

The coordinators were asked whether learners' participation in Science Expos has the potential to inspire them to pursue sciences related subjects at tertiary level.

SEC1 stated that her brother participated in Science Expos and had received a bursary to study science at Rhodes University and has currently completed his studies in computer sciences. SEC1 is also an example of a successful participant in Science Expos as she is a coordinator of Science Expos in the Grahamstown Region (SEC1, pers. comm., 19 April 2013). She also knew of some learners who won bursaries and they went on to study science at Rhodes University. She was concerned about learners from disadvantaged schools not winning bursaries, "*I have seen one or two coming through and such motivation is there*" (SEC1, SSI5 , 19 April 2013).

SEC2 explained that learners that attended SAEON workshops started while they were in Grade 10 and were monitored by SAEON until Grade 12 and they are currently doing science subjects at Rhodes University. She further stated that "*learners who participated were seventeen learners and eleven learners registered with Rhodes University and the others did not qualify to be admitted to universities*" (SEC2, SSI4, 04 March 2013).

4.11 Coding and profile of school teachers

Pseudonyms have been used for the participants and names of schools for ethical purposes. The participants are coded as indicated below. Teachers and interviews codes: Teacher Dalia (TD), Teacher Noye (TN), Teacher Melk (TM), semi-structured interview (SSI1), semi-structured interview two (SSI2) and semi-structured interview three (SSI3).

4.11.1 Teacher Dalia (TD): teacher who has participated in Science Expos and has been a judge

TD started her teaching profession in the year 2000 at a Catholic College of Education as an assistant lecturer in Mathematics. Due to the College closing down in 2001 she moved to Temba combined school where she stayed for two years as a relief teacher. In 2003, she was then employed formally by the state at the same school. She has been teaching Mathematics, Natural Sciences, Life Orientation and *isiXhosa*. However, since her school has many Mathematics and Natural Sciences teachers, she ended up teaching Natural Sciences and *isiXhosa* in the Senior Phase (Grade 7 – 9).

Currently TD has been teaching for 12 years. She has a Masters in Science Education; Senior Diploma in Education (STDE), Higher Diploma in Education (HDE), BEd Hons specialising in Education Leadership and Management; Science Education and Curriculum Theory. TD has currently enrolled for a PhD in Science Education and she is a Head of Department for Mathematics and Natural Sciences at her school.

4.11.2 Teacher Melk (TM): teacher who participated for the first time this year

TM is a Physical Sciences teacher who started teaching in 1986 at T.T. College in Zimbabwe. He then transferred to school 4 in Grahamstown in 2008, where he is currently teaching Natural Sciences. Altogether, TM has been teaching for 27 years. TM is doing BEd Hons at Rhodes, and he has an Advanced Certificate in Education specialising in science, a Diploma in Psychology and a Certificate in Education specialising in Life sciences and Biology. TM only started participating in Science Expos in 2013.

4.11.3 Teacher Noye (TN): A former participant teacher in Science Fairs/Expos

TN started her teaching career in 2001, in the Eastern Cape, South Africa. She has been teaching Physical Sciences in grade 10 – 12 and Life Sciences in grade 10. She taught for eleven years and moved to Rhodes University where currently works. TN has a Masters in Environmental Education from Rhodes University and is now doing her PhD.

I interviewed these three teachers individually and the code for the semi-structured interviews is (SSI).

The data sets are divided into the following categories in line with the research questions:

- Teachers' perceptions of their participation in Science Expos;
- Teachers' experiences on their participation in Science Expos;
- The importance of science educators and learners in participating in Science Expos;
- Challenges and suggestions in participating in Science Expos;
- Motivation of teachers and learners to participate in Science Expos;
- Strategies used for motivating learners;
- Learners' participation in Science Expos and their perception towards Science as a subject; and
- Successful Science Expo Projects and successful learners.

4.11.4 Teachers' perceptions of their participation in Science Expos

Teachers were asked to give their perceptions of Science Expos. All teachers had almost similar responses of the purpose of Science Expos. According to TD, Science Expos,

> ...expose learners to be independent scientists and investigators since they work on their own projects and investigations, it gives opportunities to learn more about how to investigate in science and develop the process skills in the classroom situation. Whenever learners are involved in Science Fairs/Expos, they are doing a long term research over a long period of time; hence they are also developing science concepts (TD, SSI2, 21 May 2013).

In addition, TM indicated that Science Expos are intended for learners to display their innovativeness. Similarly, TN mentioned that Science Expos "*make science exciting for learners as well as for the application and a better understating of the abstract scientific concepts*" (TN, SSI1, 4 March 2013).

Initially, the three teachers had the perception that learners who entered the Science Expos were from former Model C schools and private schools. They were not sure if their learners could imagine it as something that they can do as well. When teachers were asked about their fears when they first participated, they indicated that,

> I wondered if I would be able to assist learners well with their projects, but then I got help from partnerships, really helped with both from conceptualization of projects, resources and coaching of learners (TN, SSI1, 4 March 2013).

> I feared that my learners would not get anything when they go to participate at the Science Fairs/Expos and they would see it as a waste of time, and say we are not participating anymore (TD, SSI2, 21 May 2013).

4.12 Teachers' experiences on their participation in Science Expos

TD indicated that she had good and bad experiences to share. Regarding good experiences, TD said that she felt she has grown a lot through being involved in Science Expos and even more so being one of the Science Expo judges. Moreover, TD indicated that she has grown towards understanding what Science Expos are all about and how she can encourage learners to participate in them. As a result, this was her sixth year of participating. In her first year she started with four learners who ended up going to Pretoria for the National Science Expo.

Therefore, she learned how to talk to people about how they can help her learners especially the professors and scientists from the Science Museum and Rhodes University. As a judge she experienced that judges are inspired by learners' topics. Finally, she said that the quality of the project matters a lot since learners need to follow the project requirements.

Pertaining to bad experiences, she indicated that learners were disadvantaged in terms of resources or materials that they can use to prepare their projects. She also stated that learners lack support from home and she works alone with learners when preparing their projects.

She added that most of the teachers at her school see the Science Expos as only for Natural Sciences teachers. Parents do not understand what is involved in Science Expos. For instance, when their children go home and ask their parents to buy materials for their projects, some parents ask, "*Is it for marks*?"

As an attempt to address this, she has tried to write letters to parents in English and *isiXhosa* explaining what Science Expo is and what benefits learners can get from it. TD indicated in her own words that,

> I was fortunate to be with the parents during the parent meeting, where one of the parents happened to ask about the science projects that, "I see my child busy with this project what this is?" I got an opportunity to explain to parents why is useful to do this Science Fairs/Expo projects and which could be a good platform to call parents as I have said, time wise also is where the disadvantage is.(TD, SSI2, 21 May 2013).

TN indicated that at first when learners carry out their science projects, they were not good enough to be submitted for the Science Expos. They then received help from Rhodes University and the South African Environmental Observation Network (SAEON) and those projects were subsequently up to Science Expos standard. TN indicated that,

> It is important, to have partnerships with people who have expertise in the sciences and scientific method to enrich the experience for learners and to make science exciting (TN, SSI1, 4 March 2013).

She further said,

> Learners who had up to standard science projects are those who are self-motivated to actually decide that, let me work hard on my practical investigations that I can submit for the Science Fairs/Expos, some of these learners are serious are As, they go out and meet people and connect with others (TN, SSI1, 4 March 2013).

4.13 The importance of science educators and learners participating in Science Expos

When educators (teachers) were asked about the importance of teachers and learners participating in Science Expos all the educators indicated that it was really important for them to participate.

According to TD, it is important to encourage learners, since as a teacher you need to have experience about Science Expos first and then bring that experience back to the classroom. As the Natural Sciences curriculum encourages learners to do investigations and projects and teachers guide them:

> I think that is an opportunity for teachers to say okay, this is what is happening in Science Expos, this is how I can teach my own children how to go about doing investigation projects. Furthermore, teachers who are not involved in Science Expos,

> their learners are missing out a lot in so many things, because learners do learn from each other's projects (TD, SSI2, 21 May 2013).

TN felt that,

> Science Expos actually extend what the teacher has to do in terms of implementing the curriculum because Science Expos make the scientific investigations or methods alive for the learners in a practical way (TN, SSI1, 4 March 2013).

TN further commented that Science Expos make "*science alive and learners being interested to take science related career in future. Learners actually happen to understand the methods of practical investigations and application of knowledge*" (TN, SSI1, 4 March 2013). Moreover some even "won scholarships".

TD mentioned that, "*most learners used to be interested to participate even though they did not win because they used to learn a lot and want to improve on their projects. Most importantly, participating in Science Fairs/Expos provided learners an opportunity to choose their careers*" (TD, SSI2, 21 May 2013). Similarly, TM indicated that "*teachers need to instill into learners the ability to be innovative and remove the notion that science is a difficult subject*" (TM, SSI3, 24 May 2013).

All three teachers indicated that Science Expos provide opportunities for learners to grow and understand investigations in sciences. TD mentioned that when learners carry out science projects they are "*developing their writing skills and investigating skills*" (TD, SSI2, 21 May 2013). TN stated that, through Science Fairs/Expos "*learners interact with other learners from other schools and they learn through their participation and they get to see things*" (TN, SSI1, 4 March 2013). In addition, learners' involvement in Science Fairs/Expo "*exposed them to the wide range of investigations*" (TM, SSI3, 24 May 2013).

4.14 Challenges and suggestions in participating in Science Expos

Teachers raised their concerns that they experienced in participating in Science Expos. They focused more on lack of motivation among some teachers and learners. According to TD, "*there is something lacking somewhere somehow in terms of motivating schools to participate then I usually have a question that, who is supposed to motivate who and some*

people are not willing to help? " (TD, SSI2, 21 May 2013). In support of this, TM said, "*People are not motivated and there is no empowerment and TM emphasized that people need to be motivated and exposed*" (TM, SSI3, 24 May 2013).

In some cases "*teachers are not willing to go the extra mile or maybe they are waiting for something to come from the Education Department*" (TD, SSI2, 21 May 2013). TM suggested that "*this should not be an event for few schools, there must be marketing of this event, some schools they are not aware of such event taking place*". TM further emphasized that "*there must be a strong drive in terms of marketing of Science Expo*" (TM, SSI3, 24 May 2013).

TN commented that lack of participation in Science Expos is exacerbated by teachers' lack of scientific investigation skills: *"if we were also comfortable with doing practical investigations, because I think that this is because, we are not confident ourselves in terms of looking at practical investigations, variables, and the steps"* (TN, SSI1, 4 March 2013). She thus suggested that the starting point should be to convince or motivate teachers or to help teachers to work with practical investigations, how to do practical investigations and how to design practical investigations.

Regarding learners' participation, TD indicated that, "*some learners see Science Expos as too much work because they have other assignments and projects that they do for all teachers, most of the time, is time constraining*" (TD, SSI2, 21 May 2013). According to TM, sometimes it is difficult for learners to come up with their topics and hence "*learners tried to do projects which have been already done, they cannot think of something new*" (TM, SSI3, 24 May 2013).

Furthermore, only few learners manage to come up with good projects because they do not get enough support from their teachers and parents. All this happened because "*we do not have all the knowledge on learners' topics"* (TD, SSI2, 21 May 2013). Similarly to TD, TN indicated that "*we do not have enough knowledge about a particular topic that learners want to pursue; therefore, one needs to know where to refer learners to for help*" (TN, SSI1, 4 March 2013).

Lack of resources is one of the major concerns raised in most of the schools as a result some learners even fail to complete their projects or participate in Science Expos,

> In our case we do not have lots of resources, we are a bit restricted ... a number of my learners did not finish their projects and I was disappointed. There was a time when one of the learners started with the project well and then changed the project she then got discouraged and she gave up (TM, SSI3, 24 May 2013).

TM indicated that it is sometimes difficult to encourage learners to attend workshops that are conducted outside the school premises because there are some procedures to be followed, especially during holidays as most of the learners who participate are not from the Grahamstown area. During the holidays is supposed to be a good time to support learners. Some schools do not have strategies in place to keep the successful projects after Science Expos "*the best projects most of the time, they take them, some they like to take them to their homes because it is their product, I did not think of making copies*" (TD, SSI2, 21 May 2013). The three teachers also indicated that some township schools do not participate and they have a perception that Science Fairs/Expos are for former Model C and private schools only and they saw this as the biggest challenge.

4.15 Motivation of teachers and learners to participate in Science Expos

Teachers were asked what motivated them to participate and how they in turn motivate learners to participate in Science Expos.

TD indicated that, at first she was told by one of the Rhodes University lecturers to go and observe the Regional Science Expo, even though she did not have learners to participate at that time. She was inspired by what she saw at the National Science Expos and felt that "*If things are happening why we do not know them*?"(TD, SSI2, 21 May 2013). From the Regional Science Expo she came back and motivated her learners at her school and four learners were interested.

TN indicated that she got motivated when she attended the teacher Science Expo workshops and seeing colleagues who have been involved in the Science Expos competition:

> Usually, the Science Expo committee invites schools to participate where we were assisted on how we could prepare our learners for Science Expo, we were shown and

> given projects that had been entered for the expo to show to our learners and received Cds (TN, SSI1, 4 March 2013).

In addition to this, TM was inspired to participate because of challenges which face the community in the township "*I am pushed; I would like to see my learners being part of the Science community whereby they can display their innovations*" (TM, SSI3, 24 May 2013).

4.16 Strategies used for motivating learners

When the three teachers were asked how they motivate their learners to participate in the Science Expos, each teacher had different strategies for doing this. TD and TN mentioned that they first talk to learners about bursaries and scholarships that learners can get to further their studies. TD encouraged learners by pointing out that if they joined in while they are still young they can improve on their projects and when they are in grade ten, eleven and twelve they can win scholarships to go to university. Furthermore, she said "*I always try to speak in a positive way that, it's not all about winning, it's about learning*" (TD, SSI2, 21 May 2013):

> According to the curriculum's requirements, each child is supposed to have a project and that project should be marked. So, I do to motivate my learners and say everybody is going to have a project, and then if you work hard enough then we can take your project to the Science Expo. That is the strategy I am using to motivate my learners….this is what the curriculum requires for learners in grade 9 to have a project, but somewhere somehow Science Fairs/Expos and curriculum do click (TD, SSI2, 21 May 2013).

TM explained that,

> I normally present to them challenges, so I expose my learners to such challenges like global warming and advise them that you guys you have the opportunity to do something in the community, you are going to see what other young minds are doing. I encourage my learners to attend Science Expo and workshops to be exposed to a wide range of investigations (TM, SSI3, 24 May 2013).

TN indicated that,

> I share with them all the materials from the Science Expo workshops and the experience of meeting other Young Scientists and I tell them that, let us do practical investigations and then if it is good enough then you can be enter to take part in Science Expos (TN, SSI1, 4 March 2013.

The three teachers interviewed made suggestions about what should be done in future to motivate learners. TD and TN emphasized that there is a need to have proper workshops starting earlier in the year.

> I think children need to begin like before the end of the year, children need to be called upon... including teachers not only learners because you will find that if you speak about Science Expo some teachers still say 'Science Expo?' but it has been there for years now (TD, SSI2, 21 May 2013).
>
> The starting point should be to convince or motivate teachers or to help teachers to work with practical investigations, how to do practical investigations, how do you design practical investigations because once teachers are confident, they will be able to practice with their learners, then it will be easy for teachers to motivate learners (TN, SSI1, 4 March 2013).

4.17 Learners' participation in Science Expos and their perceptions towards science as a subject: Teachers' perspectives

The three teachers in this study were asked whether learners' participation in Science Expos influenced their perceptions towards science as a subject or not. All teachers gave similar responses. According to TD,

> I have a learner who took a career in science because of Expo, he is doing Maths and Science and after attending the Science Expo he was one of the learners who said that, "I am definitely doing something in Science as my career" (TD, SSI2, 21 May 2013).

TN indicated that Science Expos "*enrich learners' understanding of scientific concepts and methods and to realise that science is around them and not so abstract after all*" (TN, SSI1, 4 March 2013). TM explained that learners are doing wonders, by producing quality projects in the class and have the opportunity for peer assessment, and their perceptions of science are changing. He further said when learners are "*exposed to a wide range of scientific knowledge definitely they improved*" (TM, SSI3, 24 May 2013).

TM further stated that learners who participate in Science Expos tend to choose Physical Sciences in grade 10 which is regarded by many as a difficult subject and most of these learners have indicated that they would pursue science related careers.

When asked whether participation in Science Expos improves teachers' and learners' understanding of scientific investigation and science projects or not, they all agreed that

Science Expos do improve their understanding of scientific investigations and science projects. According to TD, "*learners are exposed to academic research, where they are expected to do hypothesis, the aims, the background, the data collection and have analyzed data, this is what I am doing at University level*" (TD, SSI2, 23 May 2013). In support, TM said, "*Understanding of scientific investigation is enhanced* "(TM, SSI3, 24 May 2013). TM indicated that he found that learners who do not participate in Science Expos generally struggle with scientific investigations.

4.18 Successful Science Expo projects and successful learners

Teachers were asked what they think should be done with the successful projects and successful learners after the Science Expos. Each teacher gave their ideas on what they thought should be done.

4.18.1 Successful Science Expo projects

TD mentioned that it has been a concern that there were no mechanisms for dealing with successful projects. She emphasised that "*those projects can be used to motivate other learners who do not know anything about Science Fairs/Expos. In that way, other learners could be inspired*" (TD, SSI2, 23 May 2013). She further stated that, those projects can be used during workshops, as learners and teachers will learn that "*if this child can do it our children can do it too*" (TD, SSI2, 23 May 2013).

Normally, when learners have participated in Science Expos, they keep their projects at home. TD suggested that it could be good if the projects could be displayed at school as resources to teach others how to do projects. For instance, she lamented "*I had one learner who went to the Science Expo in 2011 and I did not think of even making copies and keep the project, I think that was my weak point*" (TD, SSI2, 23 May 2013).

In addition, TM indicated that the projects should not be for display only, it must benefit the community. He further urged that, "*if those projects can be put into practice and be exposed to the community, they must be innovative*" (TM, SSI3, 24 May 2013). TN pointed out that the projects should be used to motivate others:

> In one of the meetings that I attended for teachers, the Science Expo officer presented actually some of the learners' projects that had won at the Science Expos; it was a good example of how the projects should look like (TN, SSI1, 4 March 2013).

TN further emphasised that the projects should be shown to other learners so that they can see the quality work that is required for Science Expos. For example, at TN's school when a project has won at the Science Expo, they usually show the project to other learners in order to motivate them to participate.

4.18.2 Successful learners after the Science Expos

All teachers gave similar responses as they suggested that learners should go to schools and motivate other learners. "*I believe learners can learn better from their age mates*" (TD, SSI2, 23 May 2013).

TD added that, it does not make sense to only show the projects to other learners. Instead, it would help if those learners explain their own projects to others, even though it will be time consuming, it needs to be done after school hours and it can help a lot.

> Last year, we were called to attend a mini-workshop at one of the schools that had learners who went overseas to participate in Science Fairs/Expos and those learners were shown around and presented their projects, it was motivating. During Science Fairs/Expos the top five learners used to get an opportunity to present their projects to tell how they come up with their projects (TD, SSI2, 23 May 2013).

TM mentioned that successful learners need to be nurtured and be given bursaries to study so that they can be incorporated into the science and technology industry.

> Attach that learner to companies so that during the holidays the learner can now actually practise the innovation on a larger spectrum. Let say someone has done very well in the motor industry, that learner should be attached to a company which assembles vehicles (TM, SSI3, 24 May 2013).

TN indicated that learners normally used to receive prizes and scholarships to study science.

> I think that is a very good motivating factor for learners because most of the learners that we teach actually in the location, financially they are unable to go to University. But if they know that by being involved in the Science Expos we can actually have an opportunity to get scholarships where we can study and do science the way we want to. I think that is a very motivation factor (TN, SSI1, 4 March 2013).

The three teachers emphasised that there must be a way of following up on those learners who win and encourage them to continue researching on their Science Expo topics while studying at university.

4.19 Concluding remarks

In this chapter I presented the interview data from the educators which highlighted the motivations of teachers and learners to participate in Science Expos; educators' and learners' enablers and challenges in their participation in Science Expos; Science Expos judges; the quality of learners' projects; successful projects and learners; the importance of science educators and learners participating in Science Expos; strategies used for motivating learners. It concluded with teachers' perceptions of learners' participation in Science Expos and towards sciences as a subject.

The learners' data are presented in the next chapter.

CHAPTER 5: DATA PRESENTATION (LEARNERS)

> *They are using laptops; we are using boxes': township learners' conceptions of Expo. ...There is a discrepancy in access to resources between learners from well-resourced private schools with involved parents and learners from under-resourced township schools whose parents are usually peripheral to the process* (Taylor, 2011, pp. 67-69).

5.1 Introduction

The data sets presented in this chapter are from the focus group interviews conducted with learners who have been participating in Science Expos and those who participated for the first time in 2013 as well as individual semi-structured interviews with two learners who have participated in National/International Science Expos. Some of the data sets presented are derived from observations of learners' workshops. The chapter starts with a description of the learners' profiles and then presents the data according to the identified themes which are in line with the research questions.

5.2 Learners' profile and other codes for educators, learners and interview used in this chapter

In this section I present the learners' profiles (Table 2) which I obtained through questionnaires and interviews. Pseudonyms and codes have been used throughout the research as follows: Learners (Ls), learner one (L1), learner two (L2), learner three (L3), learner four (L4), learner five (L5), learner six (L6), Teacher Dalia (TD), Teacher Melk (TM), Teacher Noye (TN), SAEON Science Expo Coordinator SEC2 , SciFest Science Fairs/Expos coordinator (SEC1), University lecturer 1 (Lt1), University lecturer 2 (Lt 2), and Workshops (WS), focus group interview one (FGI1), focus group interview two (FGI2), Semi-Structured interview one (SSI6) and Semi-Structured interview one (SSI7).

Table 2: Learners' Profiles

Learners' code	Gender	Age	Grade	School	Subjects/field	Participation
L1	F	15	9	1	Natural Sciences, Mathematics, Economic Management Sciences	First time
L2	F	15	9	1	Natural Sciences, Mathematics, Economic Management Sciences	First time
L3	M	17	11	2	Physical Sciences, Life Sciences, Mathematics & Accounting	Participated from 2012 and went to National/International in 2013
L4	M	15	11	3	Physical Sciences, Life Sciences. Mathematics & Geography	Participated from 2011and went to National/International in 2013
L5	M	16	11	5	Physical Sciences, Life Sciences, Mathematics & Geography	Participated from 2009 and went to National/Internationals in 2011 & 2012
L6	M	16	12	6	Physical Sciences, Life Sciences, Mathematics & Economics	Participated from 2011 and went to National/Internationals in 2011 & 2012

The profile above shows the six learners, four boys and two girls from four townships and one boy from a former Model C school, in Grahamstown, South Africa. The girls who jointly entered a project participated for the first time in 2013 and their project did not go on to the National/International Science Expo. The two boys who participated in 2012 also did not go on to National/International Science Fairs. However, in 2013 their projects were successful and have been chosen to participate in the National/International Science Expo. The other two boys participated in Science Expos and went to National/International Science

Expo in 2011 and 2012. One of the boys received a bronze medal at the National/International Science Expo.

All these learners do science subjects at their schools and they indicated that they really want to participate in Science Expos to learn more.

The data sets are divided into the following categories in line with the research questions:

- Learners' perceptions of Science Expos;
- Learners' experience of participating in Science Expos;
- Science Expos in schools;
- Learners' challenges in participating in Science Expos;
- Successful Science Expos projects and successful learners;
- Science Expos and the promotion of the understanding of scientific investigations in classrooms;
- Learners' projects and presentations; and
- Motivation and support for learners.

