# MENTORING FARM SCHOOL TEACHERS TOWARDS EXPO FOR YOUNG SCIENTISTS PROJECTS

By

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# DECLARATION

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## ABSTRACT

The study *Mentoring Farm School Teachers towards Expo for Young Scientists Projects Participation* was prompted by the fact that no farm school has ever participated in Science Expo for Young Scientists in the Thabo Mofutsanyana Education District. Expo for Young Scientists is an event were school learners present their projects to be adjudicated. Mentoring is used as a strategy of the study. The researcher used Critical Theory as a theoretical framework. The conceptual frameworks covered three areas, which included (i) mentoring, (ii) Expo for Young Scientists and (iii) Farm schools. A related thorough literature review was done on the three conceptual frameworks.

The research design of the study was Participatory Action Research. Data was generated using notes, recording verbal discussions, the free interview attitude, photographs and body language. Forty participants were used, amongst which were four local teachers and twenty-nine grade nine learners.

Data analysis and interpretation of findings were done using Critical Discourse Analysis. The findings of the study were that the smooth running of Expo for Young Scientists was hindered by the inability of farm school teachers to start the project, their indifferent attitude towards their community-related Science, the investigation steps conundrum, lack of appropriate resources and insufficient references, the absence of free access to the Internet and unavailability of apparatus.

The study made several recommendations for successful mentoring on Expo for Young Scientists: (i) starting with the projects as early as February of each year for the August regional finals, (ii) providing teachers (who are mentors) with hands-on training on the projects, (iii) letting teachers find a way of using the same projects to contribute to school-based assessment of learners, (iv) different subjects in the same school utilising the same projects, (v) verifying through the use of a feasibility table whether the intended project will be possible or not, (vi) involving as many local people and other interested parties as possible, (viii) deploying the simplest way to have a successful project by using easily available locally based resources.

This study will motivate all farm schools and isolated rural schools to participate in the Science Expo.

# CHAPTER 1

## INTRODUCTION AND BACKGROUND

### 1.1 Introduction, background to the research problem and relevant literature review

The proposed study of *Mentoring Farm school teachers towards Expo for Young Scientists projects* seeks to prove that, with appropriate mentoring, farm schools can prepare proper science projects for participation in Expo for Young Scientists. For over fifteen years the researcher has encouraged farm schools in the Thabo Mofutsanyana Education District (TMED) to enter Expo yet, according to his records and recollection, not a single farm school has done so. Lately, teachers from a few farm schools have expressed their eagerness to participate in Expo but only if he is still prepared to guide and assist them. It has also been his desire to see farm schools receiving equal opportunities like all other schools especially in science competitions such as Expo for Young Scientists. The researcher's vision is underpinned by Chapter 2, Section 29 of the Constitution of South Africa (RSA Constitution, 1996: 12) which talks about social justice for all. Expo for Young Scientists (popularly known as Science Expo in the District) is defined as "*an exposition or science fair where students have a chance to show others their projects about their own scientific investigations*" (Eskom Expo, 2012: 5). In sub-Saharan Africa where more than 70% of the inhabitants stay in rural areas, socio-economic conditions impact adversely on science education and hence participation in science fairs (Ramos, 2014: 9; Isaac, 2016: 3). Studies by a South African, Alant (2010: 1), on rural schools, indicate that their biggest concerns are inequality in science and technology education and deprived conditions. Mentoring provides advice, counsel, guidance, support and feedback to the school community. In the researcher's interaction with farm schools, he was open to learning about the unfamiliar territory of farm conditions as it was his first serious interaction with this type of project in this type of setting. Despite his good intentions he was wary of being regarded as a threat because sometimes a mentor may be viewed as a stranger who does not fully understand local challenges. Because a mentor is regarded as an expert, co-researchers may hesitate to raise their opinions freely (Chavez, 2003: 87; Barton 2001: 899). Teachers may also feel threatened by learners who initiate projects that are beyond teachers' knowledge and understanding. Understandably first-time participants in science fairs, particularly those from rural areas, feel intimidated (Alant 2010: 7).

Tunnicliffe (2012: 4) observed that farm school teachers and learners seem unaware of the rich resources around them which are freely available like a farm and open veld. The researcher has experienced that learners participating in Science Expo want to come up

with very difficult projects which according to them will have the "*wow factor*". A study by Mothokwa (2014: 35) indicates that the main purpose of science projects is to inculcate scientific investigation skills. The implication is that a mentor should create conducive conditions from the beginning for co-researchers to own research study as habit or tradition of participating in Science Expo and that farm schools should continue to participate in Science Expo even after the mentor's initial involvement has ended. Lui (2006: 9) added that a mentor should guide co-researchers through the Science Fair processes throughout the study. The Policy on Rural Education in South Africa(PRESA) advocates for farm schools to be given equal support like all other schools, hence this study (Gardiner, 2008: 27; Gordon and Qiang, 2000: 24; Kitchen 2009: 7).