5.3 Learners' perceptions of Science Expos

Learners had varied understanding of Science Expos depending on their level of participation. By the level of participation in this context, that they were a mixed group in terms of attending Science Expos as described above.

L1 who participated for the first time indicated that the purpose of Science Expos is "*mostly to educate kids about science, prepare their minds and get ideas on what they know more about science, what they learnt and what they want to know*" (L1, FGI1, 19 July 2013). In addition, L2 said that "*to see the talent that we might get from science projects*" (L2, FGI1, 19 July 2013).

L3 and L4 indicated that Science Expos expose learners to many new things in science because they discovered things that they never knew (L3 & L4, FGI2, 20 July 2013). L5 and L6 understood Science Expos as intended to develop science learners as future scientists (L5 & L6, SSI 6 & 7, 23 August 2013 & 01 September 2013 respectively).

Projects are the main driver of participating in Science Expos, and learners felt that projects gave them insights into what real science is and become more interested in science. Furthermore, L3 said that doing projects,

> Gives you any experience of how really things are out there and projects take you through the steps of how you approach things in science, how you investigate things in science and how you determine them (L3, FGI2, 20 July 2013).

In addition, L4 said that, *"projects help us to have potential to make things that can be available to people and to the environment and give power to know that we contribute and have done something in life"* (L4, FGI2, 20 July 2013).

L1 mentioned that:

> I did not know all about science, how to do a Science Expo project and what to have in the project and if we can do many things. So, right now through seeing other learners' doing projects I really learnt a lot. At first I was not really into science, I was only doing science as part of the school work, now I want to discover new things and learn more from what other people do. I am thinking about studying science in future (L1, FGI1, 19 July 2013).

Most of the learners in this study indicated that at first they were scared of not winning during the Science Expos as their knowledge of science was limited. According to L1 and L2,

> I did not know whether we will win or we were going to lose because I did not know all about sciences, how to do a science project and what to have in a science project, I was not really interested and I was not really into sciences at that time (L1, FGI 1, 19 July 2013).
>
> I did not know if I could do such a huge project (L2, FGI1, 19 July 2013).

In addition, L5 said that, "*I did not know Science Expos till grade seven, my science teacher introduced it to us, is when I started liking Science Expos since..... When people started entering, I also started liking science; the prizes attracted me*" (L5, SSI6, 23 August 2013).

I was fearful that I will not fit to the environment since I was not used to many people (L6 SSI7, 01 September 2013). L5 further stated that,

> This year I had a feeling before the Expo that I will not win anything because I did not start earlier with my project, because I could not think about any idea throughout the year. I only had three weeks to do the survey; last year when I won I started early (L5 SSI7, 23 August 2013).

Learners indicated that through participating in Science Expos, they gained a lot and have insight of scientific investigations and were exposed to how to do projects, "*I discovered things that I never knew myself*" (L3, FGI2, 20 July 2013). L4 said that, "*I am not afraid to do the project now, I am not afraid to give my ideas and make the other person understand my visions*" (L4, FGI2, 20 July 2013).

Some learners explained that at their schools Science Expos were not regarded as important because they are the only ones who participate. They also only heard about Science Expos from their friends and family members. They further indicated that most learners in their schools are not aware of Science Expos because there were no workshops conducted at their schools for motivating learners.

L5 who participated at the National/International Science Expo mentioned that not many learners at his school do participate because they think that, "*Science Expo is not really a big thing, not really many people who participate, our school is a sporting school, many people are doing sport and do not have time for Science Fairs/Expos*" (L5, SSI6, 20 July 2013).

Some learners (participants) indicated that they were nervous in the beginning especially knowing judges might ask questions that they could not answer correctly and give the clear answer that the judges wanted.

For instance, L3 stated that:

> My fear was when judges asked me a question and I was like I do not have an idea about it and that automatically could turn me down, I was a bit nervous about those kind of things (L3, FGI2, 20 July 2013).

Learners who participated for the first time stated what they heard from other learners that sometimes the judges become really serious which made them scared especially if one plagiarised then they would be disqualified.

> I had a fear of being disqualified, I have been actually reading a booklet that were given and said if judges saw that you plagiarised automatically you are disqualified that let me know that if I take something from the internet then I should reference it and acknowledge the author or the internet site where I took the information (L2, FGI1, 10 July 2013).

5.4 Learners' experiences of Science Expos and projects

Learners were asked about their experiences of Science Expos. L2 indicated that "*I found out that science is not bad, I want to be a scientist, in doing science you actually discover new things in everyday life and learn more*" (L2, FGI1, 19 July 2013). Almost all the learners in this study felt that it was not easy to do Science Expo projects because of time constraints as they have other school work to do.

L1 said that her experience was a bit challenging but "*is also good to work on the project that you do not know about and you find information about it*" (L1, FGI1, 19 July 2013). L3 who has been participating in Science Fairs/Expos said "*it is really hard to work on the project; it is much easier to say I will do this and that when it comes to the doing that is the difficult part though it taught me a lot and be exposed to do a project*" (L3, FGI2, 20 July 2013).
L4 who has also been participating in Science Expos indicated that "*I gained a lot, I like the experience I got, I was a boss for my project, and I controlled everything that I did. It is a fun moment even though I did not win the other year*" (L4, FGI2, 20 July 2013).

L5 and L6 who participated at National/International Science Expos indicated that they enjoy Science Expos. They felt that it was an amazing experience and they got an opportunity to socialize with other people, make friends and learn from other people and experiences (L5 & L6, SSI6 & 7, 23 August 2013 & 01 September 2013 respectively). L5 indicated that,

> I did not win for the first time, I was not confident when I participated for the first time. As I was a young student when I entered the Expo with a small poster in grade 7, among the grade 9s, 10s, 11s and matrics. So, you already start getting scared hearing

> big words they were saying, in grade 7, I did not really know sciences; you only know basic science (L5, SSI6, 23 August 2013).

L5 further indicated that this year he was sure that he would not go to National/International Science Expos because "*I did not present my project the way I should have done it, I was having too much information and did not know how to reflect it to the judges as well as not sure of things that I wanted to do*" (L5, SSI6, 23 August 2013).

L1 and L2 who participated for the first time said that even though they did not win, they will still participate next year and put in more effort in order to win. "*We were told that we should start earlier since we started a bit late we did not have enough information thus why we did not win during the Science Expo*" (L2, FGI1, 13 September 2013). Their experiences were indicative of the fact that Science Expos arouse learners' interests to pursue science related careers especially with learners in grade 11 who have obviously already made the choice to study science subjects.

Learners were asked about their experiences of the Science Expos' judges. Most of the learners revealed that the Regional Science Expos judges were supportive and they indicated that they liked the way judges criticised them so that they could learn from the criticism. L1 and L2 who participated for the first time indicated that;

> When I was waiting for the judges I was nervous, I thought they were that serious, but they were good people. When they came to us they started reading our project and we told them about our project, they told us what we needed to improve on. The comment they gave us was that it was good and inspiring (L1, FGI1, 13 September 2013).

L2 indicated "*they were like advisors not judges, we expected judges to be harsh*" (L1, FGI1 13 September 2013).

Both L5 and L6 had participated at National/International Science Expos. In contrast to L1 and L2, L6 indicated that:

> The judges were different at Regional Science Expos they were not supportive comparing to National Science Expos, because when they noted an error they did not give you any advice on how to go about fixing that error. Their comments, however,

were motivating a lot because they were helping to improve on our projects (L6, SSI7, 01 September 2013).

According to L5,

> At Regional Science Expos compared to National/International is like they criticise which is very good so that you can learn from the criticism. You can benefit from criticising because sometimes if they only saying your project is good you cannot learn anything, they pin point on anything and make you think about your projects (L5, SSI6, 23 August 2013).

5.5 Science Expos and schools

Learners participate in Science Expos on a voluntary basis through their schools. The Science Expo coordinator (SEC1) sends information to schools regarding the Science Expo that needs to be passed on to the learners (SC1, personal comm., 19 April 2013). In the Grahamstown District, there are twenty-four schools altogether; twenty-one are public schools and three are private schools. In 2011 and 2012 twenty schools participated in Science Expos (Grahamstown Regional Science Expo Database, 2012).

In 2013, a large number of learners who participated in the Regional Science Expos were from urban schools. Some schools had more learners who participated compared to other schools, and some schools did not participate at all. Some learners indicated that their schools neither organise workshops nor arrange time to motivate learners to participate in Science Expos to support them with their projects. Apparently, one of the township schools had around 16 learners who wanted to participate and only about eight learners participated in the Regional Science Expo this year. Some learners did not finish their projects as they were far from completing them.

Learners indicated that some schools/learners do not participate because they are not inspired or have never heard about Science Expos. To this end, L4 commented,

> I did not get that much support from my school I got only few support from one teacher instead of my science teacher I was helped by another teacher at the same school, I did not have that relationship of working with my science teacher (L4, FGI2, 20 July 2013).

In contrast, L3 indicated that "*our school principal is very supportive in terms of involving in such programme, she organised workshops to encourage us to enter Science Expos at our school*" (L3, FGI2, 20 July 2013). At this school, it shows that the principal is the one who motivates learners to participate and not the science teachers.

In addition, L5 said "*you get help from the teacher but you have to do it mostly on your own time*" (L5, SSI6, 23 August 2013). L1 and L2 indicated that at their school there is only one science teacher who helps them with their projects, adding that "*our teacher has been a huge help*" (L2, FGI1, 19 July 2013) and she told us that "*if you do these projects there will be lots of opportunities in life and you can learn a lot of things from doing these projects and you can be independent*" (L2, FGI1, 19 July 2013). L1 indicated that:

> My parents helped me a lot with buying me the equipment like seeds and the pot plants....They also help with extra information and printing. They take us to the internet cafe in order to print our project and so they were a huge help (L1, FGI1, 13 September 2013).

L2 said "*my parents encourage me a lot even though there were challenges to make me stop, but they also helped me with money that I needed to print out the information*" (L2, FGI1, 13 September 2013).

L3, L5 and L6 indicated that they are the only ones from their schools who participated in Science Expo this year, while the other learners said, "*we are about ten this year*" (L3, FGI2, 20 July 2013). L6 indicated that,

> I am the only one at my school and I received positive comments from people at our school congratulating me on the participation that, I am a good example to others (L6, SSI7, 01 September 2013).

Some learners mentioned that when they first participated they heard about Science Expos from their friends that were attending different schools. L3 indicated that

> I heard about Science Expos first from a friend, that there is such a thing and you might want to join. At that time my friend had participated in Science Expo before. He told me about this and I said, is quite interesting and then I entered (L3, FGI2, 20 July 2013).

> I heard about Science Expos from my cousin who is right now at the University and she also participated and had won first prize at Regional and gold Medal at National Science Expos (L6, SSI7, 01 September 2013).

Some of the learners indicated that they were motivated to participate and supported to carry out their projects by their teachers, SEC2, L1 and SEC1, friends and parents. L5 indicated the way his parent supported him that,

> My dad really gives me advice like, if you do want science and you can do projects and have time to work on that is really good. He helped me with everything, like testing things, like when I do experiments I get things that I needed basically when I was typing my stuff I usually use his computer no matter what time it is, sleeping at 1 and 2 o'clock. (L5, SSI6, 23 August 2013).

In contrast, L6 commented that,

> I live with my grandmother and she does not understand about Science Expos or anything which has to do with science. She does not even ask me to explain to her what it is. I usually go to one of the lecturers at Rhodes University and then I speak to him or to SEC2 at her organisation (L6, SSI7, 01 September 2013).

SEC2 is one of the Science Expo coordinators in Grahamstown, and she organises Science Expos workshops for learners specifically from the township. This is a group of learners which attended the workshops and hence constituted a community of practice (CoP) (see Section 2.8.1). These learners call themselves the SciExpo Stars. Together with SEC2 from SAEON, TD and Lt1 motivated them to participate and gave them support on their projects.

L1 and L2 said that apart from SEC2, their parents also helped them. Learner 3 pointed out that;

> My teacher, SEC2 supported me and Rhodes University lecturer 1 who inspired me and first told me that if you participate in Expo programme you will get experience and is what I got. So, I would like to thank Lt1 and my parents were so much supportive (L3, FGI2, 20 July 2013).

L4 revealed that

> My Geography teacher, Rhodes University Lt1, SEC2 whom I worked very close with her and my friend too motivated me since they could not make it, so they encouraged me to go forward with it (L4, FGI2, 20 July 2013).

5.6 Learners' challenges in participating in Science Expos

In this section I present the challenges that learners experienced in their participation in Science Expos.

Generally, as in most cases in life when one wants to do something for the first time one starts off being nervous. Some people can get discouraged in the process while others encourage themselves to proceed or carry on. From my experience, it is natural to be nervous. L1 indicated that she feared losing and she encouraged herself by saying that,

> In life you actually fall in order to pick yourself up, maybe if we are not going to win it will motivate me more to do another one next year in order to win (L1, FGI1, 19 July 2013).

The learners who participated in Science Expos indicated that they experienced some challenges. L1 and L2 participated for the first time and they found out that at their school there were other learners who did similar projects but different topics to theirs. So, it was difficult for them to focus on their projects so that it would not be the same as the other projects. To this end, L3 indicated that,

> My experience of doing my project, things never turned around when you expect them to be. Lots of things are happening and I was also like should I give up now or should I not, it was very difficult. I faced the challenge of typing; it took me three hours to type only one page (L3, FGI2, 20 July 2013).

L4 said,

> My challenges were on resources that I needed. I do not have money or computer and also the data I got I could not find a way to analyse them. I did not get more support from my school and some of the learners from our school discouraged me that, I should not come to Expo, I will embrace our school, they were like you will lose, you will fail (L4, FGI2, 20 July 2013).

Furthermore, L6 said, the standard of the competition was very high, "*I did not have correct resources to carry out the science project experiment*" (L6, SSI7, 23 August 2013). He also indicated that, some of his school mates were saying it was a waste of time to participate in Science Expos, where he could not get anything out of it. To this end he commented that "*I have proved them wrong*".

L5 who participated at the National/International Science Expos indicated that it was not easy to finish the project, "*there is nothing hard like having a lot of information*" (L5, SSI6, 23 August 2013). He also indicated that the collection and analysing of information was really difficult. All learners indicated that time constraints were one of their challenging factors.

Learners raised some of the challenges that constrained other learners who never participated in Science Expos. L3 said "*some learners think they are from poor background and they do not have money for resources*" (L3, FGI2, 20 July 2013). L4 urges that,

> They do not get inspirations from others and they lack motivation, other learners are not aware of this as I was. I would like to say that the teachers should be engaged with the Science Expos" (L4, FGI2, 20 July 2013)

Furthermore, L4 mentioned that,

> …but we were three but others could not reach to finish their projects because of other programmes to attend to and that programme is very much demanding and needs hundred percent attendance (L4, FGI2, 20 July 2013).

5.7 Science Expos projects and promotion of the understanding of scientific investigations

Before learners participate in Science Expos, they are expected to carry out projects that they would present at Science Expos. They carry out those projects at school, after classes, in the afternoons or at home.

Similarly, in their schools learners are expected to carry out scientific investigations and projects as stipulated in the National Natural Sciences Curriculum Statements (2011). All these scientific investigations and projects have to follow the scientific methods such as identification of a problem, hypothesis, methods, and data collection, analyse and interpret data and conclusion (Eskom Expo project guide, 2013). Therefore, the projects are essentially scientific investigations.

Learners were asked if those who were participating or have participated in Science Expo have improved their understanding of scientific investigations and if their participation influenced their perceptions of science as a subject.

L1 who participated for the first time responded that,

> Yes they do, I think they improve a lot because before we actually started with this project we were chatting to them on how to do science projects, how do we expect the judges to be and they told us everything they can (L1, FGI1, 19 July 2013).

L2 who also participated for the first time stated that,

> They show to understand because they have a booklet about Science Expos, they read more and they knew more and they told us things we did not know and we also learnt a lot from their understanding (L2, FGI1, 19 July 2013).

L1 and L2 who participated for the first time had a follow-up interview after they had participated in the Regional Science Expos. They were asked if Science Expos improved their understanding of scientific investigation/Sciences in their classroom. L1 responded that:

> It has helped me because when we were at Science Expos while the top five learners were presenting their projects, I actually learned a lot and the information I got whenever I wrote a test I easily realise that somebody mentioned something like that which is similar to that and compare those and what I was writing in the test (L1, FGI1, 13 September 2013).

L2 indicated "*we were given also to research on different types of metals, this was easy to do as well as we were recalling the scientific procedures*" (L2, FGI1, 13 September 2013).

L3 said that, "*Yes, it has showed me how to carry out investigations, I see by doing it, like science is everywhere, my project was just a small project but it ended up being more and bigger project*" (L3, FGI2, 20 July 2013). L4 explained that,

> I have a better understanding now, I understand science much better now, getting my own topic and has to be original, write the prediction and do your methods, get your results and have to record them down, discuss the result and challenges and when you read the article or Google you have to write references (L4, FGI2, 20 July 2013).

L5 stated that,

> Yes, I know how to set up a project and investigations to a standard of national. Every time we do our investigations my marks have improved. It is really benefiting me especially in the section that my project involves science, and I am learning more from that area of science (L5, SSI6, 23 August 2013).

L6 indicated that,

> Yes it has, it helps me in terms of following the correct methods when doing projects and scientific investigations, it improved my performance in sciences and made me choose science subject at grade 12. Furthermore, my cousin has been participating and now she is right now at University doing science (L6, SSI7, 23 August 2013).

5.8 Motivation of other learners who never participate, successful learners and successful projects

This section presents ideas on what needs to be done to motivate other learners to participate in Science Expos; what needs to be done with the successful projects after the science Expos and what needs to be done with the successful learners after the Science Expos. In this case successful projects or learners, means the projects or learners that won either during the Regional or National/International Science Expos.

5.8.1 Motivation of other learners who never participate in Science Expos

Learners indicated that there are some science learners who never participate in Science Expos because they are not motivated or have never heard about Science Expos. "*So, there is a great need for them to participate because they will become more interested to study science further"* is mentioned by L1. Another reason is that they will learn more and gain skills in scientific investigations that they can apply in science classrooms as the curriculum requires.

Learners tried to give ideas on what should be done to motivate other learners to participate in Science Expos. L1 stated that,

> To advertise the Expo like in our communities, other children need to be motivated to join, maybe to show out by taking our projects and posters to show to community just to give an idea to other kids (L1, FGI1, 19 July 2013).

L3 mentioned that,

> I think lots of the Science Expo workshops should be carried out in our townships, the procedures of doing science projects and what Science Expo is all about. Most of the learners are not aware of this as I was (L3, FGI2, 20 July 2013).

L4 responded that,

> I think instead of hosting only one Regional Expo, it could be made possible to have school Expos so that we can learn from experience. The people who are Expo Directors should visit the schools to inform the learners and how to benefit them as individuals later in life (L4, FGI2, 20 July 2013).

L5 and L6 explained that other learners need motivation from the teachers. Furthermore, the school itself should support Science Expos. That is, there should be time arranged at schools for those who want to participate. They further emphasised that the school should organise people or ambassadors of Eskom Expos for Young Scientists to conduct workshops at the schools.

5.8.2 Successful Science Expos projects

Every year learners present their science projects at Science Expos; some are successful and win medals and prizes at Regional and National/International Science Expos. The question that then arises is: what should be done with those successful projects after the Science Expos?

Learners explained that normally the top five finalists in the Science Expo present their projects to other participants during the Fair for the judges to decide on the first prize. The presentations are intended to help other participants to carry out or improve their projects. Unfortunately, learners who did not attend would lose out. Thus some learners suggested that the science projects be kept at a special place for reference purposes. The projects could be kept at schools so that people, even those not involved in Science Expos, might learn from them.

L3 said that information provided by the projects should be applied, while the solutions they offer should be evaluated. L4 indicated that the projects' ideas should be:

> Improved and make it reality and be enlarged. Invest money to improve the projects and make it long term projects that can benefit people. Moreover, the projects can be used to present to others who never been successful with their projects and motivate others. (L3, FGI2, 20 July 2013)

Learners who participated in National/International Science Fairs indicated that at this level there are usually private companies with special judges who occasionally buy learners' ideas and further build on those ideas: " *it is good to take Young Scientists' ideas and be expanded and will benefit everyone*" (L5, SSI6, 23 August 2013). L6 said, "*I think the projects can be taken to the companies where those projects are relevant and adapt the process of making those projects*" (L6, SSI7, 23 August 2013).

5.8.3 Successful learners at Science Expos

This section discusses the experiences of learners whose projects were successful in Science Expos. What should be done with the successful learners after the Science Expo? I was prompted to ask this question to understand learners' views on the purpose of Science Expos. Do Science Expos motivate learners to pursue science in future, or do the learners merely see it as a competition?

L1 said "*I think they should be given bursaries and scholarships. They should tour around South Africa. They can be used to teach other people from other places*" (L1, FGI1, 10 July 2013). In addition, L2 suggested that "*successful learners should get prizes and recognition because they did a lot*" (L2, FGI1, 19 July 2013).

Some learners emphasised that successful learners need to be supported, guided, encouraged to do more, inspire others and act as role models, with someone monitoring their progress (L3 & 4, FGI2, 20 July 2013). According to L5 (SSI6 23 August 2013), "*the private companies instead of buying the ideas should hire that person to work with them and improve the projects and make it practical and bigger*". L6 added that "*I think those learners can be admitted to Universities after matric*" (L6, SSI7, 23 August 2013).

5.9 Participation in Science Expo's workshops

Observation was my third data-gathering technique. I observed three Science Expo learners' workshops that were organised by SEC2 from South Africa Environmental Organization Network (SAEON), and two workshops organised by the Scifest office. I also watched a video of two workshops for learners who went to an International/National Science Expo, also organised by the SciFest office.

The codes used in the table below are as follows: SAEON Science Expo coordinator (SEC2), teacher Melk (TM), teacher Dalia (TD), teacher not a research participant (TX), lecturer1 (Lt1), judges (Js), workshop (WS), SciFest Science Expos coordinator (SEC1) and Learners (L1, L2, L3, L4, L5 & L6).

Table 3: The context of the workshops observed

Workshop	Date	organizer	Time	Participants Attended	Venue	Aim
WS1	06/03/13	SC2	Wednesday Afternoon	Ls, Lt1, TD & TM	X-organisation	Motivate Ls
WS2	21/04/13	SC2	Sunday Afternoon	Ls, Lt1, TM	School 4	Ls to present their project ideas
WS3 Video	20/05/13	SC1	Monday Afternoon	Ls, TD & Tx	School 3	Motivate & guide
WS4	03/07/13	SC2	Wednesday Morning Holiday	Ls, D, Lt1	Lodge	Prepare Ls for Regional Science Expo by discussing & presenting projects.
WS5	19/07/13	SC1	Friday Morning	Ls, Js, SEC2, TD	Chemistry Department	Showcase projects at Science Expo event
WS6	19/08/13	SC1	Monday Afternoon	Ls	Scifest office	Preparation for National/International Fair

The workshops were conducted in the afternoons during the week and weekends so that they did not interfere with normal teaching activities. But I could not attend some of the workshops. The workshops were well attended by learners whereby the science coordinators and teachers motivated them by explaining the importance of the Expos and indicating the rewards for winners, such as bursaries and other prizes.

Furthermore, learners were briefed on what Science Expos were all about, how they could come up with topics for their projects, and how to structure their projects. The different components and categories of the projects were also explained to the learners, and organisers made sure that they were familiar with the project guide. By attending the workshops, learners got ideas for developing their projects and got to know other learners who were participating in the Science Expos.

Figure 1: First Science Expo Workshop (Community of Practice)

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WS2 was held at school 4 for TM who participated for the first time. During the workshop learners presented their project ideas and what they had done so far. Educators and learners gave feedback to the presenters on how they could improve their projects. From the comments and discussion, learners gained ideas on how they could improve their projects.

WS4 took place outside of Grahamstown at a Lodge, as an alternative learning Environment. This occurred during the holidays and was well attended by 13 learners from three schools.

The workshop was aimed at developing their scientific investigation skills. Learners presented such progress as they had made with their projects, while educators and learners made comments and posed questions to the project presenters.

WS5 was the Eskom Expo which took place at the Rhodes University Chemistry Department. Learners who had managed to prepare sufficiently participated and exhibited their projects. Learners were split into two rooms where they presented their projects. Teachers and lecturers judged the learners' projects. There was a difference in the appearance of the display boards of learners from private, former Model C and township schools. For instance, the display boards of learners from private schools and former Model C schools were colourful compared to some projects from the township schools.

Figure 2: A project from a township school

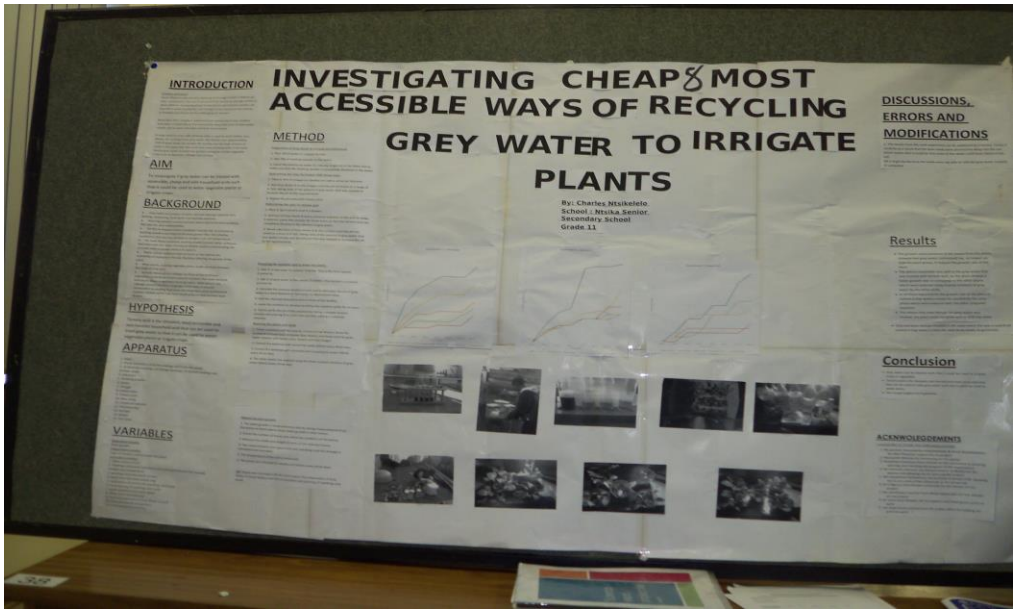
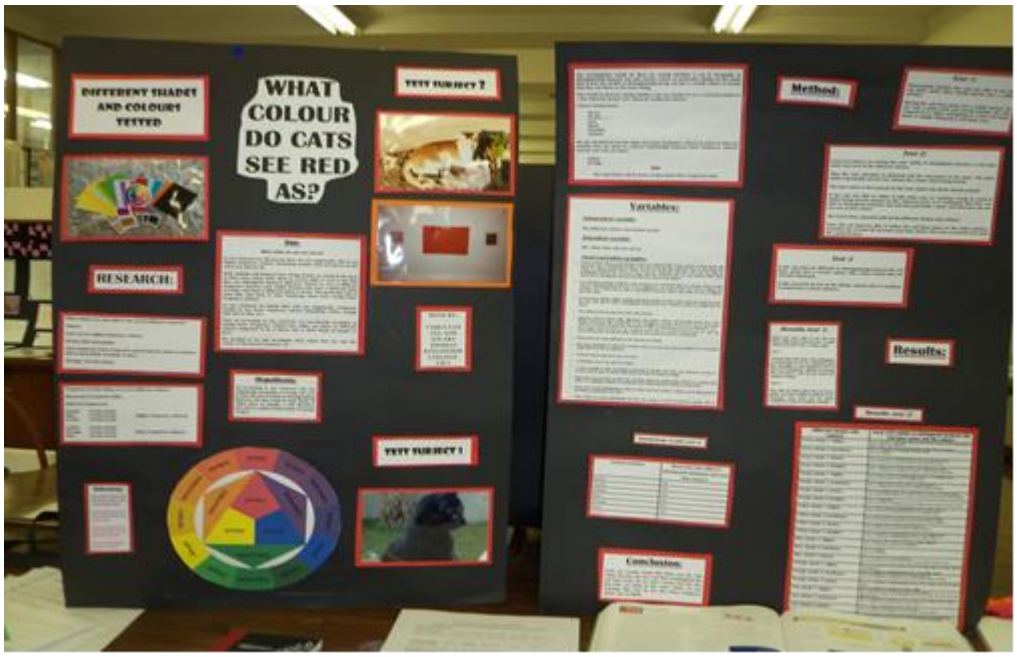


Figure 3: A project from a former Model C or Private school



Learners were awarded a variety of prizes ranging from trophies to medals. Two learners from township schools and who were involved in the SciExpo Stars project were selected to go to the National/International Science Expo in Pretoria.

Figure 4: Learners' projects displayed during the Regional Science Expo 2013

WS 6 was held to prepare the top ten Regional Science Expo learners for the National Science Expo. WS 6 took place at the Scifest offices and was conducted in the afternoons

over a week. Learners attended the workshop and received individual help. The coordinators from SciFest shared the tasks: one was busy discussing and guiding learners with their projects to make sure they were up to standard, while the other coordinator helped learners to display their projects according to the design set out on the floor of the room.

The aim of all the workshops was to motivate and support learners, and for them to meet with other learners and educators to share ideas or knowledge about Science Expo projects. This was a community of practice for both educators and learners who were participating for the first time and those with experience of National/International Science Expos. Some of these learners were thus at the peripheral (Lave & Wenger, 1991) stage, while others were actively participating. When they regularly met during these workshops, knowledgeable educators and learners assisted those who were participating for the first time. The latter were supported when presenting their projects, while and at the same time learning from those who had participated in previous years.

5.9.1 Learners' projects and presentations

Learners' projects displayed most components of the research done, for example, background, methodology, presentation of the findings and references. Learners presented their projects well and felt free to share and contribute to each other's presentations by giving suggestions, comments and asking questions that prompted others to think about ways of improving their projects. L5 indicated that:

> It is always good to have a room to improve the project. The favourite part of it was that learners give each other input instead of only judges giving you input, but someone of your age giving you input is good, I learned some of the things that I never thought about ever, there were lots of good ideas and had science on it, everything had science in it, they really investigated science. Most of learners' projects are trying to solve problems in their communities, for example, how they can recycle used water to irrigate plants (L5, SSI6, 23 August 2013).

5.9.2 Learners' motivation and support

Learners receive motivation and support from different offices/people such as SEC1, SEC2, some teachers and Lt1. They get support through attending the workshops and presenting their projects. For instance, SEC2 provided them with Compact Discs (CD) on which to save their project write-ups, and explained to them how to use the CDs. They were also encouraged and supported when they were taken to a new environment to present their projects.

However, I observed poor participation on the part of some teachers. Most of the learners who attended the workshops were not accompanied by their teachers and seemed to lack support from their schools. I compared the number of schools which were participating with the number of teachers – only one or two – who attended the workshops. I was hoping to see more teachers participating so as to be in a position to support their learners back at their schools.

The presence and involvement of the lecturer at learners' workshops motivated them to participate. Some learners indicated that if they were in need of materials they would go to Lt1 or Lt2. Likewise, SEC1 and SEC2 support learners with resources such as display boards to showcase their projects during the workshops and during Regional and National/International Science Expos. They also assist them with the printing of their project reports.

5.9.4 Good examples of supporting and motivating learners' projects observed

SEC2 invited learners from township schools with only a few would-be participants to attend a motivational workshop at SAEON, while conducting workshops at schools which had more than ten learners who wanted to participate.

SEC2 provided learners with materials such as CDs and made regular contact with them just to keep in touch. She organised workshops, some outside of Grahamstown, to arouse the learners' interest in participating in Science Expos and take them out of their regular context.

SEC2 tried to involve interested teachers and Rhodes University lecturers to motivate and guide learners.

SEC1 initially organised workshops for teachers only, but realised that it was better to conduct learners' workshops because some teachers did not bother to share the knowledge they had gained with learners once they had attended the workshops (SEC1, pers. Comm. March 2013). Learners were also free to go to the SciFest offices to get support for their projects.

5.9.5 Learners' challenges observed

I observed that although some learners were pairing up when presenting their projects, they did not appear to have a strategy for sharing their project work load. I also noticed that when learners were presenting their projects, one would often know the project procedures better than the other. This situation might mean that only one learner did the project because they were from different neighbourhoods and did not get time to prepare their project together.

The other challenge is the lack of resources. Although SEC2 gave them CDs, some learners ended up not using them because they did not have access to computers to type their projects. Some did not have posters to present their projects, nor cameras or mobile phones with camera to take pictures when they were carrying out their projects, which led to their project presentations being of poor quality.

Some learners found it difficult to identify a problem that they wanted to solve, while others struggled with the graphs that were ostensibly a significant part of the project. Some found it difficult to manage their time so as to carry out their projects at the same time as doing school work. As a result, some learners could not complete their projects.

5.10 Concluding remarks

This chapter presented data from the interviews and observation of workshops. I discussed learners' perceptions and experience of their participation in Science Expos; learners' challenges of participating in Science Expos; successful Science Expos projects and successful learners; Science Expos and the promotion of the understanding of scientific

investigations in classrooms; learners' projects and presentations; motivation and support for learners;

Discussion and analysis of the data are presented in the next chapter.

CHAPTER SIX: DATA ANALYSIS AND DISCUSSION

> *To display the data is certainly important; the interpretation of the data is the essence of the research. Without inquiring into the intrinsic meaning of the data, no resolution of the research problem or its sub problems is possible* (Leedy & Ormrod, 2010, p. 295).

6.1 Introduction

As noted in the previous chapters, this study investigated educators' and learners' perceptions and experiences of their participation in Science Fairs/Expos in Grahamstown, South Africa. In this chapter, I analyse and discuss the findings presented in chapters four and five, in relation to the literature reviewed in Chapter Two. A variety of data-gathering techniques was used, including document analysis, interviews and observations, in order to provide answers to the following research questions:

- How do science educators and learners perceive participation in Science Expos?
- What are the educators' and learners' experiences of participation in Science Expos?
- How are science educators and learners motivated to participate in Science Expos?
- What challenges do science educators and learners experience in participating in Science Expos?
- In what ways do science educators and learners deal with the challenges they are faced with in participating in Science Expos?
- How can science educators and learners improve participation in Science Expos?
- In what ways do science educators' and learners' experiences of participation in Science Expos influence their understanding of scientific investigation?

The analysis is presented in terms of six themes, as shown in the table below.

Table 4: Shows the themes discussed in this chapter

Theme	Research questions
1. Educators' and learners' perceptions and experiences of Science Expos	1, 2, 3, 4, 5 & 6
2. Motivation and support of educators and learners in or to participate in Science Expos	3 ,5 & 7
3. Science Expos judging	1 & 2
4. Challenges of participating in Science Expos. (Lack of motivation, lack of resources, time constraints, insufficient support, lack of knowledge in learners' projects and quality of projects.)	1, 2, 4 & 7
5. Successful (winning) learners and projects	1,2,3,4,7
6. Participation in Science Expos and the promotion of the understanding of scientific investigation (and potential to pursue science-related career)	1, 2 & 6

6.2 Educators' and learners' perceptions and experiences of Science Expos

Some educators understand that the rationale for Science Expos is to empower learners to become independent scientists or investigators. This involves learners' independently identifying a problem in the community and trying to solve it. This view is supported by Blair (2003), who observes that Science Expo projects are independent education activities that include a range of skills, many of which learners have to teach themselves as they go along (see Section 2.3). Some educators also said that Science Expos encourage learners to pursue science-related careers and get involved in research and innovation. Science Expos are also intended to arouse learners' interest in science.

In contrast, the learners had rather different understandings of what Science Expos are about, depending on how many times they had participated in Science Expos.

Learners who were participating for the first time understood Science Expos as intended to educate and prepare learners' minds for scientific thinking (L1). Science Expos were also perceived as aiming to find out what ideas learners had about science and what they wanted to learn through scientific investigation. This concurs with Thomson's (2012) view that scientific investigations provide opportunities for students to connect their knowledge, experience and interest with the subject (see Section 2.4.1), whether obtained in the science classroom or arising from their prior everyday knowledge.

Some of the learners who had participated before in Science Expos said that Science Expos aimed to groom science learners as future scientists (L5, see Section 5.4). Furthermore, Science Expos exposed learners to many aspects of science, not just content knowledge gleaned from textbooks but actual physical involvement in the various steps of approaching and investigating things in a scientific way (L3). Through working on their projects, learners gained skills that might prove useful when they embarked on their own research projects at university and after. Some learners said that it was good to work on a project that involved searching for information (see Section 5.4).

L4 indicated that "*I gained a lot, I like the experience I got, I was a boss for my project, and I controlled everything that I did. It was a fun moment even though I did not win the other year*" (see Section 5.4).

The educators' and learners' understanding of Science Expos resonates with the vision of the Eskom Expo for Young Scientists, which is to inspire young scientists and researchers (Eskom Expo for Young Scientist Project Guide Book, 2013) (see Section 2.3). The Eskom Expo aims to develop young scientists who are able to identify a problem, analyse information, find a solution and present the findings (Eskom Expo for Young Scientist Project Guide Book, 2013).

6.2.1 Science Expos are for whom?

Some educators in this study initially perceived Science Expos as being intended for former Model C schools or private schools. That is, they were not aware of the fact that learners

from township schools could also participate. This could be the reason why in the past very few township learners have participated in Science Expos.

For instance, when TD attended a National/International Science Expo for the first time, she noted that it was up to individual teachers or schools to decide whether they wanted to participate or not. There was nothing saying that Science Expos were for former Model C schools or private schools only. Subsequently, TD was motivated to encourage her learners to take part in Science Expos. Windschitl (2004) notes that teachers need to be engaged in scientific investigation themselves so that they can mentor their own learners through inquiry, drawing on first-hand experience and reflection on that experience (see Section 2.7.1).

In essence, it could be argued that Science Expos are intended for all science learners who want to pursue science-related careers, irrespective of their socio-cultural background.

6.2.2 The value of participating in Science Expos

It was important for this study to ascertain the educators' and learners' understanding of the value of participating in Science Expos.

Some educators in this study emphasised that the value of participating in Science Expos lay in the way in which the experience boosted learners' interest in science and gave them insight into how science could be applied in real-life situations. Avargil, Herscovitz and Dori (2012, p. 207) argue that "science education develops learners' scientific literacy and higher order thinking skills" through "learning science in context as well as learning science concepts and processes through dealing with real world problems" (see Section 2.4.2).

Mangena (2007) points out that Science Expos are intended to encourage more youths to pursue careers in Science (see Section 2.3). This was seen when some learners who had participated in Science Expos in the past chose science subjects for further study (TM). Furthermore, the educators in this study said that Science Expos taught learners scientific methods that they could use to solve problems in their communities. This thinking is reflected in the comment made by TN that, "*by doing science projects they actually discover new things that they never knew in everyday life and learn more on what they discovered*" (TN).

These views resonate with the aims of the South Africa Natural Sciences Curriculum Assessment Policy Statement (2011, p. 5), whose mission is to produce learners who are able "to identify and solve problems and make decisions using critical and creative thinking" (see Section 2.2.1). This closely parallels the Eskom Expo for Young Scientists' goal for learners to participate in Science Expos and identify problems, analyse the data, find the solutions and share their findings effectively.

It emerged from the data that learners did not know a lot about scientific investigation from doing classroom science (L2). However, they indicated that when they got involved in Science Expos they learnt how to carry out scientific projects.

According to L1 (see Section 5.4), "*I was thinking about studying science in future*". Furthermore, L2 indicated "*I did not know if I could do such a huge project*" (see Section 5.3). Learners felt proud of the scientific projects that they had done, and these had aroused their interest in studying science in the future.

Tave Verhoef, a winner of the Eskom International Science Fair for Young Scientists (2012), said that she never thought that her simple research project would win and help her make new friends and learn new things (see Section 2.8.1). Moreover, she stated that when she started preparing her research project, it was not all about the prizes but rather about learning new things and broadening her horizons. She expressed what she went through thus:

> Never under estimate your abilities and that hard work really pays off, after many hours of doing and redoing my project I doubted if it was going to be worth it and the answer is 49 million times yes, the lasting friendships I have made, the things I have learnt and the new experiences I have are what I will treasure most from this astounding Expo. (Intel 2012) (see Section 2.7).

Through participating in Science Expos learners in this study indicated that they were now not afraid to share their ideas and help other people understand scientific investigation. "*I was a boss to my project; I controlled everything that I did*" (L4, Section 5.4). Doing "real" science was a strong motivation towards studying science: "*I found out that science is not bad I want to be a scientist, in doing science you actually discover new things in everyday life and learn more*" (L2, Section 5.4).

Some learners in this study initially had a negative perception of science, but subsequently experienced science as "easy" by doing and discovering things for themselves through carrying out science projects. It appears that some of them had gained no understanding of scientific investigation from classroom work as part of their curriculum.

One of the educators maintained that it was important for teachers to be involved in Science Expos and get experience that they can take to their classrooms. The experience that teachers can obtain would help them scaffold (Vygotsky, 1978; Goos, 2004) their learners when carrying out science projects. Also, learners should support one another through collaboration, as highlighted by Goos (2004) (see Section 2.8.1).

For those teachers who were not involved in Science Expos, "*their learners are missing out a lot in so many things*" (TD, Section 4.13). Science Expos are intended to supplement what teachers are required to do by the Natural Sciences curriculum (TN) in terms of learners carrying out scientific investigations. Science Expos help provide learners with the skills they need to thrive in field of science (Intel 2012) (see Section 2.7.2).

To participate in Science Expos provides opportunities for learners "to learn new things, receive awards, improving their grade, have good experiences of science, improving presentation skills and meet new people" (Czerniak & Lumpe 1996, p. 355) (see Section 2.6.2). Learners who participated in this study indicated that they enjoyed Science Expos and the opportunities they provided for them to socialize with other people and gain experience.

Blair (2003) points out that the benefits learners get from Science Expos are scholarships and tuition grants, networking with the best minds in science and exposure to the scientific community. Herein lies the importance and relevance of the community of practice as proposed by Lave and Wenger (1991) (see Section 2.8.1).

6.2.3 Motivation and support of educators and learners to participate in Science Expos

What motivates educators and learners to participate in Science Expos? How do educators and learners get motivated and supported to participate in Science Expos?

Some teachers indicated that they motivated their learners by conducting meetings with them at their schools. Others said that they started by telling learners about bursaries and scholarships that learners could win to further their studies if they participated in Science Expos. Some stated that they made connections with different people, such as professors and scientists from Rhodes University and the Albany Science Museum, who were in a position to help their learners.

This suggests that their learners learned from collaborative interaction with science experts. Through scaffolding by experts learners were enabled to solve problems beyond their unassisted efforts (Vygotsky, 1978; Goos, 2004). Central to the notion of scaffolding is the gradual withdrawal of expert support as the learner comes to understand the task so that he or she can perform more independently.

One educator indicated that he started by talking about the challenges facing people in the communities, for example, global warming, and advised learners to identify problems in their community and try to solve them. Others indicated that they took their learners to Science Expo workshops and events so that they could observe and learn from what other learners were doing.

When learners were asked what motivated them to participate in Science Expos, some said that they had heard about Science Expos from family members (parents, cousins), SEC1, SEC2, Lt1, science teachers and friends. For example, the question – What inspired you to participate in Science Expos? – was answered thus:
Some learners indicated that,

> I heard about Science Fairs/Expos first from a friend, that there is such a thing and you might want to join, at that time my friend has participated in Science Expo before. He told me about this and I said, it was quiet interesting and then I entered. (L3, Section 5.5)

> I heard about Science Expos from my cousin who is right now at the University and she also participated and had won first prize at Regional and gold Medal at National Science Expos. (L6, Section 5.5)

One of the learners stated that:

> I did not know Science Expos till grade seven when my science teachers introduced to us, is when I started liking Science Expos since, my first proper science teacher introduce to all of us at school about Science Expos, when people started entering. I also start like science; the prizes attracted me and lots of stuff. (L5, Section 5.3)

Learners agreed that the people who most motivated them to participate in Science Expos were those who had participated themselves or who had a background of Science Expos.

When the educators were also asked what inspired them to participate, one of them, TD, indicated that she was motivated by Lt1 from Rhodes University to go and attend the National Science Expo in Pretoria. When she saw how learners were presenting their projects there, she asked herself why her learners shouldn't do the same. Hence, she then came back to motivate her learners.

Another educator, TN, said that she was first invited to the workshop organised by the Scifest office, where she and others were shown projects completed by learners in previous years. Successful projects were thus used to motivate educators, giving them insights that they could use to assist their learners.

From the study observation I found out that educators such as SEC1, SEC2, TD, and Lt1 conducted learners' workshops to motivate and support learners. These workshops were conducted by two different offices. Some workshops were conducted by SEC1 from Scifest office and others from the SAEON office, where SCE2, DT, and Lt 1 were among the workshop organisers.

SEC1 said that at first they used to motivate teachers through conducting workshops, so that teachers could in turn motivate their learners. During the workshops they used to show teachers how Eskom Expo teaches scientific methods relevant to their science classroom activities. They then realised that even though some teachers attended the workshops they did not pass the information on to their learners in order to motivate them. As a result, the Scifest

office in 2013 started conducting workshops for both learners and educators, so that information could be passed directly on to the learners.

For instance, in the first workshop conducted by SEC2 and other educators, they asked learners to identify the problem that they wanted to investigate and start working on their projects. They could then present their ideas at other workshops and receive feedback and guidance. Learners were taken through the Eskom Expo Projects Guide booklet to show them how they could use the booklet and what they were expected to do.

Several workshops were conducted in which learners presented their projects to their educators and peers. Teachers were in this way able to encourage learners to become members of the community of practice (Lave & Wenger, 1991), encouraging them to seek expertise from professionals when they were developing their project ideas (see Section 2.8.1). Learners need assistance and encouragement from people who are already acculturated (Hodson & Hodson, 1998), for example, educators or peer learners or any expert in the science field (see Section 2.8.1).

The last workshop I observed was conducted at one of the lodges outside Grahamstown. This workshop aimed at motivating learners to present their projects in a different supportive environment. Woolnough (1994) states that the role of teachers in Science Expo projects is to create a supportive environment, take learners into new areas in which they might learn fruitfully, and provide training in knowledge and skills that can be used throughout their investigations (see Section 2.6.1).

Some learners presented their projects individually, some in pair. Watson and Wood-Robinson (1998, p. 84) argue that during the investigative work, learners "make their own decisions; either to work individually or in groups" (see Section 2.4.1). In addition, some learners used PowerPoint presentations. According to LaBanca (2008), oral presentations which make use of PowerPoint have become a primary communication mode for learners engaging in open inquiry (see Section 2.4.1).

After each project presentation, educators and learners engaged in discussion and gave comments on how learners could improve their projects. It was a wonderful learning platform

for educator-learner and learner-learner interaction. That is, both educators and learners played a role in scaffolding (Vygotsky, 1978; Goos, 2004) (see Section 2.8.2) learning during the presentations, and collaborated in proposing how scientific methods could be used in the science projects. In this way learners were able to move from a low to a high ZPD. Essentially, the notion of the ZPD is characterised as having transformative potential, a semiotic field for interaction and communication where learning leads to development (Newman & Holzman, 1997; Meira & Lerman, 2001) (see Section 2.8.2).