The South African Schools Act (SASA) (RSA DBE 2005: 13) stresses that the government should redress injustices in education provision. Despite this injunction farm schools still lack basic resources and computers, printers and Internet connectivity are luxuries. Although access to these resources is not essential to Science Expo participation, lack of access to them inhibits the potential of learners who are already disadvantaged. There are challenges unique to farm schools that further obstruct equal education provision and participation in Science Expo. Many learners have to leave farm schools during the year when parents move to other farms resulting in a loss of interest in completing Science projects. Since Science Expo projects are time-consuming and require resources and support some parents may force their children to abandon their projects out of frustration. Presentations at the finals of Science Expo are done in English which is not the home language of farm school learners. Consequently they may lack the confidence to present their projects in front of judges (Barton, 2001: 899).

Despite the impediments mentioned above, the researcher is confident that the study will yield the following indicators of tangible progress: teachers grasp scientific methods and are able to support learners, learners begin to understand scientific investigation steps, learners start to work on projects with more independence and co-researchers are able to work on their own between general review meetings without waiting for the mentor. Ultimately there should be science projects ready to be registered for participation in the Regional Science Expo. The improvement in completion of science projects as part of School-Based Assessment (SBA) will indicate a positive influence beyond participation in the Science Expo (RSA DBE 2009: 89).

### 1.2. Research interest, focus OR problem

The non-participation of farm schools in Expo for Young Scientists because they cannot start science projects due to a lack of focused mentoring.

### 1.3. Paradigmatic, disciplinary and theoretical (or conceptual) framework for the study

In order to focus on the study *Mentoring Farm school teachers towards Expo for Young Scientists projects*, the theoretical framework of Critical Theory has been chosen as a lens. Crossman (2016:1) describes Critical Theory as:

"A *social theory orientated towards critiquing and changing society as a whole in contrast with traditional theory orientated only to understanding and or explaining it"*

Critical Theory originates from the Frankfurt School which was established by Felix Weil in 1923 with the aim of developing Marxist studies in Germany. The first generation of prominent theorists was led by Mark Horkheimer. He wanted to establish a theory that would assist people to free themselves from all enslaving conditions. The group reinterpreted Freud and Marx's work. When the Nazis closed the school in 1933 some of these theorists moved to the USA and later to other parts of the world. The second generation was led by Jürgen Habermas from 1956. He is regarded as a contemporary critical theorist. He espoused that it is through self-emancipation and liberation of people from structure of domination that humanity may create their history in a more self-aware manner (Adorno, 2001: 2, 5; Higgs Smith 2006: 68). The concepts of self-creation and self-awareness relate to the study as it advocates that its sampled school community be able to work independently on future Science Expo activities (Giddens, 2009: 1; 5). The critiques of Douglas Kellner, a third generation theorist, on the relationship between media and culture (Knutson & Weaver, 2016: 12) are also pertinent to this study.

Critical theorists believe that there is no objective and timeless truth but that each generation may create and have their own consensus. This stance opposes logical empiricism which postulates that all true knowledge is based on things that can be experienced and measured (Higgs & Smith, 2006: 73). Critical theory differs too from postmodernism because its focus is on society whereas postmodernism asserts that individuals are unique with different encounters (Higgs & Smith, 2006: 75).

Habermas saw the development of industrialisation, technocratic consciousness and capitalism as controlling human beings (Corradetti, 2001: 3).His critical theory emphasised ethics and rule of law in which people could reach consensus on what is right or wrong.

This emphasis complements research requirements and mentorship objectives which are conceptual concepts of the study. Habermas, unlike other afore-mentioned theorists, believes that some actions are basically right and others are basically wrong (Higgs and Smith, 2006: 73). The fundamental objectives of Critical Theory are conscientisation, transformation, communication, critical thinking, self-determination and emancipation. Each objective is elaborated on in Chapter Two of this study (Higgs& Smith, 2006: 77; Barnes & Rich 2004: 3). The success of the study is also dependent on the successful achievement of the aforesaid objectives.

### 1.4 Research question.

Question: How can mentoring be used as a strategy to assist farm school teachers in developing science projects for participation in Expo for Young Scientists?

### 1.5. Research aim and objectives/hypothesis

The main objective of the study is:

To use mentoring as a strategy to support farm school teachers in preparation for science projects for Expo for Young Scientists.

Objectives:

1. Determination of challenges for the school's participation.
2. Response to challenges determined.
3. The anticipation of threats that arise.
4. Ensuring conducive conditions for all members to function
5. Indicators of success through achievements.