After the presentations, learners brainstormed the name of their group as a community of practice and the name "SciExpo Stars" was chosen. The name suggests that the learners identified themselves as a community of young scientists.

The SciExpo Stars indicated that they had learned a lot from other's presentations and the comments they had received. They learnt how better to carry out their projects and display or present them. Learners learn more effectively when they interact with others in a collaborative community of practice. One learner commented in his journal entry that, "*I found this experience different because I've never 'judged' another person's project and gave them ideas that I thought could work better, it was truly amazing. Also, getting other learners' views about my work was quite interesting*" (L5).

Furthermore, learners learned and shaped their identity[8] (Lave & Wenger, 1991) as they were supported and empowered by educators and peers. In fact, during the presentations some learners had difficulty in clearly explaining the problem that they were trying to solve (as an answer to the most common question that was asked of them) (Section 5.9).

TD stated that learners seemed to understand the methods of practical investigation and the application of knowledge through engaging in science projects and interacting with other members of the SciExpo Stars. Bigelow (2011) suggests that to make Science Fairs/Expos meaningful experiences there should be, among other things, long term preparation of projects with learners, training for teachers and judges, parents being informed about their role, and social interaction (see Section 2.7.1). Learners do not only learn from educators and

[8] Identity is the way of belonging and talking about how learning changes to who they are (Lave & Wenger, 1991).

peer learners who meet regularly, but also from people outside their communities of practice (Lave & Wenger, 1991) (see Section 2.8.1).

The SciExpo Stars group participated in the Grahamstown Regional Science Expo this year. At the Regional Science Expo L5 received a bronze medal, L4 was amongst the top ten participants and L3 was one of the top five winners. L5 received a gold medal and a bursary to study science at Rhodes University. All the other participants (learners) received certificates of participation at the Regional Science Expo.

L3 and L4 participated in the International Science Fair this year. At the International Science Fair, L3 received a silver medal and a SAEON best project; and L4 did not win anything. It is normal practice that after the presentation of projects at Regional or National/International Science Expos, successful learners receive a variety of prizes ranging from medals and trophies to bursaries/scholarships (Abernathy & Vineyard, 2001; Taylor, 2011) (see Section 2.3).

According to Lave and Wenger (1991), newcomers participate on the periphery[9] at first, and then when they become knowledgeable through interacting with other learners and educators they will start moving to the centre of the community of practice to become active and full participants (see Section 2.8.1). This implies that first-time participants can use the opportunity to observe and learn from others, and then when they participate a second time they will effectively be experts in their project fields.

For instance, in the Regional Science Expo learners who participated for the first time this year often did not succeed in going on to the International/National Science Expo. It could be argued that they were still on the peripheral level of participation, though there might well have been other contributing factors.

[9] A peripheral is a newcomer who needs to identify himself/herself within the community of practice, develop an interest, become accustomed to the culture or activities of Science Expos produce and reproduce what is learned, become competent, innovative in order to be an active member and full participant of a community of practice.

In contrast, in the first year that TD participated in a Science Expo, she motivated four learners to participate too; these first-time participants won awards at the Regional Science Expo and were selected to go to Pretoria for the National Science Expo. This suggests that both the educator and learners had put some effort into scaffolding and preparing their projects, which resulted in the learners moving quickly from a low ZPD to a high ZPD. TD indicated that she had had regular interactions with her learners and made contact with science experts to support them, but was afraid that if they did not win they might see the Science Expos as a waste of time and not participate anymore (Taylor, 2011) (see Section 2.7.2).

SEC1 from the Scifest office also conducted more than two workshops for learners who had succeeded in the Regional Science Expo this year. The workshops aimed at guiding learners to improve their projects for the preparation of the National/International Science Fair. The workshops provided opportunities for educators and learners to discuss and collaborate. According to Goss (2004), children learn best by collaborating with adults (see Section 2.8.2).

Drawing on Vygotskian theory, Hodson and Hodson (1998) view teachers as important in navigating learners in the ZPD through scaffolding, apprenticeship and enculturation (see Section 2.8.1). So, one would expect educators (teachers) to attend these workshops so that they could in turn be able to assist learners at their schools.

All six learners involved in this study indicated that they enjoyed themselves during the Science Expo, since they were afforded an opportunity to interact with different people, make friends and learn from scaffolding opportunities afforded by teachers and peers (Vygotsky, 1978) (Section 5.4).

6.4 Science Expo judges

6.4.1 Procedures for selection of judges

SEC1 clearly explained how they recruit judges for Science Expos. After schools have entered the projects for learners who would like to participate in Regional Science Expos, the

projects are classified into different categories and the organisers then try to find judges for each category. They invite science teachers together with academics from Rhodes University, lecturers, people from other organisations around Grahamstown, people who have a marketing background, librarians and moderators who have worked with Eskom Expos. The Scifest office sought to use young academics from Rhodes University as role models, to talk to young learners about their projects so that learners would not feel threatened (Section 4.7).

SEC1 conducts workshops for judges, in which they are taken through the rubric for the assessment of learners' projects. Judges are also paired or grouped according to their experience, so that the most experienced judges are paired with novice judges. This helps to equip the latter with assessment skills for the judging exercise, in accordance with CoP practice in which novices learn from the knowledgeable (Vygotsky, 1978; Lave & Wenger, 1991) (see Section 2.8.1).

TD mentioned that "*judges used to be challenged by learners' topics, which they carried out, due to many problems that are faced in the country*" (see Section 4.11). In other words, learners identify problems in their communities that judges are simply not familiar with. Some Regional Science Expos judges are recognised at National/International Science Expos because of their experience of judging at this level as well, and, generally speaking, the quality of judges at Regional Science Expos (SEC2) is high.

6.4.2 First time participants and experienced learners' encounters with Science Expos judges

Learners who participated for the first time this year in Science Expos were afraid of the judges, and nervous that judges might ask questions that they could not answer. They were also worried about plagiarism,[10] as they had been told by learners who had participated before that if they plagiarised they could be disqualified. (Plagiarism is one of the Science Expo ethical aspects. Scientific fraud and misconduct such as plagiarism and forgery are not allowed at any level of research and competition (Eskom Expo Project Guide Book, 2013).

[10] Plagiarism means to use some one's words or ideas and pretend that they are your own (Eskom Expo Project Guide 2013).

However, in reality learners found judges to be very supportive and generous with advice (L1 and L2). They said judges gave them good comments as they were told how they could improve their projects. In contrast, in Taylor's (2011) study conducted in Cape Town, learners claimed that the judges were not fair when they were judging their projects.

Experienced learners (i.e. learners who had participated in previous years) felt that judges at Regional and National/International Science Expos were different. They noted that at National/International Science Expos judges were not supportive, because when they found an error they did not provide advice on how it might be corrected. Some felt that the judges were too critical, while others thought this was good because they could learn from the criticism and improve their projects (Section 5.4).

According to Mangena (2011), learners get most negative criticism from judges who typically spend insufficient time looking at learners' projects. Grote (1995) noted that some learners were not confident when presenting their projects, and took negative criticism too personally. On the other hand, poor judging at Science Expos might discourage talented learners from pursuing a scientific career (Grote, 1995).

In this study, however, learners indicated that even though they did not win they would still participate and put more effort into future projects, so that they might succeed in future. One learner commented in her journal entry that, "*I might have not won a gold medal, silver medal or bronze medal or travelled to Pretoria, but I was not put down by that. Next year I will enter the science expo again and also the following years*".

Bunderson and Anderson (1996), in their study of elementary teachers' attitudes toward past experience of Science Fairs, found out that the participants were negative towards the judges and the judging process because Science Expos were associated with competition. However, in spite of the competition, learners who participated knew that learning was the major benefit (Dionne et al., 2012). In addition, most learners like competitions because they add extra spice and fun to Science Expos (Woolnough, 1994), and have a positive effect on motivation.

6.5 Challenges in or of participating in Science Expos

6.5.1 Motivation of educators and learners to participate in Science Expos

All the participants (educators and learners) indicated that there was a lack of motivation among educators and learners from township schools in particular to participate in Science Expos. For instance, SEC1 and SEC2 who coordinate Science Expos in Grahamstown explained that they found it difficult to motivate educators, who tend to regard Science Expos as an additional task that they have to do. Czerniak and Lumpe (1996) assert that the participants in their study regarded Science Expos as a waste of time, especially as learners had to work on projects during weekends, and were nervous to present to a group of people.

Only two teachers attended workshops conducted by the Science Expo coordinators. This suggests that teachers are not interested in participating in Science Expos. The study indicated that some of the educators do not want to participate because Science Expos present an extra work load to be shouldered.

Another very important issue that emerged from the data presented in Chapter Five is the fact that most learners do not participate because, either they are not interested, or have never heard about Science Expos. Reasons were not given as to why some learners had never heard of Science Expos as information and invitations about the Science Expos events was sent to schools. The question should be asked: was this information passed on to learners or not, and who was supposed to pass on the information to learners at their schools?

TD posed a question that has been a concern to her about the lack of motivation among educators and learners - who is supposed to motivate whom? (see Section 4.12). My data revealed that no-one could come up with an answer to this question.

One of the educators who participated for the first time emphasized that "*people are not motivated and there is no empowerment*" (Section, 4.12). This reveals that it is the role of educators to find ways to provide incentives and encourage all learners to develop their science literacy skills (Abernathy & Vineyard, 2001). SEC1 confirmed this by saying:

> I don't think it is the job of Scifest to motivate teachers, the teachers are not motivated because it's an extra thing, because they don't get paid enough or they don't have the resources they need or simply because they don't have the work ethic, unfortunately it is not the role of SciFest Africa to motivate, that really should be with the department of education and with payment in South Africa.

Learners said workshops needed to be conducted in township and rural areas to inform parents, teachers and learners what Science Expos are all about. Furthermore, L4 recommended that instead of hosting only Regional Science Expos it would be great if there could be School Fairs/Expos so that they could learn from each other's projects (Section 5.8.2).

All educators in this study said that learners who participate in Science Expos performed well in science subjects at school. According to Dionne (2012, p. 671), learners decide to participate in Science Expos because of a "high sense of self- efficacy[11] and personal accomplishment that can be achieved through inquiry-based activities, passionate about science learning, teaching and learning strategies" (see Section 2.6.1). Most learners at an early age already know if they like science or not, this could be due to learners' experiences at school and outside school (Joyce & Fareng, 1999). For instance, some learners in this study indicated that they saw their brothers, sisters and friends participating in Science Expos. This was experience outside of the school proposed by Joyce and Fareng (1999).

When I watched the video of the workshop for teachers and learners that was conducted by the Scifest office on 20 May 2013, I saw it was attended by only two teachers, one of whom was TD. According to SEC1, schools were informed in advance about provisional dates for the workshops. As quoted from the letter which was sent to schools "It was evident that learners did not receive all the required forms and information sent to educators ... therefore, in future workshops will be aimed at learners, with educators in attendance" (2013 Eskom Expo for Young Scientists letter to schools, 2012, p. 1).

[11]Self-efficacy is an individual perception of ones' own competencies to learn in a given situation (Dionne 2012, p. 671).

From the documents sent to schools by the Scifest office, one can see that this office is trying its best to encourage both educators and learners to take part in Science Expos. It is, however, evident that SEC1 and SEC2 find it difficult to motivate educators. Most learners indicated that they were supported by SEC1, SEC2, TD, and Lt1 who conducted the Science Expos workshops in Grahamstown.

6.5.2 Insufficient support from schools and parents

Sadly, some learners indicated that the Science Expos were not taken seriously at their schools. For instance, most learners indicated that at their schools there was often only one science teacher who was prepared to help them. One learner indicated that he was assisted by a Geography teacher and some learners indicated that they were the only ones participating from their schools.

The educators in this study felt that other subject teachers could also assist with aspects such as learners' spelling or grammar. Educators highlighted lack of time in the school day and the extra work involved. In one case of the 16 learners who wanted to participate only 8 learners managed to finish their projects in time.

Some teachers who are involved in Science Expos said they concentrated on the grade they taught. This implies that at a school there could be other learners from other grades who wanted to participate but could not be accommodated.

Some learners mentioned that their schools did not organise workshops to motivate learners nor a programme for learners who wanted to participate in Science Expos. In contrast, L1 and L2 said "*our teacher has been a huge help*". L3 said their school principal supported them a lot as she organised workshops at their school to encourage learners to participate. Similarly, at L4's school, the principal was the only one interested in Science Expos. Most learners indicated that they were motivated and supported by the SEC1, SEC2, TD, and Lt1 who conducted the science Expos workshops in Grahamstown. Taylor (2011) in his study found out that in some schools, learners do their investigative science projects through science clubs with the assistance of the student teachers from the university (see Section 2.6.1).

L4 and L6 explained that they were discouraged by their colleagues who said they would be wasting their time. L6 commented that he had proved these learners wrong (Section 5.6) since they only perceived the Science Expos as a competition.

A lack support from home was another contributing factor for many learners as some parents are not educated in science subjects. However L1 and L2 said their parents helped them a lot with money, buying equipment such as seeds, plant pots and printing out of the information (Section 5.5). L2 emphasised that her parents had encouraged her.

L5 whose parent is a science educator indicated that his father advised him to participate in Science Expos and helped him to test his projects when he was doing the experiment. Furthermore, his father provided him with the materials he needed.

In contrast, SEC2 said that most parents do not help their children at all. For example, L6 who stays with his grandmother indicated that he did not receive any support from her and he did not bother to tell her about his needs since he knew that she could not understand Science Expos. According to Anthony and Walshaw (2007), learners whose parents were knowledgeable and involved in Science Expos performed well and learners had positive attitude toward Science Expos (see Section 2.6.1).

In the Eskom Expo project guide for learners there are no stipulated roles for parents so that they can be informed on how they could help their children or what is expected from them. In addition, there are no meetings conducted for parents to inform them about their roles in Science Expos and this could be an area for future research.

TD indicated that she had an opportunity to explain what Science Expos were as well as the importance of the science projects at a parents' meeting. This experience thus sensitized TD to realize that she needed to inform parents (Section 4.1) about their learners' Science Expo projects. TD subsequently wrote letters in the vernacular language which is *isiXhosa*, explaining to parents about Science Expos.

TN explained that some parents do not have the capacity to assist their children with their projects as they do not attend the Science Expos exhibitions to see how other children were

presenting their projects. LaBanca (2008) indicated that in Australia parents were often involved in the mechanical process of editing work, helping with the layout of posters, or attending the Science Expos. Furthermore, the Science Guide for British Columbia (2007) emphasises that parents should support Science Fairs and they provide guidelines to assist them.

6.5.3 Time constraints

Time constraints were another challenging factor indicated by all of the participants in this study. Time constraints in this context refers to the time required for educators to support learners, learners to engage with their science projects, interact with others and at the same time to concentrate on their school work.

What emerged from the observation was that some educators put in extra effort and conducted workshops during weekends and holidays (see Table 3, Section 5.9). However, TM said it was sometimes "*difficult for learners to attend workshops during holidays because some learners were not staying in Grahamstown*" (Section 4.13).

L5 who participated in the National/International Science Expos explained that it was not easy to complete the project and to put in sufficient time to ensure it was excellent (Section 5.6). .

Some learners suggested that there should be time arranged at school for those who want to participate in Science Expos. That is, Science Expos should be part of the school's programme as it is the case with sport.

TD concurred with L5 that learners do not have enough time to prepare their projects as the projects are submitted in July for the Regional Science Expos. Thus, the SciExpo Stars group, with their educators, decided to start with their projects for 2014 this year so that learners could start collecting their data this year, then next year they would only need to write up.

Similarly, Taylor's (2011) study on the township learners' conceptions and experiences of Science Expos revealed that the participants did not win because their projects were not

prepared on time; some learners only started to prepare their projects two weeks before to participate in Science Expo. This resulted on the projects being not up to standard.

6.5.4 Lack of knowledge expertise

TN said educators had little or no expertise about project topics that learners wanted to carry out and hence they had to refer learners to experts in that field for assistance (See Section 4.16). She added that educators (teachers) were not comfortable with doing practical investigations, and emphasized that the starting point should be to convince or motivate educators to work with practical investigations in schools so that they could be able to support learners with their science projects (Section 4.13).

Rock (2011) indicates that many Science Centres in the United States of America are involved in providing professional development and support for educators on the incorporation of inquiry-based learning and real-life experiences in science. Inquiry-based teacher training helps "to move them beyond a book based approach" (p. 3). In addition, educators' participation in professional development might change their teaching styles as they have a deeper understanding of inquiry (see Section 2.6.1).

Windschitl (2004) asserts that educators need to be engaged first-hand with scientific investigations rather than only hear it from discussions so that if they are to mentor their own learners through inquiry, "they must feel some intellectual and methodological competencies, gained knowledge not only reading and hypothetical discussion but through firsthand experience and reflection on that experience" (p. 486).

The findings in this study indicated that there was a gap between the projects done by learners from township schools compared with the projects done by learners from former Model C schools or private schools.

It was also noted that some of the projects did not show creativity and in some cases learners found it difficult to come up with the topics for their projects, resulting in some learners even trying to investigate projects that had already been done. On a positive note, it was found, however, that over the past three years there was a slight improvement on the projects from

township schools because of the mentors[12] that assist some learners who participate in Science Expos. According to Grote (1995, p. 276), "The scientist mentors are necessary and make science projects valuable" in assisting learners.

6.5.5 Lack of resources

Lack of resources was one of the major concerns raised by most of the participants. This resulted in some learners not participating and some failing to complete their projects which led to a loss of interest in Science Expos (TM, Section 4.13). Additionally, SEC1 explained that it was very hard for the teachers to help learners to do research if the teachers themselves do not have access to the internet. As a result, learners have to travel long distances from township or rural schools to other places where they can get access to internet (Section 4.6).

L4 who participated in Science Expos in previous years said his challenge was in relation to the resources that he needed, "*I do not have money or computer to type my project*". This learner was helped by SEC2 so that he could type his project. L6 who lives with his grandmother and has participated in the National/International Science Expos mentioned that "*I did not have correct resources to carry out the science project experiment*" and he was helped by Lt1.

Taylor's (2011) findings from his research revealed that learners had sub-standard projects because of lack of resources such as apparatus, computers and reference books. This was compounded by the lack of support that some learners get from the local library, schools or homes. Some learners thought that since they were from poor backgrounds (L3), they could not ask their parents to assist them.

For instance, at the Science Expos, learners from former Model C or private schools had colourful, decorated display boards compared to township schools. This is because they have access to resources such as computers, and coloured paper. They also get more support from their teachers and parents. Furthermore, these learners are computer literate.

[12] Mentors are students from Rhodes University who specialise in sciences; they go to schools around Grahamstown to assist learners with the research process and spell checks (SEC1).

Judges could not penalise projects if they were not typed or not decorated as long as their projects were neat and up to standard. For example, one of the learner's project from a township school was printed on white paper and pasted on a display board, but the project was worthwhile since it had a great potential to benefit the community or the country at large if it could be effectively implemented his project was one of the top five Regional Science Expos this year. According to Taylor (2011), judges expected projects with substantial effort, some originality, good presentations and something that can convince people of its worth.

Some learners lacked confidence when presenting their projects for the first time but after participating for the second time they improved (SEC1). It is for this reason that Science Made Simple (2011) points out that participating in Science Expos helps learners to develop confidence and competence and fosters a spirit of scientific inquiry.

The participants in this study suggested ways educators and learners could be supported to participate in Science Expos. All six learners expressed that Science Expos should be advertised in communities using previous successful projects to motivate people.

Some educators felt it would be useful if more organisations could sponsor bursaries to add to the five bursaries sponsored by Rhodes University so that more learners from disadvantaged schools, in particular, could benefit (Section 4.8). It was noted that only a few learners from disadvantaged schools received bursaries. In 2013 one learner from a township school received one of the five bursaries.

6.7 Successful projects and learners

Most of the projects for the learners who participated in Science Expos were good. As part of my study, I wanted to know what happens to the successful projects and learners after the Science Expos. That is, what do educators and schools do with these successful learners and their projects?

SEC1 indicated that they encourage successful learners to continue with their projects by looking at the impact of the research they did. It was nevertheless not clear how learners continued with their projects and what happened thereafter. It appears that there were no

procedures to monitor the projects. After the Science Expos some are displayed\during the Science Festival (Scifest) where successful learners talked to other learners about their projects. These projects were also presented at workshops. TN explained earlier in chapter four that in one of the meetings for educators organised by SEC1, educators were shown the learners' projects that won at International Science Expos.

I observed L5 who participated in the National/International Science Expo present his project that won a Gold medal and a Rhodes University bursary at the Regional Science Expo last year at one of the workshops organised by SEC2, This presentation helped other learners to see how to carry out, display and present their projects (Section 5.9).

The participants indicated that during the Science Expos the top five learners presented their projects to all the other participants and judges, who then selected the first prize winner of the Science Expo. These presentations were an opportunity for all participants to hear how others carried out their projects. Moreover, winning learners were awarded bursaries to study science at Rhodes Universities.

TD who had a learner who participated at National/International Science Expo mentioned that when learners participated in Science Expos, they kept their project at home. Furthermore, she stated that "*I did not think of even making copies and keep the projects*" (Section 4.17.1).

At TN's school when a project had won at the Science Expo, learners are usually given opportunity to show their projects to their peer in order to motivate them to participate.

TM and some learners indicated that successful learners need to be nurtured and could possibly do work experience with companies and during holidays.

6.8 Participation in Science Expos and the promotion of the understanding of scientific investigations and potential to pursue science related career

In chapters four and five, the participants were asked whether their experiences of participating in Science Expos influenced their understanding of scientific investigations in

their classrooms or not. They were also asked if participation in Science Expos had the potential to motivate learners to pursue science related careers in the future.

It emerged from this study that educators and learners were involved in scientific investigations which were relevant to science as stipulated in the Natural Sciences Curriculum Assessment Statement policy (2011). This group of participants engaged actively in the participation of Science Expos as a community of practice which is a process of learning and knowing (Wenger, 1991).

Learners were exposed to a wide range of scientific knowledge that enriched their understanding of science concepts and methods (TD) and commented that "*I realise that science is around them and not abstract after all*" (TN, Section 4.16). Hackling (2005) states that scientific investigations are an essential part of learning science and research skills (see Section 2.4.1). Essentially, Science Expos give learners an opportunity to carry out scientific investigations (Abernathy & Vineyard, 2001). In this study, all the educators indicated that learners learnt a lot about how to carry out scientific investigations and that helped them in the classroom.

SEC1 mentioned that the first objective of Science Expos is to teach learners scientific methods. The second objective is to encourage learners to do science related subjects through getting involved in research and innovation. Likewise, the Science Expo project guide (2013) stipulates that it motivates learners to pursue science in future and to inspire Young Scientists.

In addition, Olson (1989) posits that participating in Science Fairs/Expos influences learners in science career choices. TM expressed that learners' understanding of scientific investigations was enhanced. In their study, Jona and Adsit (2008) point out that most teachers agree that exposure to scientific investigations are an important part of learning science.

L3 expressed that science projects showed him how to carry out investigations and he indicated that "*I see by doing it*". L4 stated that he understands science much better now. That is, finding an original topic, writing a hypothesis, follow the methods, get results, analyse and

discuss the results (Section 5.7). Mathews (1994) argues that through inquiry training learners learn to come up with hypothesis and test them through experiments and interpret the results (see Section 2.4.1). L5 mentioned that,

> I know how to set up a project and investigations to the national's standards. Every time we do our investigation my marks have improved, it is really benefiting me especially in the section that my projects involved in sciences (Section 5.7).

L6 indicated that "*It helps me in terms of following the correct methods when doing projects and scientific investigations, and also it improved my performance in science*" (Section 5.7).