### 1.6. Research design, methodology and methods

The research method for this study on *Mentoring Farm school teachers towards Expo for Young Scientists projects* is Participatory Action Research (PAR). PAR emphasises collaboration and experimentation. Collaboration is knowledge production in which participants takes part in setting the agenda of research, data gathering and analysis, and influence outcomes. (Cassano & Dunlop, 2005: 4). Mojapelo (2009: 32) points out that the community should participate fully in order to collect maximum information. As a practice PAR relates to CER in empowering and enabling those who are most affected to make positive changes. PAR in this study primarily focuses on teachers as well as learners at a farm school. Collective efforts will be made to transform the researched community. relates with the study due to its involvement of co-researchers (Cassano & Dunlop (2005:7). PAR

relates to ethnography though the latter observe externally in a passive way (Rapport, 2005: 7; Stratton, 2006: 7).

The involvement of parents where possible, should be sourced as a support to their children and school. PAR draws on a range of experiences. In research by Bergfold and Thomas (2012: 36) they indicated that after the dictatorship rule in Argentina in the 1980s, people were successfully engaged in PAR. They were mentored to fast track change and perceptions. The involvement of this farm community in mentoring will as such make them owners and pioneers of this initiative which have eluded them over the years. Interpretivists place confidence only on authentic lived experience while PAR uses critical edge in looking for voices of inherent traction and prevailing culture (Baunj, McDonald & Smith, 2002: 9). The fundamental principles of PAR are (1) democracy as a precondition (2) the need for a safe space (3) the definition of community (4) the degree of participation with distinctive features.

### 1.7 Data collection

In this study discussions, recordings, fieldwork, notes, a reflective diary, focus group transcripts, reporting and minutes will be used as data.(William, 2006: 4; Hinckley, 2005: 294; Stratton, 2006: 2).Studies indicate that data collection is sometimes viewed as labour intensive as it seems too open. The researcher comes with his tested expertise which may cause subjective procedural problems. Researcher bias is built-in and unavoidable (Rapport, 2005: 6). Disagreements between the researcher and co-researchers may arise. Studies done in Britain indicated that there is reluctance to participate in research studies as co-researchers feel that the principal researcher benefits at their expense. (Thomas, Nelson & Silverman, 2015: 1). They fail to see collaboration as mutualism and may instead regard it as perpetuation of their exploitation and oppression especially when the research idea comes from the researcher. Sensitivity to social and cultural content of co-researchers will at all times be considered. In order to pre-empt disagreements, a face to face meeting will be held with the entire team once a month (Tadevosyan & Schoenhuth, 2016: 8). The meeting will reiterate the purpose of the study and the support to be given to all co-researchers especially teachers and learners at the school. There will also be weekly meeting to support teachers and learners with the Science Expo projects. Information will be shared with parents of learners to ensure support needed by learners. This researcher has observed that in communities where parental support is substantial, Science Expo is traditional. If parents have an overall understanding of what their children do, their support and encouragement will increase. During meetings, notes will be taken and audio and video

recordings will be made. Afterwards transcripts will be distributed to allow for a deeper understanding of the discussions held. At the start of each meeting, a summary of what transpired at the previous meeting will be read to the group. The group will be allowed to critique the report. This is to ensure ownership of process and product. (Hinckley, 2005: 295). PAR further relates to the study since it encompasses community and seeks to establish a deeper understanding in order to map the best guide, counsel and assistance.

### 1.8. Selection of research participants or data sets (i.e. sampling)

Preselected criteria relevant to the research aim will be drawn. Only co-researchers who can best inform the research question and enhance understanding of the phenomena of the studies will be included (Sargent, 2012: 2). Co-researchers should be given sufficient power to inform the outcome that can be attributed to intervention (William, 2006: 4). They should be well informed about important elements of the phenomena being studied.

1.Study site: A Farm School.

2.Participants:

- The Principal as the local coordinator
- A Church representative as required by policy for religious schools in South Africa
- Two School Governing Body members to represent parents
- A Natural Sciences Subjects Advisor for content support
- A Mathematics Subject Advisor for assistance with Mathematical approaches in the Expo project.
- A Language teacher to assist learners with project report writing.
- 29 grade 9 learners.
- Three final year Education university students for them to gain experience.

Creswell (2003: 220) supports the idea of taking a large sample as there is a high probability of having a diverse representation. Furthermore if a participant should fall by the wayside the study does not collapse.