All learners in this study indicated that their participation in Science Expos improved their scientific literacy so they could understand, interpret, and evaluate information and make conclusions based on scientific research (see Section 2.4.2).

The practical investigations or projects learners do in their classrooms are similar to what they do for the Science Fairs/Expos. In fact, the science projects that learners have to carry out at their schools require the same scientific procedures. According to Jona and Adsit (2008, p. 5), "scientific investigations have strong educational value in engaging students deeply in both the content and process of science and by providing a practical perspective and cognitive connection to the theoretical materials presented in a classroom setting" (see Section 2.4.1).

In reply to the question whether participants in this study felt that Science Expos have the potential to encourage them to pursue science related careers, the educators confirmed that many learners who had won bursaries during their participation in Science Expos were currently studying science subjects particularly at Rhodes University and the University of Johannesburg (Section 4.16).

6.9 Concluding remarks

In this chapter I analysed, interpreted and discussed the data presented in Chapters Four and Five in relation to the literature reviewed and presented in Chapter Two. The data were discussed under six themes. I concluded with how participation in Science Expos promotes

an understanding of scientific investigations in the classroom as well as the potential of pursuing science related careers.

In the next chapter, I provide a summary of the findings of the study, some recommendations and areas for the future research and conclusions.

CHAPTER SEVEN: SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

> *Any research report should end by bringing closure to the interpretation of the data. All loose threads should be gathered together. This is a place for looking backward, for distilling into a few paragraphs precisely what has been accomplished in each phase of the research activity* (Leedy & Ormrod, 2010, p. 296).

7.1 Introduction

This study explored educators' and learners' perceptions and experience of their participation in Science Expos. The research interest was developed from my work experience as an education officer and a Science Expo committee member in Namibia where I became aware of the poor participation among some science teachers and learners in Regional Science Expos in Namibia.

This study was carried out in Grahamstown, Eastern Cape, South Africa. It involved five educators and six learners.

I used semi-structured and focus group interviews as my main data gathering techniques. I also used document analysis and observation of workshops and exhibitions to complement the interviews for triangulation purposes.

The study was guided by the following questions.

Main question

What are the educators' and learners' perceptions and experience of their participation in Science Expos?

Research questions

- How do science educators and learners perceive participation in Science Expos?
- What are the educators' and learners' experiences of participation in Science Expos?

- How are science educators and learners motivated to participate in Science Expos?
- What challenges do science educators and learners experience in participating in Science Expos?
- In what ways do science educators and learners deal with the challenges they are faced with in participating in Science Expos?
- How can science educators and learners improve participation in Science Expos?
- In what ways do science educators' and learners' experiences on their participation in Science Expos influence their understanding of scientific investigations?

This chapter thus presents a summary of the research findings and recommendations for practice in South Africa and Namibia or elsewhere. I finally make suggestions for future research and describe the limitations of the study.

7.2 Summary of research findings

The study highlighted educators' and learners' understanding of Science Expos. A Science Expo was understood as empowering/acculturating (Hodson & Hodson, 1998) learners to become independent scientists and investigators.

The data revealed that learners' participation in Science Expos boosts their interest in science and gives them insight into how science can be applied in real life situations. That is, Science Expos teach learners scientific methods which they may use to solve problems that they might identify in their communities through exploring scientific investigations.

It emerged from this study that some educators from township schools tend to perceive Science Expos as being geared towards former Model C or private schools. Hence, this thinking has resulted in low participation from township educators and learners in the past.
Prior to participating in Science Expos learners did not understand scientific investigation even though it is part of the Natural Sciences curriculum (See Section 2.2).

In participating in Science Expos learners carry out scientific investigations (science projects) that relate to their prior everyday knowledge. In the process, they follow the scientific

methods to solve problems they have identified with the assistance of some educators. As a result, learners who participate in Science Expo display a willingness to study science in the future (L1). Learners felt proud of their projects which they came up with within a short period of time.

The study further found that educators were not comfortable with doing scientific investigations in their classrooms and they were not knowledgeable about all of the learners' projects. To overcome this, they made contact with subject experts to assist learners by discussing their projects together with them and guiding them on how they could get information on their projects.

It was noted that township learners faced challenges including lack of resources such as internet, display boards, printing and papers (Taylor, 2011). It could be argued that the idea of judges being sensitive to the learners' background does help learners from township schools to succeed.

The gap between schools with access to resources and township schools is narrowing thanks to the support these learners receive from various people. This resonates with Grote's (1995, p. 276) argument that "scientist mentors are necessary and make science projects valuable". Time constraints were regarded as one of the factors that discouraged both educators and learners in participating in Science Expos.

Educators (SEC1 and SEC2) decided to conduct workshops for learners and teachers during weekends, holidays and in the afternoons to enable them to attend without interfering with their normal school work. However, it was difficult for some learners to complete their projects as they believed that they were not provided with enough time to carry out their projects and proposed to be given special time at school to enable them to do so.

In most cases, the projects that did not win were those that were not done on time, that is, learners started late with their projects. Also, those learners who did their projects in pairs highlighted shortcomings such as finding it difficult to meet up with their colleagues to work on their projects together.

It was noted that there was lack of motivation amongst teachers and learners to participate in Science Expos even though there were workshops conducted from two different offices (SciFest and SAEON) in Grahamstown. In addition to this, the Scifest office provides the Eskom Expo Project Guide booklets to schools which show learners how to carry out their projects. It was found that some learners were not in possession of the Project Guide even though they were supposed to receive them at school. It was revealed that few teachers attended Science Expos workshops conducted in Grahamstown.

In most cases learners indicated that they heard about the Science Expos from friends and families. Few learners said that they heard from their teachers at school and the two coordinators from Scifest and SAEON offices.

The study revealed lack of motivation and support from some schools. Amongst all the participating schools, there were only one or two teachers who encouraged and supported learners to participate.

There were only few schools that arranged workshops at their schools to encourage learners to participate. Some of the learners were discouraged to participate by their peers.

Most of the parents did not support their children and were not exposed or aware of Science Expos as there were no meetings called for parents so that they are informed about these activities/events. According to Anthony and Walshaw (2007), learners performed well and had a positive attitude towards Science Expos if their parents are aware, knowledgeable and involved. Yet, it emerged in this study that one of the questions that was frequently asked by parents; was if the projects were for marks?

It was revealed though, that parents' roles are not included in the Science Expo Projects guide unlike some overseas fairs.

The study revealed that judges for the Regional Expos were recruited immediately after schools entered the learners' projects. The Scifest office classified the projects into categories and identified suitable judges for each category. The judges were teachers and young academics from Rhodes University. The young academics were taken as role models for the

young scientists (learners) so that they could discuss their projects freely and would not feel threatened. The academics, considered as experts in science subjects, were paired up with teachers. The judges were then trained to familiarize themselves with the judging rubrics.

To the learners' surprise, during the judging learners found that judges were supportive and they learned from the criticisms which helped them to improve their projects. Mangena (2011) argues that learners usually get negative criticism from judges who spend insufficient time looking at learners' projects, but this is not what the learners experienced. In addition, Burderson and Anderson (1996) indicated that participants had negative feelings towards the judges and procedures because Science Expos were associated with competition.

It was discovered that there were no effective mechanisms of monitoring the winning learners and projects. At their schools, learners who had participated in Science Expos were given an opportunity to present their projects to others and received their awards during the morning devotions. In contrast, at some schools they did not share their science projects with the whole school but only with their classmates since all learners who participated were from the same grade.

Regarding what should be done with successful learners and projects, the educators recommended that the number of bursaries should be increased and successful projects should be used to motivate other learners.

A positive result was that learners' understanding of scientific investigations was enhanced. This echoes with Jona and Adsit's (2008, p. 5) notion that exposure to scientific investigations is an important part of learning science. Participation in Science Expos has the potential to motivate learners to study sciences at tertiary level.

7.3 Significance of the study

This study has added to the limited literature on this topic in the context of South Africa and Namibia, which is in a similar position. The highlighted recommendations can help

educators, the Department of Education, Curriculum developers and other readers to plan effectively for the future improvement in Science Expos.

7.4 Recommendations

The following are some of the recommendations related to the findings of this study.
The study recommends that:

- Science Expos should be part of the schools' programme as is the case with other extra-curricular activities such as sport. Schools should arrange time for learners who would like to participate in Science Expos. This might provide more time for learners and teachers to support and discuss science projects.

- Science Expos should be taken seriously in schools so that educators would be responsible to motivate and inform learners to participate effectively. Currently, some educators and learners know that Science Expos are not compulsory and most people do not see it as important.

- Schools should be encouraged to form science and mathematics clubs where Science Expo activities could be discussed as proposed by Lave and Wenger (1991) in their community of practice (see Section 2.8.1).

- Science Expos learning support materials provided by the Scifest office should be disseminated to learners as required.

- The Science Advisory Teachers (science education officers) from the Department of Education should be involved in Science Expos to work hand-in-hand with the Scifest and SAEON offices in order to motivate teachers and learners. Teachers could be motivated through their professional development workshops and when visiting schools.

- Tertiary Institutions such as Rhodes University should enhance scientific investigations in their science courses. This would help educators to be knowledgeable and feel comfortable with scientific investigations and be able to assist learners with their Science Expos projects.

- More workshops for educators and learners should be conducted to support learners in carrying out their projects successfully and identify learners' needs.

- Parents are important in learners' education; and so they should be involved in Science Expos. Parents' workshops should be conducted to inform them about Science Expos, why they are important and how they can support learners to carry out their projects. Parents' role should be included in the Science Expo Project guide. Parents should also be invited to attend the Science Expos events so that they can see the diversity of ideas that would help them to assist their children.

- All the science educators in schools should be encouraged to be involved in Science Expos so that they can assist each other in supporting their learners and also share the responsibility of attending workshops. They can motivate learners from different grades. That is, Science Expo activities should be seen as being cross-curricular.

- Science teachers need to collaborate with language teachers so that they can assist with checking learners' grammar and spelling.

- There should be Science Expos at the schools so that other learners at school can observe how others have carried out their projects and that could serve as a motivation to others to participate.

- Successful projects should be available in schools to be used as reference material and examples for learners on how to carry out their Science Expos projects and as well as their classroom-based scientific investigations. Successful learners may also be called to present at educators', learners' and parents' workshops to share how they have done their projects.

- Schools and the Regional Education Office should have a budget for the Science Expos to alleviate lack of resources that hinders learners from participating in Science Expos which would make it easier for learners whose parents are unable to support their children financially.

7.5 Future research

Further research should be taken to:

- Investigate why some educators' and learners' have never participated in Science Expos.
- Examine the in-depth impact of Science Expos on the learning of science in schools.
- Explore different strategies of motivating teachers and learners to participate in Science Expos.
- Further research should be conducted but involve a larger sample which could include more educators and learners from different backgrounds.
- Further research should be done with the parents whose children have participated and won at the Science Expos.
- Investigate the parents' perceptions and experiences of Science Expos and how they could be motivated to support their children.
- Further research can also be done to investigate what makes a good participant and what have the learners gained from going to the National/International Science Expos.

7.6 Limitations of the study

As a result of the small sample the findings cannot be generalised. Nonetheless, the study provides some insights of educators' and learners' understanding of Science Expos, the challenges that confronted them and some relevant recommendations.

There are always problems in conducting research. In one case I lost an interview and had to redo it. After transcribing the interviews, transcripts were sent to the participants for member checking and some of the participants did not return them promptly which delayed my progress. Sometimes it was difficult to find time for learners' follow-up interviews as most of the time they were busy with their school work and it was unethical to interrupt their studies.

I thus negotiated and conducted some of the interviews during the weekends and late in the afternoon.

If I were to do this study again, I would interview all the participants before and after the Regional Science Expos, conduct a formal interview with learners and educators during their workshops, and observe how learners carry out their classroom scientific investigations. Finally, in terms of the theoretical framework, I would explore using the social realist perspective to analyse my data.

7.7 Concluding remarks

This study investigated educators' and learners' perceptions and experience of their participation in Science Expos. This is necessary to improve the participation in Regional Science Expos in South Africa and Namibia.

The study confirms that there was lack of motivation and support from schools and parents and some educators.

It was recommended that Science Expos should be included in the school programme in the same way as sport is included.

The chapter concludes that further research could investigate the impact of Science Expos on the learning of science in the classroom.

REFERENCES

Abernathy, T.V., & Vineyard, R.N. (2001). Academic competitions in science: What are the rewards for students? *The Clearing House*, *74*(5), 269-276.

American Association for the Advancement of Science. (1985). *Science literacy for all*. New York: Oxford University Press.

American Association for the Advancement of Science. (1989). *Science literacy for all*. New York: Oxford University Press.

Anthony, G., & Walshaw, M. (2007). *Effective pedagogy in mathematics/Pangarau*. Wellington, NZ: Ministry of Education.

Ardichvilli, A., Page, V., & Wentling, T. (2003). Motivation and barriers to participation in virtual knowledge sharing in communities of practice. *Journal of Knowledge Management, 7*(1), 64-77.

Avargil, S., Herscovitz, O., & Dori, J.Y. (2012). Teaching thinking skills in context based learning: Teacher challenges & assessment knowledge. *Journal of Science Education & Technology*, *21*(2), 207-225.

Babbie, E., & Mouton, J. (2001). *The practice of social research*. Cape Town: Oxford University Press.

Bassey, M. (1999). *Case study in educational settings*. Buckingham: Open University Press.

Baxter, P., & Jack, S. (2008). *Qualitative case study methodology: Study design & implementation for novice researchers*. Canada: McMaster University.

Bigelow, M. (2011). Science fairs. *NSTA Journal. SciLinks.*

Blair, B.J. (1996). *The complete handbook of science fairs projects.* New York: John Wiley and Sons.

Blanche, M.T., Durrheim, K., & Painter, D. (2006). *Research in practice: Applied methods for the social sciences*. Cape Town: University of Cape Town Press.

Brand, B.R., & Glasson, G.E. (2004). Crossing cultural boarders into science teaching: Early life experiences, racial and ethnic identities, and beliefs about diversity. *Journal of Research in Science Teaching, 41*(2), 119-141.

British Science World Columbia, (2007). Science Fair Guide. Columbia: Canada.

Bunderson, E.D., & Anderson, T. (1996). Pre-service elementary teachers' attitudes towards their past experiences with science fairs. *School Science and Mathematics, 96*(7), 371-377.

Campbell, D. (2011). *Qualitative research.* Retrieved February 15, 2013, from http. // en. Wikiversity. Org/ wiki/Qualitative research

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (5th ed.). London: Routledge.

Cohen, L., Manion, L., & Morrison, K. (2010). *Research methods in education* (6th ed.). New York: Routledge.

Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education* (7th ed.). London: Routledge.

Czerniak, C.M., & Lumpe, A.T. (1996). Predictors of science fair participation using the theory of planned behavior. *School Science and Mathematics, 96*(7), 355-361.

Danarmamark, B., Ekstrom, M., Jakobsen, L., & Karlson, J. (2002). *Explaining society: Critical realism in social sciences*. London: Routledge.

Davies, B.M. (2007). *Doing a successful research project: Using qualitative or quantitative methods.* New York: Palgrave Macmillan.

Denscombe, M. (2007). *The good research guide for small scale research project* (3rd ed.). Berkshire: Open University Press.

Denzin, N.K., & Lincoln, Y.S. (2000). *Handbook of qualitative research* (2nd ed.) London: Sage Publications.

Dionne, L., Reis, G., Trudel, L., Guillet, G., Kleine, L., & Hancianu, C. (2012). Students' sources of motivation for participating in science fairs: An exploratory study within the Canada-wide Science Fairs 2008. *International Journal of Science and Mathematics Education*, *10*, 669-693.

Driver, R., Osoko, H., Leach, J., Mortimer, E., & Scott, P. (1994). Constructing scientific knowledge in the classroom. *Education Research, 23*(7), 5-12.

Duggan, S., & Gott, R. (2000). Understanding evidence in investigations: The way to a more relevant curriculum? In J. Sears & P. Sorensen (Eds.), *Issues in science teaching*. London: Routledge.

Duit, R. (n.d.). *The constructivist view in science education: What it has to offer and what should not be expected from it?* Keil, German: University of Kiel.

Durrance, J.C., & Fisher, K.E. (2005). *How a librarian helps: A guide to identifying user-centred outcome*. Chicago: American library Association. Retrieved June 13, 2012, from http://nnlm.gov/evaluation/workshops/measuring-yo.

European Commission- Community Research. (2007). Science education now: A renewed pedagogy for the future of Europe. http://ec.europa.eu/research/rtdinfo/index_en.html

Gay, L.R., Mills, G.E., & Airasian, P. (2006). *Educational research: Competencies for analysis and applications* (8th ed.). New York: Pearson Prentice Hall.

Golafshani, N. (2003). *Understanding reliability and validity in qualitative research: The qualitative research report*. Retrieved May 18, 2012, from http:// www.nova. Edu/ssss/QR/OR8- 4/golafshani. Pdf

Goos, M. (2004). Learning mathematics in a classroom community of inquiry. *Journal for Research in Mathematics Education,* 35(4), 258-291.

Gray, D.E. (2004). *Doing research in the real world*. London: Sage Publications.

Grote, M.G. (1995). Teachers' opinions concerning science projects and science fairs. *Ohio Journal of Science, 95*(4), 274-277.

Hackling, M.W. (2005). *Working scientifically: Implementing and assessing open investigation work in science. A resource book for teachers of primary and secondary science*. Department of Education and Training, Western Australia.

Hamilton, L., & Connie, C.W. (2011). *Using case study in education research*. London: Sage Publications.

Handley, K., Sturdy, A., Fincham, R., & Clark, T. (2006). Within and beyond communities of practice: Making sense of learning through participation, identity and practice. *Journal of Management Studies, 43*(3), 642-651.

Hansen, J.J. (n.d). *Validity, reliability and triangulation*. Retrieved May 18, 2012, from http:www.woodhillpark.com.

Hodson, D., & Hodson, J. (1998). Science Education as enculturation: Some implications for practice. *School Science Review, 80*(290), 17-24

Intel ISEF. (2012). *My experience at the Eskom International Science Fair for Young Scientists*. Retrieved February 15, 2013, from http:// www.exposcience.co.za/index.php/gallery/intel-isef-2013-pittsburgh

Intel. (2007). *Intel international science and engineering helps Pakistan's students improve science literacy:* Pakistan case study. Retrieved February 23, 2013, from http://cache-www.intel.com/cd/0034/24/342408_342408.pdf

Jarrett, O.S., & Bulunuz, M. (2009). Developing an interest in science: Background experiences of preservice elementary teachers. *International Journal of Environmental and Science Education, 5*(1), 65-85.

Jennings, G. (2006). *Science as a world view, or can science explain everything*? Retrieved March 05, 2013, from http:// www.astc.org/blog/2006/

Johnson, B., & Christensen, L. (2004). *Education research: Qualitative, quantitative and mixed approaches* (2nd ed.). Boston: Pearson.

Johnston, J. (1996). *Exploring primary science and technology: Early explorations in science*. Berkshire: Open University Press.

Jona, K., & Adsit, J. (2008). Goals, guidelines and standard for student scientific investigations. *International Association for K-12 online learning, Northern America.*

Jones, G. (1991). Gender differences in science competitions. *Science Education, 75*, 159-169.

Joyce, A.B., & Farenga, J.S. (1999). Informal science experiences, attitudes, future interest in science, and gender of high-ability students: An exploratory study. *School Science and Mathematics, 99*(8), 431-437.

Kibirige, I., & Hodi, T. (2013). Learners' performance in Physical Sciences using laboratory investigations. *International Journal of Science Education, 5*(4), 425-432.

Korpan, C.A., Bisanz, G.L., Bisanz, J., & Henderson, J.M. (1997). Assessing literacy in science: Evaluation of scientific news briefs. S*cience Education, 81*, 515–532.

LaBanca, F. (2008). *Impact of problem findings on the quality of authentic open inquiry science research projects*. Washington: Western Connecticut State University.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Laws, P.M. (1996,). Investigative work in the science national curriculum. *School Science Review, 77*(281), 17-24.

Leedy, P.D., & Ormrod, J.E. (Eds.). (2010). *Practical research: Planning and design* (9th ed.). Boston: Pearson.

Magnusson, S.J., & Palincsar, A. (1995). The learning environment as a site of science education reform. *Theory into Practice, 34*(1), 43-50.

Mason, J. (2002). *Qualitative researching* (2nd ed.). London: Sage Publications.

Mathews, R.M. (1994). *Science teaching: The role of history and philosophy of science*. New York: Sage.

Maxwell, J. A. (2008). Designing a qualitative study. In L. Bickman & D. Rog (Eds.), *Handbook of applied Social research methods* (2nd Ed.) (pp.214-252). Newbury Park, CA: Sage Publications.

McMillan, J.H., & Schumacher, S. (2010). *Research in Education. Evidence based inquiry* (7th ed.). USA: Pearson Education.

Meira, L., & Lerman, S. (2001). The zone of proximal development as a symbolic space. *Social Science Research Papers*, (*13*), 1-15.

Merriam, S. (2002). *Introduction to qualitative Research*. San Francisco: Jossey-Bass Publishers.

Mertens, D.M. (2005). *Research and evaluation in education and psychology: Integrating diversity with quantitative and mixed methods* (2nd ed.). Thousand Oaks: Sage Publications.

Namibian. Ministry of Education. (2010). *National Curriculum for Basic Education.* Okahandja: NIED.

National Research Council. (1996). *Inquiry and the National Science Education Standards.* Washington, DC: National Academy Press.

Newman, F., & Holzman, L. (1997). *The end of knowing: A new development way of learning*. London: Routledge.

O' Hanlon, C. (2003). *Education inclusion as action research*. Glasgow: Bell.

O'Leary, Z. (2004). The essential guide to doing research. London: Sage Publications.

Olson, L.S. (1985). *The North Dakota Science and Engineering Fair: Its history and a survey of participants*. Unpublished Master's thesis, North Dakota State University.

Patton, M. (2002). *Qualitative research and evaluation methods*. London: Sage Publications.

Punch, K. (2005). *Introduction to social research: Quantitative and qualitative approaches* (2nd ed.). London: Sage Publications.

Renner, M. (2003). *Analyzing qualitative data*. Wisconsin: Ellen Taylor- Powell.

Rock, A. (2011). *Knowledge and practice.* Retrieved March 04, 2013, from http:astc.org/pubs/dimensions/2011/May-Jun/MayJun11pdf.

Roth, W.M. (1995). *Authentic school science, knowing and learning in open-inquiry science laboratories: Research methods and science education*. London: Simon Fraser University.

Roth, W.M., & Lee, S. (2003). *Science education as/for participation in the community*. British Columbia: University of Victoria.

Rule, P., & John, V. (2011). *Your guide to case study research*. Pretoria: Van Schaik Publishers.

Saul, W. (2005). *Beyond the Science Fairs: Creating a kids's inquiry conference.* Portsmouth: Heinemann.

Science made simple (2011). Great science fair projects start here, a helpful science made simple. Retrieved February 15, 2013, from http://www.sciencemadesimple.com/science.html

Schock, J. (2011). The history of Science Fair. 10th annual ASEE K-12 workshop on Engineering Education. "Trying *STEM Together with Engineering*", Retrieved from http://www. Super-science-fair-projects.com/science-fair-history.html

South African Eskom Expo for Young Scientists (2013). *Discover your future: Project guide book*. Pretoria.

South Africa. Department of Basic Education. (2010). *Curriculum and Assessment Policy Statement: Grade R- 9 Natural Sciences*. Pretoria.

Stake, R.E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage Publications.

Taylor, D. (2011). 'They are using laptops, we are using boxes': Township learners' conceptions of Expo. *African Journal of Research in MST Education, 15*(1), 67-79.