### 1.9 Data analysis, interpretation and reporting

Sergeant (2012:12) says the purpose of data analysis is to interpret data and resulting themes and to facilitate understanding of the theme being structured. Data can be confirmed and refutes conjectures. Data analysis will be on-going from the beginning of the study to enable the study to focus on the main issue (Sargeant, 2012: 3-5). Data collected by means of interviews will be coded and divided into different categories according to objectives in order to assist with the final processing. Critical Discourse Analysis will also be

applied to language use in explaining and interpreting text (Wodak & Meyer, 2001: 3, 18). Progress on projects will constantly be analysed to check on their readiness and their chances at the finals (Creswell: 2003). Mentoring does not wait until the end of the process but engages the team to reflect for self-correction. Bergold and Thomas (2012: 36) advise that responses that were forced into the study should be removed and that fair meaning be attached to data. Data will be combined with explanations provided elsewhere in the study. Data can be interpreted by deconstruction, interview and reconstruction (Sargent, 2012: 4).Inferences will then be made in order to address research questions (Hinckley, 2005: 296). Reporting will be supported by data. Completed science projects will be presented in front of the school before learners proceed to Science Expo finals.

### 1.10 Value of the proposed research

The study indicates the value of mentoring farm schools where they will become beneficiaries of social justice and equality (Raven, 2011: 55). It will highlight the plight of the farm communities in science development. Results can be used by other researchers, the Department of Education and the Expo for Young Scientists organisation. The benefit of mentoring to fast-track the development of the neglected can also be translated to other projects as attested to by Ndlovu's studies (2015: 356). The research will empower the farm school community to develop confidence in general and will also enable them to do meaningful science projects which will benefit the school dually by participating in the Science Expo (*Science Expo news 10 October 2014*: 2) and producing projects for SBA requirements (RSA CAPS, 2011: 89).

### 1.11. Ethical considerations

In this study, ethical considerations were used to protect individuals and the environment involved in the study against any form of harm, manipulation or malpractice by working within the law, using professional guidelines and acting morally.(McMillan & Schumacher, 2006: 142) .The researcher is in the process of applying for ethical clearance. Permission from TMED by way of the Free State Department of Education (FSDOE) will follow soon. The main principles of ethics are that participants should participate voluntarily and be free to pull out when they so wish. Consent to participation should be sought. If minors, like the school children at this research site are involved, their parents' consent should be sought. These learners will engage in minor hands-on activities and field trips during data generation therefore specialist adults should be in their presence at all times. The information on, names and photographs of learners should be kept confidential and anonymous as much as possible.

### 1.12. Layout of chapters

1. Introduction and background
2. Theoretical Framework and Literature review
3. Research design and methodology
4. Data analysis and interpretation of findings
5. Recommendations and Conclusion

# CHAPTER 2

# THE THEORETICAL FRAMEWORK AND LITERATURE REVIEW ON MENTORING FARM SCHOOL TEACHERS TOWARDS EXPO FOR YOUNG SCIENTISTS PROJECTS

## 2.1 Introduction

This chapter intends to explain Critical Theory as a theoretical framework for the study. Different constructs starting from the origin of Critical Theory through its objectives, ontology, epistemology and relation between researcher and co-researcher will be explored. The study of Scotland (2012: 27) states that a theoretical framework makes what the researcher used as an epistemic thinking device explicit. The study further says a theoretical frame work is the elucidation of what the world looks like to the researcher on a specific topic of the research question. Theoretical concepts related to the study such as mentoring, Expo for Young Scientists and farm schools will be discussed.

Mpanza (2013: 11) emphasises the importance of a literature review in the planning of research as it outlines how the new study links with what has already been studied around the topic. Deeper studies can also reveal flaws like biases, the refutation of data generations and interpretation to mention but few. In addition to Mpanza, I as a researcher will be well informed throughout the path of the study and will be in a good position to add value or to generate a new dialogue or argument around existing findings.

### *2.1.1 Origin of Critical Theory*

Studying the origin of Critical Theory will help the researcher not to unnecessarily re-walk the path. He will have an opportunity to raise challenges while still appreciating the theory's strengths and reported successes. Understanding the origin of Critical Theory will also assist the researcher to adapt it to suit co-researchers and their inputs.

Critical Theory is sometimes called the Frankfurt School owing to its link to and genesis in the Frankfurt Institute of Social Research. The Institute was founded through the donation of Felix Weil in 1923. Weil was a political scientist with a passion for Marxism (Saler, 2008: 2). Critical Theory generally deals with theories that are critical against capitalism and domination (Fuchs, 2009: 1). It was established out of concern over the developing revolutionary, philosophical Western Marxism and Stalinism in the East. Critical Theory supports exploration of the world and vehemently opposes capitalism from the West (Kilenchoe, 2008: 17). Its founders were concerned that the culture of industry was only interested in commodification, standardisation and massification. Because of its strong stance, the school was forced to relocate to New York in 1933. Critical Theory's main

objective is to critique a changing society (Fui, Khin & Ying, 2011: 129). It relates to positivism as both are extremely opposed to oppression and demand that the oppressed be given the power to enhance their lives (Anderson 2008:6). In this study the people involved were not taken for granted as mere utensils to finish my studies. Instead, the study was used as a start to a robust change and the instilling self-belief in the community.

2.1.1.1 First generation of Critical Theory

Horkheimer led the first generation of the school. His work with Ardono, Marcuse, Benjamin, Pollock, Lowenthal and Fromm questioned any form of domination. Consequently their focus was on establishing a non-dominative society with no exploitation and injustice. Horkheimer (1972: 244) is quoted in the Standard Encyclopaedia of Philosophy (8 March 2005: 1) as follows: "Theory is critical to the extent that it seeks human emancipation from slavery, acts as liberating…influence and works to create a world which satisfies the needs and powers of human beings". Marcuse believed that Critical Theory is about human happiness which he believed is only achieved through transformation (Fuchs, 2009: 2). It is clear that transformation gives birth to excitement among people. Happy people are motivated to do more. Ardono and Fromm, with Habermas's support, developed psychoanalysis of media which is a Marxist sociological approach to media studies. The school later totally abandoned Marxism (Anderson, 2000:3).They saw media lessening resistance as they popularised certain cultures and were of the opinion that people are enslaved by being satisfied with their popularity in media at the expense of their freedom and real transformation (Fastest 2016: 1). Their belief in the theory will support the aim of the study as a mentoring strategy by extension transforms, emancipates and removes stereotypes created about farm school communities.

In the 1930s the state was engaged in monopoly capitalism where large corporations managed the economy while individuals, mostly workers, had to submit to the state and big businesses in the name of Enlightenment. Adorno rejected Kent's Enlightenment project because while it talked of freeing people from tyranny it supported the mushrooming of industrialisation. Its aim was to maximise profit which was achieved by enslaving workers (Anderson, 2000:3).It serves as a warning to researchers not to do the study with material gain as a priority or collaborate with anyone with such bad intentions.

In 1941 Horkheimer moved from Germany to Los Angeles in the United States of America. He worked closely with other theorists who had moved to New York. It was at this time that the division between schools of thought on the campuses based in the two cities were influenced by anti-Semitism from the east coast (Corradeti, 2001: 6; Meyer-Emerick, 2005:

542).Horkheimer found that the grass is not always greener on the other side. He was irked by seeing positivists' empirical practices being taken for granted by American social science researchers. They did not have the moral realism of separating irrationality from rationality (Steinberg & Kincheloe, 2004: 141; Meyer-Emerick, 2005: 542). In 1951 the school was reopened back in Germany (Anderson, 2016:6; Corradeti: 2001:6). Horkheimer's strong stance emboldens me as a researcher to challenge any malpractice that continues to harm farm school incumbents.

#### 2.1.1.2 Second generation of Critical Theory

The second generation was led by sociologist Jürgen Habermas from 1956. Habermas is today regarded as a contemporary critical theorist. He preached the spirit of optimism (Higgs, 2006: 73) and he broadly defended Enlightenment's goal with his many writings which were mainly on political emancipation. I do understand the point of defending Enlightenment on its emancipation objective as it was for the benefit of the people at that time. We cannot always reject every theory without checking what good can be learned out of it. Similarly in South Africa, not every product of apartheid was worthless. However, we should at all times look critically at any theory brought to our attention before being its spokesperson.

The second generation began their work they conceived as psychoanalysis by reinterpreting Marx and Freud's work (Corradeti, 2001: 7). They were concerned about people being treated as a commodity in a modern society that was was being consumed by capitalism. Capitalism denies people the freedom to engage in democratic political decisions. The daily scope of human activities, human work and interaction is defined as praxis which is empowered by theoretical and practical learning. This generation's development of their theory assisted the study to anticipate hindrances and eliminate them. They believed attainment of total emancipation should occur at a collective level which requires communal participation in democracy. In this study, while copying the good practices of the time, efforts were made to be to as inclusive as possible. Giddens (2009:2, 9) goes a step further by saying "The future of critical theory must focus mainly on the creation of civil society instead of the negation of factors that hinder its realisation".

#### 2.1.1.3 Third generation of Critical Theory

The third generation is in fact not from the Frankfurt school as they were divided by geography, nationality and race. They were shaped by a plethora of different events than earlier generations. This meant they had an interpretation of the theory in their different

contexts (Pensky, 1999: 1). They focused on social integration, civil society, international justice, human rights and multiculturalism. They were vocal against neoliberalism and the rise of nationalism and capitalism (Anderson, 2000:6). Honneth succeeded Habermas in 1994. He emphasised that more attention should be paid to the notion of conflict in society and among societal groups. This shift was in conflict with Critical Theory's emphasis. It espoused a struggle for recognition hence its focus on human emancipation. Honneth, however, agreed with generations before him on non-subjective social institutions (Corradetti, 2001: 9; Anderson, 2000: 7). Adaptation of the theory to times, place and local needs agreed with the study that it should respond to the challenges of the research site. The approach was to be tailored by researchers to suit and assist in achieving the main aim of the study.