Thomson, K.N. (2012). *Scientific investigations: Tips to do them, how to think like a scientists, and questions for the Mare community*. Retrieved February 12, 2013, from http:// coseenow.net/mare/ocean-day.

Vygotsky, L.S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Watson, J.R., & Wood-Robinson, V. (1998). Learning to investigate. In M. Ratcliffe (Ed.), *ASE guide to secondary science education* (pp. 84-91). Cheltenham: Stanley Thornes.

Webb, P., & Mayaba, N. (2010). The effect of an integrated strategies approach to promoting scientific literacy in grade 6 and 7 learners' general literacy skills. *African Journal of Research in MST Education, 14*(3), 34-49.

Wellington, J. (2000). *Education research: Contemporary issues and practical approaches*. London: Continuum.

Wilson, J.D., Sheila, C., & Carol, U. (2004). Science fairs: Promoting positive attitudes towards science from student participation. *College Student Journal, 38*(1), 122-155.

Windschitl, M. (2004). Folk theories of "inquiry:" How pre-service teachers reproduce the discourse and practices of theoretical scientific methods. *Journal of Research in Science Teaching, 41*(5), 481-512.

Woolnough, B.E. (1994). *Developing science and technology education: Effective science teaching*. Buckingham: Open University Press.

Yore, L.D., & Treagust, D.F. (2006). Current realities and future possibilities: Language and science literacy-empowering research and information instruction. *International Journal of Science Education, 29*(2-3), 291-314.

APPENDIX A (1-4)

RHODES UNIVERSITY
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EDUCATION DEPARTMENT

Tel: +27 (0) 46 603 8383

Fax: +27 (0) 46 622 8028

PO Box 94, Grahamstown, 6140

9th April, 2013

Scifest Africa

TO WHOM IT MAY CONCERN

We are writing to obtain your permission for Mrs Wendy Kahenge (student number 11K7113) to do a 'contextual profile' of your institution and thereafter to conduct a research project on the Science Expo co-ordinated by your institution.

Wendy is a registered Masters student at Rhodes University in the field of Science Education under our supervision. Her research interest is on the investigation of science teachers' and learners' perspectives and experiences of Science Fairs/Expos.

Her contextual profile will provide the necessary context and background for her main study. For her contextual profile and research project, she will need to access some relevant documents on the Science Expo and to observe the exhibition of the Science Expo projects. She also hopes in the near future be approaching selected science teachers and learners to seek their permission and active participation in this study. Teachers' and learners' participation in Science Expos is an important issue, yet it is under-researched and we are confident that Mrs Kahenge will produce a valuable and high quality study.

Thank you in anticipation for your permission and support. If you have any queries please feel free to contact us.

Yours sincerely,

Dr Kenneth Ngcoza, Dr Charles Chikunda and Mrs Joyce Sewry (supervisors)

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PO Box 94, Grahamstown, 6140

22 July 2013

The school principal

Grahamstown

Dear Sir/Madam

Congratulations on your learners' achievement at the Science Expo on Friday. We are therefore writing to obtain your permission for Mrs Wendy Kahenge (student number 11K7113) to conduct a research project on your school's involvement in the Science Expo.

Wendy is a registered Masters student at Rhodes University in the field of Science Education under our supervision. Her research interest is on the investigation of science teachers' and learners' perspectives and experiences of Science Fairs/Expos.

For her research project, she will need to interview the science learners who have participated in the Science Expo as well teachers. Teachers' and learners' participation in Science Expos is an important issue, yet it is under-researched and we are confident that Mrs Kahenge will produce a valuable and high quality study.

Thank you in anticipation for your permission and support. If you have any queries please feel free to contact us.

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PO Box 94, Grahamstown, 6140

22 July 2013

The Parent

Grahamstown

Dear Sir/Madam

Congratulations on your child's achievement at the Science Expo on Friday. We are therefore writing to obtain your permission for Mrs Wendy Kahenge (student number 11K7113) to conduct a research project on your child's involvement in the Science Expo.

Wendy is a registered Masters student at Rhodes University in the field of Science Education under our supervision. Her research interest is on the investigation of science teachers' and learners' perspectives and experiences of Science Fairs/Expos.

For her research project, she will need to interview the science learners who have participated in the Science Expo as well teachers. Teachers' and learners' participation in Science Expos is an important issue, yet it is under-researched and we are confident that Mrs Kahenge will produce a valuable and high quality study.

Thank you in anticipation for your permission and support. If you have any queries please feel free to contact us.

Yours sincerely,

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22 July 2013

The school teacher

Grahamstown

Dear Sir/Madam

Congratulations on your learners' achievement at the Science Expo on Friday. We are therefore writing to obtain your permission for Mrs Wendy Kahenge (student number 11K7113) to conduct a research project on your school's involvement in the Science Expo.

Wendy is a registered Masters student at Rhodes University in the field of Science Education under our supervision. Her research interest is on the investigation of science teachers' and learners' perspectives and experiences of Science Fairs/Expos.

For her research project, she will need to interview the science learners who have participated in the Science Expo as well teachers. Teachers' and learners' participation in Science Expos is an important issue, yet it is under-researched and we are confident that Mrs Kahenge will produce a valuable and high quality study.

Thank you in anticipation for your permission and support. If you have any queries please feel free to contact us.

Yours sincerely,

Dr Kenneth Ngcoza, Dr Charles Chikunda and Mrs Joyce Sewry (supervisors)

k.ngcoza@ru.ac.za/c.chikunda@ru.ac.za/j.sewry@ru.ac.za

APPENDIX B

APPENDIX B1

LEARNERS' INTERVIEW SCHEDULE (focus group interviews for learners who previously participated):

Thank you for coming to this interview. And let me thank you once again for accepting to participate in this research. This interview is voluntary and you are free to withdraw whenever you want. Feel free to give your views. Let us start with our conversation. The first question is:

1. Could you tell me what you think is the purpose of Science Fairs/Expos?
2. What are your experiences of;
   (a) Your school's participation in Science Fairs/Expos?
   (b) Your own participation in Science Fairs/Expos?
3. a) Who motivated/inspired you to participate in Science Fairs/Expos?
   b) What were your fears when you first participated in the Science Fair/Expo?
   c) Who supported you in carrying out your Science Fair/Expo project?
4. What challenges did you or do you encounter when participating in Science Fairs/Expos?
5. (a) What excites you about Science Fairs/Expos?
6. (b) How did your participation in Science Fairs/Expos influence your perception of Science as a subject?
7. Do you think your participation in Science Fairs/Expos has improved your understanding of what is meant by **Scientific Investigations** or not? Explain
8. What do you think needs to be done to motivate other learners (both girls and boys) from your school and other schools to participate in Science Fairs/Expos?
9. What do you think should be done with:

   (a) Successful projects after the Science Fairs/Expos?
   (b) Successful learners after the Science Fairs/Expos?

Thank you very much!

APPENDIX B2

TEACHERS' INTERVIEW SCHEDULE:

Good afternoon and welcome to the interview. Thank you for your time you devoted on this, please feel free to give your opinions of any kind. I have few questions here, just to start with my first question:

1. Could you tell me what do you think is the purpose of Science Fairs/Expos?
2. What are your experiences of:
   (a) Your school's involvement/participation in Science Fairs/Expos?
   (b) Your own involvement/participation in Science Fairs/Expos?
3. Do you think it is important or not for science teachers;
   (a) To be involved/participate in Science Fairs/Expos?
   (b) To motivate their learners to participate in Science Fairs/Expos? Explain.
4. (a) Who inspired you to participate in Science Fairs/Expos?
   (b) What fears did you have when you first participated in Science Fairs/Expos?
5. (a) What inspired you to involve and motivate your learners to participate in Science Fairs/Expos?
   (b) How did you or do you motivate your learners to participate in Science Fairs/Expos?
6. What challenges did you or do you encounter when **motivating** or **supporting** your learners with their Science Fair/Expo projects?
7. What do you think needs to be done to motivate other learners (both girls and boys) from your school and other schools to participate in Science Fairs/Expos?
8. Do you think participation/involvement in Science Fairs/Expos :
   a) Influences learners' perceptions towards science as a subject? Explain
   b) Improves your and their understanding of **Scientific Investigations** or not? Explain.
9. What do you think should be done with:
   (a) Successful projects after the Science Fairs/Expos?
   (b) Successful learners after the Science Fairs/Expos?

Thank you very much!

APPENDIX B3

SCIENCE EXPO COORDINATORS' INTERVIEW SCHEDULE

Thank you very much for your time for me to interview you today. I have a few questions to ask you and please feel free to give your opinions as much as you can.

1. Could you please tell me what is the **purpose** or **rationale** for Science Fairs/Expos?
2. What are your experiences of being involved with Science Fairs/Expos?
3. (a) How does your institution motivate teachers and learners to participate in Science Fairs/Expos?
   (b) How do you ensure that Science Fairs/Expos are not perceived as just mere competition?
4. (a) What do you think **enables** science teachers and learners to participate in the Science Fairs/Expos?
   (b) What do you think **constrains** science teachers and learners from participating in Science Fairs/Expos?
5. a) Who and how do you recruit judges for the Science Fairs/Expos?
   b) How do you ensure that judges are knowledgeable about learners' science projects exhibited during Science Fairs/Expos?
6. (a) Could you please comment on the quality of learners' science projects during Science Fairs/Expos?
   (b) What challenges are you faced with when learners' science Fair/Expo projects are judged?
7. What do you think should be done with the:
   a) Successful projects after the Science Fairs/Expos?
   b) Successful learners after the Science Fairs/Expos?
8. Do you think motivating learners to participate in Science Fairs/Expos has a potential to inspire them to pursue science related subjects at tertiary level or not? Explain.

Thank you very much!

APPENDIX B4

LEARNERS' INTERVIEW SCHEDULE (Interviews for learners who were participating in Science Fairs/Expos for the first time):

Thank you for coming to this interview. And let me thank you once again for accepting to participate in this research. This interview is voluntary and you are free to withdraw whenever you want. Feel free to give your views. Let us start with our conversation. The first question is:

1. Could you briefly tell me what do you think is the purpose of Science Fairs/Expos?
2. Could you tell me about your experiences of your schools' involvement/participation in Science Fairs/Expos
3. What motivated you to participate in Science Fairs/Expos?
4. a) What fears do you have in participating in the Science Fair/Expo?

   b) Who do you think will support you in carrying out your Science Fair/Expo project?

5. What challenges have you heard from other learners who participated in Science Fairs/Expos in the past?
6. Do you think other learners who participated in Science Fairs/Expos have improved their understanding of what is meant by **scientific investigations** or not? Explain
7. What do you think needs to be done to motivate other learners (both girls and boys) to participate in Science Fairs/Expos?
8. What do you think should be done with:

   (c) Successful projects after the Science Fairs/Expos?

   (d) Successful learners after the Science Fairs/Expos?

Thank you very much!

APPENDIX C

TRANSCRIPTION OF INTERVIEW WITH (TN) (*Codes used)*

W: interviewer

TN: Interviewee

Thank you very much and welcome to this interview, I really appreciate that you accepted to participate in this interview. I have only few questions that I want to ask you.

Without wasting time let me just start with the first question.

Could you please briefly tell me how do you understand Science Fairs/Expos?

W: Could you please tell me your experience of your school involvement in Science Fairs/Expos.

TN: *Aaa… is usually what the Science Expos people or the committee they invite schools to participate on, from my school grade 8 to 12 participate. So, aa… one year one of my students who was in grade 11 at a time decided to participate, because sometimes you give your learners aaamm… practical investigations. So, what she did was she decided on the topic that she was interested in which was on Astronomy. So, she just decided on the topic and she tried to go direct to Expo.*

What I normally do when learners want to enter a Science Expo because I don't have all the expertise in all the field I look for somebody here at the university because the university is quite close and there are many experts who can actually help develop the ideas and take it further then, they and they hook up with the who whichever department and then I get feedback on what they have been doing in terms of the scientific methodology. How is going and variables and all those type of different aspects that they have to consider? Then I also get a pamphlet from the science centre committee that states what exactly what the learners have to do, all the materials what they have to use, what to prepare for the science expos so all sort of use it as a guide.

W: You mention practical investigations, Is practical investigations part of the curriculum?

TN: *Yes, it is part of curriculum, they every year learners have to do a practical investigations and so that can be used and entered for a Science Expos.*

W: What inspired you to participate and motivate your learners to participate in Science Expos?

TN: *Well that is very difficult actually, because you know you… you just tell them guys let's do practical investigations and then if is good enough then you can be entered you find out that even what they submit for practical investigations, is not up to standard that you can actually use it for Expos, it takes particular learners who are self-motivated to actually decide that go work hard on my practical investigations that, I can submit it for the Expos, and I think is because some of these learners are A's target, who are very serious learners who go out and met people and connect with others and not just all the student that I teach or I use to teach.*

W: Do you give them topics that they have to investigate or they choose their own topics?

TN: *Is better to have them come up with their own topics because if they come up with their own topics they are passionate about them and they are willing to find information then posing a particular topic on them.*

W: Do you think is important for teachers to participate or motivate learners to participate in Science Fairs/Expos?

TN: *It is very important in the sense that the Science Expos actually, extends what the teachers have to do in terms of implementing the curriculum because what the Science Expo does it makes the scientific investigation or method alive for the learners in the practical way. So, they choose their interest and then they can use science to learn from their practices, it is very important and essential that they extend that to make science interesting to the learners.*

W: What challenges did you or do you encounter when you encourage or support your learners with their Science Fairs/Expos projects?

TN: *Well as I have mentioned already I aa.. in terms from my side the challenges that I normally have I don't have enough knowledge about a particular topics that learners what they want to pursue so then is when I have decide to ask for help from the university people who might know much then what I actually do, so that they can help learners to go further with their projects.*

W: What do you think needs to be done to motivate learners (both boys and girls) to participate in Science Fairs/Expos?

TN: *Wawuu… I wish I knew, but I think if as teachers we were also comfortable with doing practical investigations, because I also think that is, because if as teachers we are not confident ourselves in terms of (pause) looking at practical investigations, variables, and the steps so, if that was done early with learners I think by the time learners go to grade 8, for an example, it becomes easy for a learner who is now in grade 10 who wants to be part of Expo because now they have been dealing with the scientific methods in the lower grades and but now if that is not done the basics have not been developed from them then it becomes difficult for the teacher, now then especially if the teacher is also not quite confident with practical investigations.*

W *mmmm…*

TN: *Because as much as is there in the curriculum that practical investigations should be done, sometimes teachers don't do a practical because if they say no we don't have this we don't have that or is so it become very difficult.*

The starting point should (pause) to convince or motivate teachers or to help teachers to work with practical investigations how to do practical investigation? How do you design practical investigation and now if because once teachers are confident they will be able to practice with their learners? Then, it will be easy for teachers now to motivate learners because they are confident of this is how I can support my learners to do practical investigation to participate in Expos.

W: Do you think girls also used to participate in Science Fairs/Expos at your school?

TN*: Yaa… for instance, aa… first learner that actually participate and actually won a scholarship to study at Rhodes. She was unique, her topic was on SKA and it was aa… at a cutting edge at that time because she was, when started and there was no sufficient support she was.. dealing with something about actually at a time.*

W: Which means?

TN: *They are interested to participate, actually is open to everyone.*

W: mmm

TN: What do you think are the advantages and disadvantages for teachers and learners to participate in Science Fairs/Expos?

W: *There are no disadvantages is as I mention that is is't part of learning it extend the learning and it make science alive and it make learners being interested.*

The advantage is that it it will help learners with actually understand the the methods of practically investigations and also to learn from that. That no no, Because It is not only knowledge but can be used socially, application of knowledge and at the same time through Science Expos learners they go to National National aa competition, they interact with other learners from other schools and they learn through their participate and they get to see things and the learner around that I talking about the lady she actually won a scholarship. So it is very beneficially for the learners actually to take part of in the science Expos.

W: is there a motivation from successful learners who won scholarships to other learners to participate in Science Expos?

TN: *Yaa for instant the the the one now who are two years ago there was aa a learner in grade 10 who also submitted a project for science Expos, aamm he won a silver medal and then last year some of the learners now because he was saying noo I am going to do it again next year, so they got up interest that, they also want to participate, but then because they submitted their projects investigation very late they couldn't submitted for the Science Expos, but I could now see, they are getting interested because they can see how it can help them.*

W: Did you observe where some learners once they participate in Expo and did not win, they gave up from participating?

TN: *No, not had a learner that participated and did not won for instance the one who had won a silver medal three years ago, last year he got a bronze but already when he came back already had an idea that, he has an interest that next year I gone participate they already had talked about their structure what they gone do and contact people might help them do carried out forward. So I don't think it really de-motivate them, I also think it also motivate them especially if they go there and they see it, because the kind of judgments that they get, their getting specific feedback or this could be improved laalla la, so from there they come and see other learners work and want to improve their projects for the next time around.*

W: What do you think should be done to the successful projects after the Science Fairs?

TN: *Uumm wawu, very good question, very good actually. I am… (pause) in terms of motivation that could also motivate other learners, for instance aam.. (Pause). In one of theee, meetings that I have attended where they introduced the Science Expos, they actually had some of the learner's work that has won at the Science Expos. So.. as some kind of any example are of how the projects look like. So I think they could be used to motivate learners, that this kind of work, this is the quality that is required for Science Expos. We have a look at that, and aa.. (pause) in schools for instance like in my school if learners has won something like that have gone for Science Expos, we make a bit hello of it even at assembly, we show the project, that the learners have won these talalaala, so to sort of motivating other learners, to actually participate in the next year to come. They should be used as kind of motivation for other student as well.*

W: Let me say your learners who participated they only won bronzers but there are some who participated and won gold and participate in the international Expo. Do you use to have access to the successful projects that won gold for example?

TN: *No, but I don't think it is difficult to get access because we could (pause) through network with the organizers; we could actually find a way of getting those, I don't think is difficult to get those.*

W: Do the successful learners get opportunity to share with other participants about their projects?

TN: *I am not sure what happen to other schools but with my learners (pause) even during the course of presentation they present also in class, so that other learners can have an input and so so to aaam to improve the projects, so even if they come back they tell us the experiences of having involved and what happened and everything that have happened and yaa.*

W: Ok, which means during the Science Expos learners do not use to be given chances to present to other learners who come to participate during the Expos?

TN: *Aaam, I am not sure exactly but what I do know is that before they go to the national one, they had aa workshop that organized by the organizers of the Science Expos, to sort of improve their projects because initially they have the projects and presented at district level and from there, we got the judges, now they give you feedback and then learners are taken through workshops in the afternoon, after school, where they can improve their (pause) their work before they can go to regional and also have workshop after that before they can go to national. So this quiet constant support up can go to national before they can win and probably go to international.*

W: What do you think should be done with the successful learners after the Science Expos?

TN: *Aaaa, you know what they they normally they kind of praises actually give out actually give different for example scholarship study any think in science, I think that is a very good motivating factors for learners because most of the learners that we teach actually the in the location financial they are unable to to go to University. But if they know that by being involve in the Science Expos we can actually have an opportunity to get scholarship where we can*

study and do science the way we want to I think that is very a motivation factor if they have get a scholarships.

W: Are you aware whether learners who use to get bursaries through the Science Expo if they study in their field of projects or they do something else?

TN: *Aaa my learners still in the science who are actually won the scholarship and then the other one is in grade 12 this year, and I sure he will be gone be studying science and I am hoping that he is still continue with the projects even though I am not there, because we have already have a kind of set up the people that he can relying on so.*

W: Do you think participating in Science Fairs/Expo has improved your understanding of what is means by scientific investigation or not?

TN: *It has actually because I, teacher also called to the meetings because every year they invite teachers to come to a meeting, to tell them about the science expos, the expectation and everything so they actually go through the requirements with the teachers exactly the scientific methods what they need to know and actually give us sorts with the teachers with the Cds and they give us lots of materials which then when I get back to school I use it knew what I have to do with the learners I give them CDs and the staffs and I explain to them all the methods what is required it actually helped me about investigation better and also to get ideas on the kind of projects that I can even give my learners in the course of the year, It really very grateful.*

W: OK, Now looking at your learners who participate in Expo comparing to those who did not participate. In your science classroom Do you think the one who participated in Science Expos has improved their understanding of learning of science?

TN: *Yaa, It definitely does improve, even though I like to mention that learners who are actually participated already were high achievers but I also believe that having been part of that experience also improved their experience of understanding what science is about.*

W: The lower achievers, did you motivate them to participate or they just not want at all?

TN: *They just doesn't want because they I never try to make the investigation compulsory that they have submit it for Science Expos. I only give them practical investigation for marks. Ok So then is up to them to sort of upgrading it and submit for science Expos maybe thus why if may be there was sort of motivation or it was made compulsory but I don't know may be that could motivate and work harder and harder on their projects.*

W: Do you think this Science Expos are working hand in hand with the science curriculum?

TN: *Yes definitely, because Practical investigations are part of the curriculum anyway it does not matter which topic you… you want working with because the bottom line is the skills that learners need to acquire will be scientific methods because so it does matter which topic they are working with, is just the application of the skills that they have learn in science to purse something that they interested in so yaa.*

W: Can you remember or do you know where the initiative came from?

TN: *I, I can't remember I can't remember when it started but this have happened came long time.*

W: And you don't know even who initiated the Science Expos?

TN: *I don't.*

W: I understand there is a centre at monument?

TN: *Monument, but you can even go to they might have something them they will give you a history, the winner and the topics of the Expos.*

W: Is it a government or non-government organization?

TD: *Aaaammm, it is a non-government although it is sponsored by the Department of science and technology.*

Thank very much TN, for the time you have devoted here, the information and the what I have record I will keep it for myself and I will not reveal to anybody, and if I will have some ideas I will come again. Thanks.

TD: *Welcome*

Haaa ha haaaaaaaaaaaa(All of us laughed, laughed. Laughed).

APPENDIX C2

Transcribing of TD interview, who has been participating in Science Expos in SA. (***Codes used)***

TD - interviewee

W - Researcher

Ok, TD! Thank you very much and welcome to this interview, I really appreciate that you accept to participate in this interview. I am going to use a Voice recorder, so that I will remember what we are going to discuss. I have only few questions that I want to ask you.

Without wasting time let me just start with the first question.

W: Could you tell me what do you think is the purpose of the science Fairs/Expos?

TD: Aa to my understanding Wendy, Science Expos which I would like to use Science Expos a lot, yes is Science Fairs, I think science Expos is more about exposing learners to be independent scientists and independent investigators since they work with their own projects and investigations. So, Science Expos are giving them opportunities to learn more about how to investigate in science which is, it helps them also to develop the process skills in the classroom situation, so when they are involved in Science Expos, Science Fairs what is being done now, they are doing a long term research over a long time and in doing so they are getting to understand what involvement and skills requirements that are involved in doing Science Expos. That means they are developing in terms of concepts in science especially based on **investigation**.

W: What are your experiences of your school's involvement/participation in Science Fairs/Expos?

TD: First of all I may say, mmmh… there are good experiences and bad experiences since most of my learners are disadvantaged in terms of resources or materials. Most of the time, I would like to start with challenges, mmm… our children I may say my children in the school, they are lacking support from home because since these are independent projects aaa…as a teacher every time, I work alone and that is one of the challenges in terms of the school environment. Most teachers they see the Science Expos as only for Natural Sciences teachers, while to my understanding is for all science subjects which may be, Social Science teachers can be involved, language teachers can be involved as well, because when they are doing projects, children may be helped in terms of developing their writing skills, investigating skills or can be other Biology or Geography and Natural Sciences but in my school the challenge I face is I am the only one who is interested and see it as a Natural Sciences baby you see and secondly, coming to learners now most parents from home, they are unfamiliar with what we do at school this day so, I find most of my children struggling to get support from parents and also in terms of materials sometimes because maybe need something to buy then parents don't understand what this for? **Is this for marks?** Those are the questions that will come up or just to waste time so I get challenges where I have to write letters to parents and explain what is this projects about and what could/how it could benefit them at the end of the day as learners. Mmh… so think those challenges as I am working alone time wise now, because I like to work with grades 8 and 9, because I work independently to supervise the learners, so I look at the grades 8 and 9 try to supervise them but also is time consuming I may say.