Honneth was not in total favour of Marxian influenced Critical Theory that focused on deep structural dynamics. This difference, however, did not disengage him from Habermas's project which was about how to justify the normative standards to which critical social theory must unavoidably appeal in challenging injustices of the status quo (Anderson, 2000: 8). Honneth proposes the solution of locating critical perception on individuals who themselves have experienced injustices and moral violation. Deductions from observers like positivists alone would be extremely inadequate (Anderson, 2000: 8). Hence the study has chosen PAR where co-researchers won't be bystanders but deeply involved in the study.

Brunkhorst pursued a line of thought taken from the French Revolution encapsulated in the slogan of 'fraternity'. He advocated the notion of a globalised world and the power of solidarity (Giddens, 2009: 9). Of the third generation Douglas Kellner, who is based at the University of California, was critical of the way media has a tremendous influence on culture. His view relates back to the first generation. The way, for example, a farm community is portrayed in the media creates a culture of how it is viewed. (Knutson & Weaver, 2016: 12). If the farm community is stereotyped and viewed as backward, detractors may argue that learners in this community deserve inferior education and opportunities.

### *2.1.2 Objectives of Critical Theory*

For this study Critical Theory is divided into five objectives; they are self-emancipation, transformation, conscientisation, empowerment and critical thinking.

#### 2.1.2.1 Self Emancipation

Barnes and Rich (2004: 4) summarise self-emancipation as the process of democratisation by exposing injustices and discrimination. The desire to be emancipated should spring from oppressed people themselves as soon as it dawns on them that conditions are not the way they are supposed to be. They must take the necessary corrective action. Critical Theory research must be located in the social model of the selected farm school and its surrounds. No one should be politically neutral. It is government policies and bureaucracy that enslave people. The sampled farm school community should themselves challenge these obstacles and doing so is a political act. Barnes and Mercer (2004: 5) state that political engagement is unavoidable. It is obligatory the Critical Theory researcher should approach this study with a clear focus on assisting this vulnerable community to achieve the justice that has eluded them. Any injustice and discrimination should be exposed and corrected.

The Critical Theory paradigm rejects the notion of a researcher who is like an academic tourist who is only using the community to advance personal ambition. During the period of his study, the researcher must be devoted at all times to liberate and emancipate co-researchers by understanding issues from their side. His co-researchers must dominate the study and should be treated as having equal power (Barnes & Rich, 2004: 6).

Tolmie, cited in Scotland (2012: 13), elucidates that the success of critical research lies in making people aware of their situation then realising changes through praxis. Theory, data research questions and interpretation should indicate an emergent discursive relationship. This statement as the researcher sees it may seem to negate what is mentioned earlier under this construct which dictates that the community should be initiators. However, a researcher like the author may challenge on behalf of a community like this farm community when it seems content with the status quo. Complete emancipation can only be fully achieved if the whole community is involved. It is in this way that the study, while it has listed active co-researchers, is always open to everyone who is eager to participate as per school grade limitation of Expo for Young Scientists (Expo Science, 2014: 7).

It is not a given that fighting for emancipation will be fully achieved or be achieved at the expected level. Nevertheless one of the objectives of this study is to appraise any milestone achieved. It is in this spirit that changes, however negligible, will have to be noted as they are a step better than at the beginning. This does not mean that we aim for the minimum achievement in this study. A researcher needs to be aware of receiving a backlash from the very community being supported. They may be content with their status quo as people are sometimes afraid of change or are afraid to confront people they regard as superior, senior

or so-called intellectuals. If the implementation is not done carefully, lives may be changed for the worse. In one study done in Canada, the researcher's aim was to compare the performance of different races. Because of narrow sampling, their conclusion further entrenched the existing stereotype that the study was trying to eliminate (Bagley, 2014: 181)

Mercer (2004: 8) concluded by cautioning that research is judged to be successfully emancipatory after the event and if co-researchers want to emancipate themselves. The independent actions by co-researchers at the research site will indicate that the last objective of the study is being realised. Self-emancipation praxis can only be manifested through Transformation.

2.1.2.2 Transformation

The Collins Dictionary (2016) defines transformation as radical change or alteration. It further states that in the South African context it may include a national strategy aimed at attaining national unity, promoting reconciliation through negotiated settlement and non-racism. Transformation may also be seen as an action taken by people to change the status quo once they become aware of how oppressed they are (Heusinger, 2013: 6). While people have to transform drastically we are reminded that it is about the community more than an individual. They have to be taken along.

Agherdien (2006: 6) reminds us that knowledge is transformative and emancipatory. People, such as at this research site should make changes to their social, political, personal and cultural relations as individuals, the whole school and farm community. They should make changes to inequalities, exploitation and oppression. The success is most effective if it is sustainable and done in solidarity with other people engaged in the same struggle. The school involved in this study should later look at possibilities of twinning with other farm schools to cross-pollinate their gain and as such expand transformation (Thomson, 2000: 4). Transformation needs action but people need Conscientisation to do so.

*2.1.2.3 Conscientisation*

Alinsky (2016: 1) defines Conscientisation as "a process of developing awareness of one's social reality through reflection and action". Paul Freire in Berg (2004: 1) states that real problems are uncovered through critical learning. Learning which is mainly acquired through reading, writing, dialogue with meaning and encountering others awakens people to social reality. The understanding of fundamental problems by the masses raises their collective consciousness. It is not only the duty of the privileged to raise the consciousness of the

oppressed and underprivileged but also of the affected people who may accept the support of those who understand or are prepared to learn their situation (Lui, 2012: 52). Freire urged the oppressed to develop consciousness in order to take oppressors and their actions head-on (Thompson, 2000: 2).

The researcher, therefore, concurs with the idea that the best results for conscientisation are realised as a collective. In South Africa Black Consciousness made people aware of colonial and apartheid oppression. They themselves took leading action to change their situation making it easy for other countries to support South Africa in its action. Conscientisation makes people believe that their social reality can be changed. It supports the study in that together with the team we will reflect on the beliefs, problems and myths that stood in the school's way in participating in Science Expo. (Mayer-Emerick, 2005: 510). This community may oppose conscientisation by likening it to resistance and revolt. A sober and careful approach by the researcher is needed to avoid backlash. Effective conscientisation should, however, lead to Empowerment.

*2.1.2.4 Empowerment*

Empowerment is seen as the capacity of individuals or communities to control their own circumstances have the power to achieve their goals and help themselves and others. It is a journey through powerlessness and passiveness to the destination of active control of one's life, destiny and environment. A powerless person feels worthless and alienated from the environment (Sadan, 1997:13). Sometimes even non-marginalised or privileged people can share opportunities with the marginalised or underprivileged as is the case of the mentor in the study. Empowerment can be reached through encouragement, development and motivation (Jennings, 2006: 35). Mentoring, which is a strategy for this study, has been chosen to empower the research community. The Mercer Science and Engineering Club (2000: 17) reminds us that it is not really about how we emancipate people but about when people have decided to empower themselves. It is, therefore, the researcher's duty as a mentor in the study to put his skills and knowledge at the disposal of the research community for them to be utilised in whatever way that will benefit the community. After thorough analysis the researcher and co-researchers should consider how to provide the necessary skills.

Critics query in whose hands empowerment should be placed. Empowerment may be hijacked by neoliberal forces or it may be just a buzz-word used by leftist teachers both of whom may abuse it for their own benefit (Archibald & Wilson, 2008: 22). Empowerment gives people the right to influence their lives. It is a stage in their lives in which they should

be given breathing space if needed. Rushing through processes without giving co-researchers enough time to digest may choke them. (Sadan, 2002: 21). They should be allowed to critique what is put on the table before accepting it by exercising Critical Thinking.

*2.1.2.5 Critical thinking*

Cohen (2000: 3) best summarises critical thinking as the:
*"Intellectual disciplined process of actively and skillfully conceptualising, applying, analysing, synthesising, and evaluating information gathered from general by observation, experience, reflection, reasoning or communication as guided by belief and action"*
Being educated forms the basis of critical thinking. We, however, are warned by Freire (1993:1) that traditional education has domesticated people to an extent that they have been programmed to accept anything that comes from the oppressor. By extension, the researcher will have to be careful not to stifle critical thinking (Humphreys & Mertens, 2000: 5). Even if the information is his copyright it cannot be forced onto specific co-researchers without them critiquing and interpreting it as it affects them in their own space. Since the group has developed consciousness as alluded to earlier, they will now be able to identify, interpret, criticise, and transformation will follow (Thompson, 2000: 1-2).