W: What other teachers are saying about involving in Science Expos or about helping learners?

TD: You see uuu… what is happening Wendy is that, the teachers will be involved only if I ask, if I ask for example I need teachers to help in terms of correcting their spelling, is when she will help you know other than that, some they don't see it as their responsibility, they see it as a responsibility of science teachers and because she likes to do things in science.

W: Is there any parent meeting or kind of workshop that have been done to involve them so that they will be able to support their kids?

TD: You know what I do Wendy, I don't do it formally, I only write letters both in English and Xhosa and explain to them why they are doing this science projects. **In fact, last week I was fortunate to be with a grade 9 parent because was our annual almighty meeting with parent giving them the report of what was done in term one, one of the parents happened to ask about this that he sees her child busy with this project what is this?** So, I got an opportunity now to greet the grade 9 parents to explain why they are doing for these projects because I meet them sometimes during the weekend or after school. So, when that parent asked me about this project, what type of projects is this one and why are they doing it. **I got an opportunity to explain to parents why is useful to do this Science Expo things and now which could be a good platform to call parents as I have said again time wise also is where the disadvantage is.**

W: Ok, so these questions were two, one was about experiences of the school involvement and the other one was your involvement/participating in science Fairs/Expos. Is there anything that you want to add may be from your own experience?

TD: Ok for me, to do, for my own experience Wendy I must say over these I grown a lot being involved in Science Expos first of all I just entered this teachers who wanted to know what is happening, how I can enter my children but I added up now being one of the judges of the day, because I grow toward to understand what is this about and how I can encourage my children to entered Science Expos, because now this is my fifth or sixth year now with the Science Expos you see. I started with only four learners I still remember, I took four projects and it was just a try and error some sort for them to go and see (pause) and it was a first time and but although the two from four ended up going to Pretoria being their first time you know. They were chosen the top ten so I was fortunate you know. So, from there I was kind of learned, how to do things, how to organize other people to help me, speak to people how can they help my learners which some of the old professors they have helped, the Museum have helped for example (Caughed) *sorry* this year for example this year I worked with Dr Ngcoza a lot he is the one sometimes who said we can send them to Museum, train them to be independent saying go to this place then there can ask help Explain you know they can do this project and explain you know. So, now this year I tried to involve Ms Seye from SAEON so I think that's how you grow when you work with people and try to have more experience when doing things, so from that alone experience I gained from the Science Expos have given me an opportunity to grow in terms of understanding what is it exactly about Investigation, especially what are they about? What are really research projects about? And how you can motivate your learners to do these projects for their own benefit at the end of the day?

W: Ok, you mention that you are also a judge for the Expo, were you trained?

TD: yes we had, I… I remember first time I was asked to be a judge to be honest, I was not trained, they combined me with someone who was experienced that was the first time, but after that they decided that we need to have workshop before, to make before the science Fairs where we sit and say how we go about judging the projects and given criteria and categories so we do get sort of the workshops.

W: Hmmm…now using the experience of judging learners projects, what have you find out from learners' projects?

TD**:** To be honest from learners, in fact, from the judges' point of view I think for judges it goes with what topic is in for that moment? What problem facing the country? at that time, because for, I think that is what triggers the judges because you have judges at a floor, which I am one of them and then you got the head judges where they will now look at this score and look at these projects which have high scores and look at the higher top five you know , for me I have noted it and I have said to myself I have seen what triggered the judges is the topic that you have chosen trying to solve what is the problem that are facing our country for example like global warming, look at the water quality that most our countries are facing now, look at how animals are dying in terms of starvation like children can come up with solutions, you know look at umm… the problems that, are encountered by the wetlands now, meaning the animals that are depending on the wetlands and now because of global warming what is happening to wetlands, how we can help, so I think it goes with what is the problem at that moment and how can one can come up with the solution I think that's what triggers the judge's minds when we comes to these projects, they are looking at the projects that can innovative for the country, that can help the country you know.

And also the quality of the project I think it matters a lot following the roles you know, of a proper project you know having the aims, how you came up with this project and how you were working on that project you know, because there are certain requirements, because you need to have your working files, your portfolio then your posters for presentation and now how you came about with your working file, because your working file you have to present it to the judges, that it holds about this topic and one will think about this topic what other things you've done in order to improve your topic the background have you done enough research and read more you know so' I think the quality of a project also does matter a lot.

W: Do you think it is important or not for the science teachers to be involved/participate in Science Fair/Expo?

TD: Wendy, I find it very, very important, because as a teacher as well, you take your experience and bring it back to classroom now. Remember, these science fairs as much as they are independent projects or private projects, what happens is this; the curricula encourages us to do investigations, projects you see so, now as a teacher; I'm teaching my child how to do a project or to do an investigation project I think that's an opportunity for me as a teacher to come back and say' okay, this is what is happening this is how I can teach my own children how to go about doing investigation projects you know and as a result; what I've found more, in terms of; especially in Grahamstown you know is that, teachers who are no involved in this things, their children's are missing out a lot in so many things, because children do learn from each other's projects as well, not all about we, is not all about always winning or being in the top ten or top

five but if you've been to the science expo as a learner I've find more children that have been there before and interested to go again because they have learned something and they want to improve on their projects, it's strange to find children who are not interested in doing science in their future.

W: (Follow up Q.) So, this means learners whose projects were not successful are still interested to participate?

TD: Yaa, yaa.

W: They are still interesting?

TD: They are! Because they improve, the other improve on their projects or say may be "I can do that and change and try to have a better project, that's what I find out the most".

W: Do you think it is important or not for teachers to motivate learners to participate in Science Fairs/Expos?

TD: As an individual; I do motivate them, I find it very important because at the end of the day Wendy, it's their future, it's… it's… it's…their future. Maybe one child may say' "I've find my carrier in doing this", if you look at the Science Fair or Science Expo, they are given bursaries there, if they have done good project, I think it's another motivation, they win prizes you know, and they get to see what careers they can do, in the future you know, because other than being there as projects for competition, there are also other activities that are being done in terms of experiment like the roads, chemistry, they always do fun things, they always been encouraged having presentation on carriers and science; so they are been motivated anyway, so for a science teacher to motivate children to go, I think it's very important, because that's where especially grade 9 learners because towards the year now where they have to choose their carrier because, for me you choose your career in grade 10, you don't choose your carrier in grade12 because in grade 10 that's where you choose the subjects that you will focus on. So, if children especially in the grades 8 and 9 they are exposed so these children will be the ones that that can better choose the subjects that they are interested in, you know kids!

W: Who inspired you to participate in Science Fairs/Expos?

TD: Hmmkhhmk, (laughed) Oo…Ok, that's another thing I, I still remember the first time I've entered the Science Expo I was, the Department of Education assigned me to go to PE just to go and observe then I was wondering if this things are happening why do we not know them, you know I went once and I spoke once to Dr. Ngcoza and he kind of like said to me that, Dalia I think we need to go, if you don't have learners then you need to go and see what is happening, then the first year then, that's the first year when I went, I went on my own I didn't have learners, just to observe then the first year that I've took my learners, I only took four learners then I said to them, because of what I have seen, then I came back and tried to motivate my learners and four of them were at least interested, because you can understand why sometimes learners have that fear of standing in front of other learners amongst other learners presenting their projects and all that, you see but, I got most motivation from Dr. Ngcoza and Mrs. Craig, Ms. Craig is the lady that I used to work with from the Mobile Science Lab, so those people had really being in my motivation and in most of the things that I have been doing when it comes to science.

***W**: Oooo;*

TD: Jaa

***W:** That's great, wuw, Ok,*

W: What fears did you have when you first participated in Science Fair/Expo?

TD: Hmmm…, first of all my learners not being to get something, when they go to participate and see it as some as waste of time and say you know we are not going back again you know, because learners are different because in Grahamstown most people that enter the Science Expo are the learners that are from former Model C schools and from private schools so my learners were just according to the status fair enough if you look we like to categorize schools, they are from this small public school and they were like "we're not sure" you know what, we are doing then, my fear was for them to see that, is not important then say we're not participating again and also my fear as a teacher was like this, even if it was one of them must for motivation you know because I was scared for them to see it as something that they can't do, that was my fear you know. That was my fear (laughed)!

W: How did you or do you motivate your learners to participate in Science Fairs/Expos?

TD: What I do, I just talk of bursaries that they could get and the presents that they could get and I always say to them that, you are still young you are grade 9 or 10, there is a chance and opportunity for you to go and see what other learners are doing and then you can improve, you never know you've got chances that between grade 9 and 12 you got lots of chances to improve your project and may be you could win from those you know, so I always try to speak in a positive way that it's not all about winning, it's about learning from what you can see around you, because there are many other projects there so you can learn from them and improve from them because learners are also given an opportunity to go around and look at each other's projects.

W: Mhhhhhm… during the Science Expo?

TD: Yes,… yes…, so they've got that opportunity to go around and look at each learner's project, so they can learn from each other's work you know, that's how I try to motivate them and say imagine yourself being a grade 9 learner, grade 8 learner winning a bursary in grade 8 for the University wouldn't want that? You know so I tried to come up with all positive work and positive say for them. When it comes to hmm… you know good, but also I try to say remember if… if you go there if you don't win, don't take it as negative aspect look at it as I am still in grade 9 so I can improve next year you know.

W: What challenges did you encounter or do you encounter when motivating or supporting your learners with their Science Fair/Expo projects?

TD: You know, some of them they see it it's too much work, because they've got other assignments and other projects that they do for all teachers and including mine, so most of the time it's time constraining because most of them they can't keep time, that's why as much as I'm interested to take like most learners, it will be only few learners that are managing to come up with a good project at least, that would go and stand amongst others projects in the Science Expo, you know so I think because of the work that is involved there, my learner turned not to have good quality

projects that they come up at the end of the day you know, I think that's the most challenge by not having enough support in terms of their topics, because as a science teacher also I do not also have all the knowledge of some of the things that I can help with you know. So, I need to know where to refer these learners to which is another challenge because may be some people are not willing to help you know, because a child may do a topic that's based on ocean, whatever now how do I begin to say go and ask help there who can help you? you know so I think you need to have people that you're connected with, in order for your children to get help where is going to be much easier if parent also can support because parents are working in this different places, may be they know so and so also who did this you know.

W: Who are those people you are connected with who can help your learners?

TD: Aaaa…, most of my students you know I used, I'm sorry to say this because the late Carol that used to work at the science monument, she is the one also that was part of motivating my learners I must say it, because she was, she used to say Dalia which project do you have? I think I can speak to Professors and so at Rhodes, I think I can speak to Professor so and so at the museum for you so that, she can or he can speak to those learners you know, so to have people like Carol, Dr Ngcoza it was, it's very helpful.

W: Hmmm…, so which means the Science Expo's organizers or coordinators, sometimes they also know people who can help?

TD: Yes, yes, that's right, so the positive things is for you as a teacher to remain connected with them and say hey' look I've got a child that doing this topic, do you know someone that can help you know, yaaa

W: What do you think needs to be done to motivate other learners (both girls and boys) from your school and other schools to participate in Science Fairs/Expos?

TD: I think we need to have proper workshops with, which is something that gives failing and failing every year, I think children need to begin like before the end of the year children need to be called upon starting from grade 9 or grade 8-12 and say hey' guys there is this and how can you go about doing this including teachers not only learners because you will find that if you speak about Science Expo some teacher still say, "Science Expo"? But it's been years you know, so I think there is something lacking somewhere somehow in terms of motivating schools to participate, may be from the departmental side I don't know, or there is another question; who supposed to motivate who?

TD: You know, who supposed to motivate who? As schools supposed to look up for such appropriate or may be teachers are waiting for something that comes from the department, because they used to be, I don't want to say to be controlled you know, because on the other hand I see teachers as people that are not willing to go an extra mile.

W: But who supposed to motivate teachers?

TD: That's... that's the question that I've always asked myself.

W: What about the Science Centre?

TD: The Science Centre, to be honest work with people that are already there, I get things because I've been connected with them, did you get my point? I've been working with them I introduced myself to them.

W: I thought it's them who used to call teachers who are interested in Expo;

TD: They don't to my understanding, they don't call all the schools, you see. Maybe they do, in fact they do for modesty schools like in town.

W: Do you think participation/involvement in Science Fairs/Expos influences learners' perceptions towards Science as a subject?

TD: It does, it does I've got few learners that have taken careers in Science because of Science Expo, because they see it as something that's wow I want to do this you know, fortunately this, today this morning I was speaking to a child that is in one of the private school in Jo'burg, he is on scholarship, he's doing Maths and Science there and after attending the Science Expo he was one of the learners that said' ***I'm definitely doing something in Science as my carrier'.***

W: Wow, was that a Science Expo scholarship?

TD: It was the scholarship no, it was not for this Expo but, because our school sometimes we do get these people saying that they've got scholarship we've got many learners that are working hard and so what my children do, when they apply its challenge experienced in this Expo they will present the evidence that, I've been to the Science Expo, here is the certificate and I've got a file if you need evidence so it does help.

W: Which means it's one of the motivations again?

TD: Yes, and most of my learners again they say this, I've done, this I've done so it does help, it does, so if the child does not end up doing something in Science but the fact that, that child is involved in things like those I think chances for motivation are there for them to find schools better school.

W: Aahmm Ok, the other question Ms. Dalia you have touched on it a bit, which is about, how do you think your participation improve your understanding and learners understanding of Scientific investigations and Science projects or not?

TD: It does improve my understanding of Science investigation and Science projects, you know are, are must say Wendy, being a student myself I'm always you know, people like to make this research things and investigation things as two different things, yes' Scientifically in a way, in terms of writing a report but in terms of academic things, I'm also growing because if you could see how the judges judge these learners as if they are academics. When we judged them in terms of academic are exposed we are expecting them to a hypothesis, the aim, the background the data collection how they come up and have analyzed data, you know they are doing things that you had never done at grade nine level and grade eight level and for me that's what is inspiring me a lot because I'm also a student you know what, this is what I am doing at the university level, imagine if you can continue with this and be the researcher, be the

investigator how much you do at the university? You know so really it does motivate me as well as the teachers to be honest just to have that a-a strength of motivating them you know.

W: Do you think there is a connection on scientific investigation for Expo and investigations in the curriculum?

TD: Yes, there is a connection W, to prove that there is a connection, all the learners in my classes grade nine, they supposed to have a project per year, according to curriculum's requirements each child supposed to have a project and that project is going to be marked and so what I do, I motivate I said everybody is going to have a project, then if you work harder enough then we can take your project to the Science Expo, that is the strategy I'm using the project that they are taking to the Science Expo is the project that I will judge and mark for their marks, mark collection, this is what the curriculum is requires for learners in grade 9 to have a project you see so, somewhere somehow Science Expo and curriculum they do click.

W: That's great, ok, the last second question I can say,

W: What do you think should be done with successful projects after the Science Fairs/Expos?

TD: You know Wendy, it's something that most of us have been talking about you know, most children that come on top I think those are the ones now going back to the question that you asked that, what do you do to motivate other learners that are unaware that are not participating? Those projects, they can be used to motivate these learners that do not know anything about Science Expo, because I foresee where this top ten students presenting their project in front of the other learners, other than the ones participating at the Expo, to say guys you can do this look at this project this how I've done it, you know in that way other children can be inspired, sort off a workshop for learners if those learners that have made it they can be organized to do workshops for schools I think that when learners and teachers can learn and say Ok, if this child can do it may be our children can do it too, you know.

W: Would it be a problem, if you have used those projects as some of your resources in your class room?

TD: The thing is, yes, I do that for our old learners if the child hasn't taken it to her/his home you know, but now the best project most of the time, they take them, they keep them, so maybe you don't know who was that child because may be is from the different school, but for my school I do try and keep them but some of them they like to take them to their homes, because it's their products, that's where the problem is and again I would say because of time, it would be lovely for those ones to come back and say this is what I did last year, so they can think of the topic the ones that are going to participate the following year you know.

Me: Would be a problem if you can make some copies on successful projects than you keep them even in the library?

TD: I don't think that's a problem I think that's something that now as you said it now, I can learn and do to have resources to teach others how to do Science projects.

W: All right. My very last question is almost similar to the last one but this one has to do with learners.

W: What do you think should be done with the successful learners after the Science Fairs/Expos?

TD: As I said I would wish for them to be used as learners that can motivate others, because I believe learners can learn best from their age mates you know, so imagine having looking at your age mate having graduated for PhD, you are motivated somewhere somehow I say' that's me you know so I think if we could use some of these learners as models to motivate other learners also not just say wow you won, they go to Pretoria and bra-bra-bra, that's it it ends there, I think they can be used to go to schools and motivate other learners, same as their projects, because if you take their projects that means also they can go and like interpret their project to those learners, yes it will be made with time consuming because it need to be done after hours, after school hours and it could help a lot, you know.

W: Hmm… don't you like even to have a project which went up to international Science Fair?

TD: Hmm, I had it two times a year before last I had one child that went there again I didn't think of making copies from that one, either said, two times I had groups that are going in the international but I never thought of making copies and keep their projects I think that's where the weak point is.

W: What about for learners from other schools maybe?

TD: Aaa…, you know I remember from last year what VG did when I took some of my learners there we had a mini workshop they had an example of a project of one child that went even overseas you know, so they were like using that one to teach others now these learners and see how they have, you know.

W: Who are those?

TD: VG learners, Victoria Girls Higher, they have most, other projects so their learners can get the opportunity to go overseas and present their projects, you know so what they did last year, they called us, people that are involved in the Science Expo and show around learners the three that are toping the projects that are done by those two girls. I think somewhere somehow, it can motivate as I said it will motivate learners.

W: During the Regional Science Expo or National Science Expo learners with successful projects who use even go to the international Science Fair; are they given an opportunity or not to present their projects to other participants during the Science Expo?

TD: Yes, yes, they get a slot when now if the top five because this five, the second five is those ones that are accompanied but the top five projects these learners get an opportunity to present their projects to us telling us how they come up with their projects, it does happens.

W: Ok, at the beginning you mentioned about, learners use to be given scholarships/ bursaries and so on.

TD: They do, and prizes, these top five they are given bursaries, books and all those things.

W: Even though learners are in grade nine or grade eight, do they use to keep their record? Or how do learners claim their scholarships?

TD: If the learner is interested and that record will be kept, because the learner is still in grade nine you know, when it comes to that, I think it's the scholarship for first year then the child for first year, semester or whole year that's why I confused but they do get towards their, so if they are interested to go to Rhodes, they know that they've a bursaries there I think they do keep the record because otherwise they won't say you've got this and they don't keep the records because the child is still in grade nine.

W: That's wonderful, I understand the Science Expo office used to organize some workshops for teachers?

TD: Yes! One says, they do that,

W: Close to the Regional Science Fair, just to check may be how far teachers and learners are there with their Expo project?

TD: Which I believe should be done at the beginning of the year not close, because for me I think beginning of the year is the best, that where teachers can now see and, but I think because also the working people with, they have been there time by time they just send documents, because they do have supportive documents for us, we do have documents that say what's science fair is all about, how one can go about doing it and projects.

W: Is't kind of a guideline?

TD: Like a guideline yes,

W: Do they also use to provide Cds?

TD: Yes, yes!

W: What is in those Cds?

TD: The Cd is more about the steps toward your project.

W: Is just the same steps which are in the guide?

TD: Yes, in the guide, in the guide and the example of how you can make it with own style is like the Cd is teaching you, yeah.

W: Hmm, but it does not have like maybe they took a video for learners participating in Expo?

TD: It does have some videos, yes, but not proper videos and all that, just examples which refresh and say that for the board.

W: Ok, thank you very much Ms. Dalia, for your time.

TD: No problem!

APPENDIX C3

TRANSCRIBING OF THE PILOTING INTERVIEW FOR SEC2

(***Codes used)***

Thank you very much and welcome to this interview, I really appreciate that you accepted to participate in this interview. I have only few questions that I want to ask you.

Without wasting time let me just start with the first question.

Interviewer: W

Interviewee: SEC2

W : Could you please briefly tell me how do you understand Science Fairs/Expos ?

SEC2: *Basically is a competition in the true essence but is not on the other side, because basically it actually, is trying to understand the interests of the young people, young learners at schools doing a projects, because once you start knowing doing a project for the Expo you start to know… getting to know what is it that you like, what is that you want to do or want to be became when you pass your matric. Is just like engaging learners into and bring that interest into sciences.*

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W: What is your experience of being involved in Science Fairs/Expos?

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W: Are you sure may be if they have those projects at their schools after the science fairs?

SEC2: *They should have it should nt be even at the school. They should be maybe kept their projects.*

W: Where do they use to keep them may be?

SEC2: *I think they should be with learners they should be with them and but I don't think it should be a problem to call upon them and you know when they go to expos they just put their papers into the plastic and get the board.*

W: What do you think should be done with the successful learners after the science fair or Expos?

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W: Let me say now a particular learner had a successful project and he/she did not make it to be admitted to go to university, What do you think should be done to that particular learners?

SEC2: *(Pause) Ok I got your ideas, yaa where you coming from, mm Is is difficult because they they get awarded the bursaries before their matric even when they are in grade 7 and they go there and present their projects, if it come to the top five they definitely get, will be awarded bursaries.*

W: And now that bursary will wait for the learners?

SEC2: *They will wait for those learners to do their.....*

W: But are they sure they keep the record of those particular learners in grade seven

SEC2*: I am sure they do I am sure they do, they do.*

SEC2: *But what you are asking now is just a question*

W: Just something need to be thought about.

SEC2*: Need To think about it.*

SEC2: *Yaa, What happened but, because it didn't happen yet we haven't think about it but all learners who are awarded bursaries they got it.*

Thanks you very much Ms* SEC2 *, It was a very interesting discussion with you. It does not mean I will stop here but may be the other days I will think of other questions then I will come again to assist me.

SEC2*: No problem I know what you are doing.*

Ha haaaaa (All of us Laughed, laughed)

W: Thanks.

APPENDIX C4

TRANSCRIBING OF THE PILOTING INTERVIEW FOR SEC2

(***Codes used)***

Thank you very much and welcome to this interview, I really appreciate that you accepted to participate in this interview. I have only few questions that I want to ask you.

Without wasting time let me just start with the first question.

Interviewer: W

Interviewee: SEC2

W : Could you please briefly tell me how do you understand Science Fairs/Expos ?

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SEC2*: Need To think about it.*

SEC2: *Yaa, What happened but, because it didn't happen yet we haven't think about it but all learners who are awarded bursaries they got it.*

Thanks you very much Ms* SEC2 *, It was a very interesting discussion with you. It does not mean I will stop here but may be the other days I will think of other questions then I will come again to assist me.

SEC2*: No problem I know what you are doing.*

Ha haaaaa (All of us Laughed, laughed)

W: Thanks.

APPENDIX: C 5

Learners' Expo Workshop 3 at Assegaai Trail on 03 July 2013 Organised by SEC2

Thirteen learners from three schools attended the workshop, 9 female, 4 males and three educators (lecturer, teacher, SAEON Expo coordinator. Learners who attended are mostly from grade 9, 10 and 11. Eight learners are for grade 9, four learners are for grade 11 and one learners for grade 10.

The workshop was for learners presenting their project as a preparation to Regional Expo on 19 July 2013.

SEO: The SAEON Expo coordinator started encouraging learners to feel free to present their projects.

T: gave them a lay out of the board during the Regional/National Expos for their projects presentation that they should adhere to such as Topic, Abstract, Introduction, Aim, Hypothesis, Variables, Methods, Analysis, Results, Discussion, conclusion, References and Acknowledgements. They were urged to reference using a guide.

Comments given during the workshop

Every learner presentation was commended.

L: learners were urged to be careful with plagiarism, they should search for scholarly article not only internet.

T: learners should write what the literature are saying about method used and why the interview is relevant to their projects. Their topic should be researchable

L: Each experiment should have a hypothesis, each step should speak to each other, your experiment should be repeatable, and you should have a journal of what works and what did not work. Be clear about the hypothesis and aims. When working with animals you need ethical clearance/ consent letter that proves that people agreed. Learners should not use brand names rather use letters.

Types of questions were asked during learners presentations

- What triggers you to investigate that topic?
- What is the problem?
- What is that you vary and what is that you hold? variables(independent and dependant)

Learners were told to write reflections about their workshop on:

- What have they learned?
- How do they feel?
- Where do they need help?

What I observed from the workshop

Learners were free to present they projects and most of them were nearly to finish with writing up of their projects. Everyone was free to comment on the presentation which was helpful.

When I talk to some learners they indicate that "we *learned a lot that will help us to improve our projects"*. Different types of questions posed to learners during the presentation really opened their mind. Learners felt good because they were taken to a new environment at one of the lodge in the farms. It was a good exposure and motivation as well.

It was good that they invite a learner who participated on National Expo the previous year to present to others so that they can see even how to organise their board.

At the end of the presentation learners were suggesting the name of their group that finally named SciExpo Stars. This is the name for their community of practice as my theoretical framework is community of practice.

APPENDIX C6

Transcribing the Expo workshop one observation on 6 March 2013

SEC2: Hallow TD, you just almost find us starting and I was only telling them, that they don't need to worry, I will try to speak isiXhosa as much as I can, as well as English so that you will not get lost completely**.**

SEC2: So thank you very much to all for showing interest in Expo, I think you all know the reason why you are here. Let me assure you that, there are other schools that are not her. They are already building for their school, discussing their projects; don't say you are alone doing these projects.

Learner's motivation

I like to say that, you are in grade 9 now, you going to enter your projects, you work on your project and when you go in grade 10 you improve your projects and you work on it on different projects and you get an idea about Expo, so that you will have awards and other things. Even if you don't have good results and you present your certificate they will see that you participate in Expo and you will get your bursary, just by taking part. I know a student in Rhodes University. Let's try and work hard.

TD: Let me tell them what happen to one of the learner, have been thinking that he want to go to one of the good school, so he make an appointment with the principal and take all his certificates to that school, to show to the principal that he took part in Science Expo, So he was admitted.

SEC2: I am so humbled by you serious, Imagine you were at school today and you are already here at quarter past three, to me you showed me that, you have interest and you want to do what you want to do.

What is an Expo?

Expo is about exhibition where learners show their scientific investigations, you speak to other learners, teachers and subject's experts about what you do.

There are different types of projects around 25, where you need to choose from, for example Physics, Engineering, and Technology and so on. Teachers have a role to play, they have to mentor you, distribute information about the Expo, and they inspire you and encourage you and encourage individual work. They guide you in your projects and evaluate the projects.

TD: There are types of projects, experimental investigation, innovations, research and whatever you want to do. It does not limit you, it make you start thinking what is that you want to do.

SEC2: I never thought of one day I will have job, because of a fish my dear, just because of science. Scientist works with fish. When people hear about fish is just food. What are I want to say is that, there are diverge opportunity.

What is expected from Science Expo?

SEC2: The judges have a way of looking at the project by looking at you scientific methods and all the process. How do you do this, do not have things without introduction or how you do it. You have idea; you ask your question and say this is what happens and so on. You don't need to copy the ideas from internet, they want you to use you own ideas. When you are asking your question, at the same time have you hypothesis. Now you go and improve your hypothesis by investigating, then you get your results. They look the way you present your projects. Is very important, the presentation skills. They want someone who is confidence. Be confident and the judges will know what you are talking about.

Toward July would like you to come before the big Expo to polish you presentation skills. So we want you to come and present your skills. If you make a mistake, you get collected and you collect you mistake. Yaa this are other things that are important. This is one of the things they use, how they present their projects on the board, that one as well it shows that someone worked harder. I know most of the school have computer now. You are going to present your project in the poster. And how you are going to present your project, they don't allow you to come with knife, weapons and animals. Again the other thing which is very important are pictures, pictures are more important, because you will not know which picture you will want, ok, this is another example but there is too much data. Any way that was about Expo project, Science Expo. The Expos normally be on 20 July every year.

TD: Sorry Seya, They do allow them to go a day before to display their projects. But there used to be time allocated in the next morning for display.

SEC2: What we wanted to find out is that, do you have already ideas of Expos projects? Hope some of you did not understand What an Expo is. May be you have already ideas but you are not sure. Do you have already ideas for your projects?

Lrs: yes (some respond)

Dalia: Let me ask Charles, What is wrong with your projects from last year?

TD: Because what is important I think is this Charles had a good project, but he needed to further find the data and information and also improve some methods, which they already have as step one. There is nothing wrong if it was your original ideas you can use the same topic but improve it, especially if the judge commend that this is a good project but one and two are lacking.

Because, if I can remember, there is a child Twapewa from Tada School, she did a project while in grade 8 and I think was the first child I worked with and that Twapewa did a project, the same project. You don't need to do anything next just find more information and now present this in a more scientific way, have grass in your projects more pictures on it, Twapewa went to Pretoria last year and was the best student using the same projects. If you cannot improve your project from last year, unless, you have good idea more than the one for last year.

What you need to do, you need to keep your original work which means that is your rough file, which is nicely typed in order, in sequence that is going hand in hand with what is in a poster, do you understand? So you are going to have at the end of day the two files, the first file will be for rough work and the second file will be for the final file which links to you poster. That is very important.

TD: That was the understanding of scientific investigations. We are going to meet on the 22 of March at least everybody should come with the ideas of what you want to do.

Don't panic we will help you throughout. We are not going to do the project for you actually you have to do your project yourself.

Sometimes the reason why you are not winning there is, because we are not familiar with your field, with what you are doing. Sometimes do not say your work was poor, look at it from both sides. I want to say that, with my first group we went to camp at PE and they were so serious, they worked hard and managed to collect their data by following scientific methods. Last year they were in first year at Rhodes and one day they came to me saying that "Ms Dalia may you please help us the book we were using during the camp". I said what for? "We will be doing exactly what you told us in Grade 11 during our camping". You are luck doing these things of scientific methods in grade 9, and the PhD candidate, they met these things now, they follow the same things, and some people only meet these things at University and you are starting at very young age. Whatever project will come you will be able to tackle it. Just imagine those learners who will not get this camping opportunity. What I am saying is that they are doable. Remember you have two files the dirt and clean file; you will leave them all there for the judges to see.

TD: Like one example, where learners were looking at two process of brewing.

SEC2: You know now what Expo is and what is expected from Expo. What is the way forward now? There is no time to go to the regional Expo.

TD: There are only two months to work on your projects.

There are many problems in Grahamstown, think about the dumping site, sewage and water pipe. I am just making you to think guys. Another example, some learners came to participate last year for the first time, but they won and went to Pretoria. When is the next workshop date?

Lrs: Next week 22 march 2013, at SDA, 14h00

TM: will organise the venue no problem.

SEC2: what we are going to do that, we will look at project ideas.

TD: On that day you should not only come up with ideas but think of what method you will going to do your projects, maybe I want to do interview or is a survey. And please we want you to be in the first five not just in a top ten, in the first five.

SEC2: I know they are going to Johannesburg.

SEC2: Alright let's meet on the 22 at DSA.

What I observed from this workshop

Learners were passionate to learners and assisted, they were listening attentively. The SAEON Expo coordinator Seye and teachers Dalia tried to motivate them and guide them how they can came up with their expo project title.

APPENDIX C7

Transcripts of learners *who was participating for the first time- Experiences* 19 July 2013

Codes used, (L1 and L2) learners who was participating for the first time, (W) is a researcher.

W: May you tell me about your experience of expos?

L1: My experience about doing a science Expos project was very great, I did not know about doing a science project, I did not know that we can do many things, our teacher told us to choose a project topic and research on it. I did not know all about that, I only knew about it, when she started explaining to us what the Expo is about and what the Science expo project is about and how the judges will be expecting from us. So it was really great doing it and really enjoyed it.

L2: My experience is a bit challenging and is also good to work on the project that you do not know about and you find information about it.

W: What motivate you to participate?

L1: I only heard last year that there is Science Expos here in Grahamstown and only saw projects last year for the grade 9 and I thought doing it. Our teacher told us to think about a topic so that we can do it this year.

W: How do you feel to participate in a regional Science Fair?

L1: It is so exciting like now as I am looking around at other kind projects they really look nice and I like ours too.

W: Do you think your participation can help you to understand scientific investigation is?

L1: Yes, because when I go to grade 10, I will know how investigate, have hypothesis in the projects that will be given and will know more next year.

W: What fear did you have when you fear did you have?

L1: The fear I have, is a fear of being disqualified, I have been actually reading a booklet that were given and said if judges saw that you plagiarised automatically you are disqualified that let me now that if I take something from the internet then I should reference it and acknowledge the author or the internet site where I took the information.

L2: and the judges because I do not know what expected from the judges, what the question they will ask and what they want you to say,

W: How were the judges' commands, were they supportive or were they frightening?

W: What have you learnt from the Expo?

L1: I learn a lot about science basically and how to do a science projects, how to interact with different people around and how to respect each other.

L2: And think like a scientist

W: What was challenging when you presented your projects to the judges?

L1: the part which was challenging is the independent and dependent variables,

L2: I did not know which one goes to which place.

W: What was easy when you were presenting your project?

L1: the easy part was the introduction, background actually and hypothesis.

W: Will you like to participate again?

L1 & 2: yes we want to participate again next year even though we will not win, because from the commands we received from the judges said we will be able to do the same projects again next year but we can think of another topic more than this, we can not just see other learners doing projects.

APPENDIX: C 8

Transcripts for learners who have been participating in Science Expo. *Focus group interview.*

Codes are used for learner 3 (L3), Learner 4 (L4) and (W) an interviewer

Thank you very much for participating in my interview. Please feel free to give your views.

W: ***Could you please tell me, what do you think is the purpose of Science Expos?***

L3: The purpose of Science Expo for me is to give us an insight of how real science is and how we can work on our projects because at university they might ask you to do your own project and is good to start doing a project at Expo. To expose learners to many things in science, to discovering young scientists and gets more interest in science. An Expo gives you any experience of how really things are out there, it gives learners some sort of work experience of how really science is not just books, reading but to be involved in science physical and it takes you through the steps of how you approach things in science and how you investigate things in science and how you determine this and that.

L4: To me the purpose of Science Expo is to give the participants new life skills and to expose them to new things, help them to be out that they have potential to make things that are available to people and to the environment. It gives them power to know that I can contribute and I am someone who can do something.

W: ***What are your experiences of your school involvement in Science Expos?***

L3: My school involvement in the Science Expo is, our school Principal is very supportive in terms of involving in such programme like this, she actually supported us. She organises workshops to encourage us enter Science Expos at our school.

W: What about your science teachers? (***Follow up question).***

L3: My science teachers always encourage me that is good to learn it practically rather than just reading a book.

W: What about other learners, are you the only one who participate from your school? (***Follow up question)***

L3: We are about ten this year, last year we were about five. So we improved from last year, the workshop have attract more learners to participate.

W: ***Learner 4 what is your school involvement in Science Expo?***

L4: I did not get that much support from my school but I got support from only few teachers like, instead of my science teacher I was helped by another teacher. I was not really having that relationship of working with my science teacher because she was sometimes out of the country, the teacher who helped me Ms Mehuka, she organises everything I need. I am the only one from my school but we were three but they could not reach to finish their projects because they have another programme to attend to and those programmes are very much demanding and need 100% attendance. They were busy with that and they did not have time to complete their projects, but they were keen to participate, but unfortunately.

W: ***What are those programmes?***

L4: Like academic support group example Cava.

W: ***What are your own experiences of participating in Science Fairs/ Expos?***

L3: My participation in Science Expo I gained lot of experience actually and I discover things that I never knew myself also. It is really hard to work on the project. It is much easier to say I will do this and that but when it come to the doing that is the difficult part. It taught me a lot of those. It gave me insight of scientific investigations and more exposed to do projects.

L4: I may say I gained a lot, I am not afraid to do the project now, I am not afraid to give my ideas and make the out person understand my visions. I like the experience I got because I was a boss to my project, I controlled everything that I did and I have to feed other people with the information I have. I was the centre of attention unlike it does not happen at school so it is a fun moment with me even though I did not win the other years. I am comfortable of doing projects.

W: ***Who motivated or inspired you to participate in Science Expos?***

L3: My teacher, Ms Seye and one of the lecturers from Rhodes University who inspired me and first told me that "*if you participate in Expo programme you will get a experience"* and is what I get now so I would like to thank him, I very much grate about it. For my project my parents were so much supportive.

W: ***Where first you heard about Science Expo before you participate?***

L3: I heard about Expo first from a friend, that there is such a thing and you might want to join, at that time, my friend has participated in Science Expos before. He told me about this and I said is quiet interesting and then how can I enter? He told me about the details and I entered.

W: ***Learner 4, Who motivated or inspired you to participate in Science Expos?***

L4: My teacher, Rhodes University lecturer, Ms Seye whom I worked very close with her and my friend too. They motivated me since they could not make it, so they encourage me to go forward with it.

W: ***What was your fear when you first participated in Science Fairs/Expos?***

L3: My worse fear was when judges asked you a question and then I was like I do not have an idea about it and that automatically turn you down, immediately if the judges knows that you do not real clear about your project, I was a bit nervous about those kind of things.

L4: The first time I entered I was scared of messing up especially with the oral interview like I was especially that if a judge ask me a question, will I be able to answer it correctly like, will I be able to give the clear answer exactly like what the judge want? So, I think that is what will mess up things on the first place. I was very scared because it was my first time.

W: ***Who supported you in carrying out your Science Fairs/Expos projects?***

L3: My teacher, my principal, Seye , University lecturer and people from the Science Office, they helped me and supported me with the printing and all that.

L4: My Geography teacher, Ms Seye, University lecturer because he gave me some criticism like what to do and some advice.

W*: What challenges did you or you encounter when you participate in Science Fairs/Expos?*

L3: Firstly, for my experience on doing my project things never turn around when you expect them to be because doing an experiment you expect them to be like this, the results there are lot of things that are happening and I was also like should I give up now or should I not, is very difficult, there are many challenges that I face like typing, I took three hours typing only one page. From there scientific methods were quiet clear.

L4: My challenges were resources that I needed; I do not have money or computer, I get a help from Ms Seye and also the data that I got I could not find a way to analyse them and try to give people like the main ideas, the help I got from Ms Seye, helped me a lot, she guided me a lot like to do this and that. Like me I did not get more support from my school but some were discourage me that I should not come to Expo, I will embrace our school, they were like you will lose, you will fail, but I prove them wrong.

W: ***What do you think are the challenges for those who do not participate in Science Expos?***

L3: Some learners think that they are from poor background; they do not have money for resources, so it does not matter where you come from as long as you believe in yourself.

L4: They do not get inspirations from others and lack motivation too. I would like to say the teachers must be engaged with the Science Expos making the point that making passion for them to enter.

W: ***What excite you about Science Fairs/Expos?***

L3: Firstly what make me excite is to see the other project of other learners that they are doing. They are very impressive and some of the things that other learners are doing I never knew them before is very difficult to do such project.

L4: Meeting new people and making new friends

W: ***How does your participation influence your perceptions about science as a subject?***

L3: My participation in Expo really gives me to decide that I can take science and a career to follow. So it taught me that you need to work hard if you want to be successes in this world.

L4: I think it improve the way I learn science in school because every time you discover a new things that make science easier to understand, to learn and to know too. From now science became too easier.

W: ***Do you think your participation in Science Fairs/Expo does improve your understanding of what are scientific investigations?***

L3: Yes it have showed me how to carry out investigations like doing it practically not just readings, I seen by doing it. Like science is everywhere, like my project it was just a small project but it end up being more a bigger project. It was just a small problem in my community that I went about and solve it and turn out a big project so my project help me with the understanding of scientific investigations.

L4: I have a better understanding now since I am done with my project and I understand science much better now. By getting my own topic and have to be original. Before you do you project you have to write the prediction and do your methods, you get your results and have to record them down. You also write you discussions, you discuss the results and the challenge that you face and then you then conclude that my prediction proves correctly or incorrect like that. When you read the articles or goggle you have to write the references.

W: What do you think need to be done to motivate other learners from your school and other schools?

L3: As like me I was motivated by my friend because is the one who told me to participate, I think lots of the Science Expos workshop should be carried out in our townships to workshop about the Expos, about the procedure to do science projects and what science Expo is all about. I really think that there is a need for such workshops in our township as this is a lack. Most of the learners are not aware of this as I was.

L4: I think instead of hosting only one Regional Expo it could be made possible to have school Expo so that we can learn from experience that this is me before I came to the Regional Expos, there will be exposed to science projects and how to conduct it. The people who are Expo director should visit the school to inform the learners and how it will benefit them as individual later in life.

W: ***What do you think should be done to the successful projects after the Science Fairs/ Expos?***

L3: To take the information and apply it, because you saw a problem and sort of evaluate our solutions and see if it can make a difference, this projects are very big and can make a huge impact.

L4: They must work on your ideas and make it a reality that I know that you did it practically and you are the only one benefited out of it, they can enlarge like may be for a certain area, they can make it a big project where they can invest money to improve your project and make it a long term project that can benefit certain people or even people of a country or a town. The project can be used to present to others who never be successful with their projects and to those who do not know about Science Expos.

W: ***Do you think is important for the top five learners to present their project to other learners?*** *(Follow up question)*

L3: It was significant important because everyone need to know who did that successful projects and how it was done since some of the learners did not see them when they were displayed. It can make other learners who did not win that Ok I can just look at the small problem in my community try to solve problem in a small community before you move to a big community.

W: ***What do you think should be done to the successful learners after the Science Fairs/Expos?***

L3: For me I would say learners need to be supported like someone has to check ok, are they making progress? Because if you enter into Expo and won you want to carry on and you need some back

up of some people who will support you all the way, they need to be guided. It is necessary for learners to encourage others to participate like you can enter it does not matter in what condition you are, they can inspire others and being a role model.

L4: I also agree with him they need to be guided and see that the problem you want to solve is really a solution to other people. It can solve many problems so it wise for many people who have more influence to guide learners, support and to drive them like encourage them to do more than this projects. My success will helps me to motivate them more. The influence I will have to them, they will really believing me and take me as their role model like almost everything I do, are always good things.

APPENDIX C9

Interview transcript for learner 6, who participated at National Science Fair/Expo.

Codes used learner 6 (L6), interviewer (W).

Profile questions

W: How old are you?

L6: I am 16 years old

W: When did you started with your primary school?

L6: I started 2002 at school X and then moved to school 5 where I am currently schooling.

W: what is your current grade now?

L6: I am in Grade 12 now.

W: What are the subjects that you are doing now?

L6: Pure Mathematics, Physical Sciences, Life Sciences and Economics.

W: When did you start participating in Science Fairs/Expos?

L6: I started in 2011 when I was in Grade 10, I was co selected to take part in science camp organised by SAEON, South African Environmental Organization Network. They told us how to do Science projects and from there they selected projects that they think are up to standards of national science projects. I am one of those who were selected to present the projects at Regional Science Fairs/Expos and from there I was selected to go participate at National.

W: Where did you first heard about Science Fairs/Expos?

L6: I heard about in 2008 from my cousin sister who is currently at the University right now, she also entered Science expo in 2008 where she won first prize at Regional and she won a gold Medal at National.

W: You did not hear about Expo from your school?

L6: No

Interview questions

W: Could you please tell me what do you think is the purpose of Science Fairs/Expos?

L6: I think the purpose of Science Expos is to expose all the science learners into how research is done at University level and is preparing us at high school for University level to some of us who want to do research at University, is equipping us to do that.

W: What are your experiences of your school participation in Science Fairs/Expos?

L6: In my school, I am the only one who participated in Science Fairs/Expos, obviously the way they react towards me is somehow different, I received positive commands from people that congratulating me on the participation that I am a good example to others at my school.

W: Did they give you support when you were preparing for your science Project?

L6: Yes they give me support, especially my science teacher and classmates. They supported me all the way.

W: Do your school organize workshop to motivate learners or you were only participate because you heard it from the cousin?

L6: The school never organise any workshop on Science Fairs/Expos.

W: Can you tell me your own experience of participating in Science Fairs/Expos?

L6: I was trying to adapt to the new environment and condition of Science Fairs/Expos, it was quiet amazing because I even got opportunity to socialize with other people, make friends and get to learn from other people and experience that is when it began up to National.

It was amazing experience, it was a great feeling that I will never forget again, I never saw myself sleeping in a three star hotel in Jo'burg any time and I did not expect it.

W: Who supported or inspired you to participate in Science Fairs/Expos?

L6: Two people motivated me, firstly my cousin who participated before and also my science teacher, helped me in trying to modify my project for National finals.

W: What was your fear when you first participated in Science Fairs/Expos?

L6: I was fear that I will not fit in to the environment since I was not used to many people, I was like I might feel like accursed or something. I was also having fear when I was presenting my projects.

W: Who supported you to carry out your science projects?

L6: My cousin as I have mentioned and my science teacher.

W: What about parents?

L6: I live with my grandmother and she does not understand about Science Fairs/Expos or anything which have to do with science, she does not both asking me to explain to her what is.

W: Where do you get the resources to carry out your project?

L6: I usually go to one of the lecturer in Rhodes University and then I speak to him or to Ms Seye at her organisation.

W: What challenges do/did you encounter when participated in Science Fairs/Expos?

L6: The competition, the standard for the competition is very high, I did not have correct resources to carry out my science project experiments. I also have challenges of time to complete my project because I was also busy with preparing for Examination. Some learners use to say is a waste of time I do not get anything out of that.

W: What excite you about Science Fairs/Expos?

L6: What excite me is the facts that Science Fairs/Expos unity people, it opens a new world for a person, you get to learn experiences from other people and make decision based on those experiences which will benefit you in a long run.

W: How did your participation in Science Fairs/Expos influence your perceptions of science as a subject?

L6: It helps me in terms of following the correct methods when doing projects and scientific investigations and it improved my performance in science. That makes me choose science subject at grade 12.

W: Do you think you participation improved your understanding of what are scientific investigations?

L6: Yes it has, I also met new terms that I never saw before on the steps to follow when doing a science project. Such as errors and modification, what do you thing went wrong when you are doing a project and how do you improve by doing it better in your results?

W: What do you think should be done to motivate other learners from your school and other school?

L6: The school should organise people or Ambassadors of Eskom Expos for young scientist to organise workshop at the school or maybe to organise workshop every year to explain what is Expos.

W: What do you think should be done with the successful projects after the science Fairs/Expos?

L6: I think the successful projects should be entered at other Science Fairs/Expos and see how they will perform at those international Science Fairs/Expos. If projects can make new products, they can take those projects and take to the company that relate to those projects and those companies can adapt the process of making those projects.

W: What do you think should be done to the successful learners after the science Fairs/Expos?

L6: I think they should also be exposed to other Science Fairs/Expos other than Eskom Expos for young scientist. Learners can also be admitted at the University after their metrics.

W: What are your experiences about Science Fairs/Expos judges?

L6: The judges were different, at Regional Science Fairs/Expos they were not supportive comparing to National Science Fairs/Expos, because when they noted an error they did not give you any

advice on how to go about fixing that error. Their commands are motivating a lot because they are helping to improve on our projects.