Critical thinking asks and answers questions which seek an alternative approach. Everyone is allowed to raise a point which they should be given the freedom to defend. The point can also be argued against. Consensus can be reached or a new reliable belief can be created. Different possible responses increase understanding and as such the path to achieving the objective becomes much clearer and reliable. The beliefs and reasons for accepting them are reflected upon. A critical thinker should also be able to reason and act on his own beliefs. Arguments carried lead to a conclusion through hypothesising, observation and explanation. Even though arguments are made about beliefs one should be aware that the community has a belief about beliefs which are unquestioned foundations (Cohen, 2000: 3-5). Critical thinking is essential to the completion of Science Expo projects in the study. Learners come with ideas that must be researched and critically challenged. These learners will be questioned about their findings and conclusions. The ability to gather information, research, draw informed conclusions and defend them should come in handy throughout the study.

*2.1.3 Ontology*

Ontology traces its meaning from the Greek present participle meaning "to exist". It deals with the nature of the knowable or the nature of reality. Critical realism is the underlying

ontological assumption which underpins critical theory (Heusinger, 2013: 4). Blaike (2000: 8) adds that it is concerned with what we believe which is a social reality. Reality has multiple interpretations which are influenced locally or are constructed historically. Critical theory persuades co-researchers at a research site not to take things at face-value but to delve deeper into what and why a community believes and also question their easy acceptability of such reality. As much as possible co-researchers should dig deep into how reality has evolved over generations.

While the reality is always available to be tapped, Scotland (2012: 14) cautions that human beings are partially influenced by laws (Higgs & Smith, 2006: 75). Paul Freire realised that social myths have dominant tendencies. It is through learning that realities and needs are uncovered. It is humans who should challenge and change the unfair laws or change their conditions (Freire, 1993: 3; 2000: 188). At the same time, learning does not encourage lawlessness. It is the view of Heusinger (2013: 5) that philosophical perspective based on realist ontology is driven by immutable laws. It is neither right nor wrong depending on mental constructions. Critics argue that the narrative of reality being neither right nor wrong renders it irresolute. It is not binding and it avoids clashes of opinion. Hence Barnes and Rich (2004: 3) summarise that doing ontological dimension addressing how and what people know is manifested in who they are and what they want to do.

Critical Theory should be compared with other theories. Dieronitou (2014: 4) defines objectivism as entailing the social entity in question and adheres to an external objective reality independent of researcher's awareness. It focuses on social research. Anti-positivism focuses more on experimentation. It is criticised for insistence on a top-down approach to research. It has a cause and effect approach with its ontology being detailed on methodology. Its preference for experimental design restricts research methodology to empirical tests under carefully controlled conditions (Tennis 2008: 2). Constructivism believes that relativist ontology's rejection of the existence of any possible reality is regarded as the foundation of research (Duisburg, 2013: 7). Critical Theory in this study recognises every step of the research as integral. The choice of Critical Theory proves appropriate as is it the only theory amongst those mentioned which put the affected at the centre. It allows them to be at the forefront of their change.

### *2.1.4 Epistemology*

Epistemology is how we know. It comes from the Greek verb *'episteme'* which means knowing something very well or to internalise something by experiencing it. It makes claims about what kind of knowledge can be created through research, how it is gathered and how

it is presented. Cohen, Marion and Morris as cited in Heusinger (2013: 5) contribute that knowledge can be hard, real or transmittable in concrete form. In Higgs and Smith (2006: 73) logical empiricists believe that all true knowledge is based on things experienced and measured. Knowledge is, therefore, a human creation and becomes the property of that society. It agrees with ontology on the point of environmental context having an influence in the shaping of knowledge.

Knowledge can also be softer, more subjective, based on personal experience and insight. Subjectivity believes that people have a different understanding of what they know. It is one of a 'possible ways of gaining knowledge of social reality in whatever way it is understood to be' (Blaike, 2000: 8,15). It claims about how what is assumed to exist can be known. The way a people perceive and understand reality shapes or influences their course of action (Alisnsky, 2016: 1). Objectivity believes that knowledge is gained through interactions, whether people are conscious or not. In this study, people's actions will explain how and what they know.

Agherdien (2006: 6) emphasises that knowledge changes with time and is also influenced by context. Moreover it should transform and emancipate. The latter statement links well with the objectives of Critical Theory of this study. Learners doing projects in the study should be allowed to challenge accepted knowledge and where possible create theirs based on their present context. It is a fact that society constructs knowledge. People with more power shape it according to Scotland (2012: 13). They control the means of communication such as media. The propagation of their construction of knowledge receives wide-spread distribution.

Cohen (2009: 97) adds that what counts as knowledge is determined by the social and positional power of the advocates of that knowledge. Human behaviour can be influenced by genetic influence and experience. Social experience and circumstances play a role in shaping people. Cultural settings such as religion, community, social class, and language develop social connections. Social constructivism argues that we are born into a community and world that already possesses knowledge that has been constructed for centuries. We become part of the system we inhabit (Scotland, 2012: 13). Many consensuses are reached and agreed upon that influence a body of knowledge. All existing knowledge should not now be ignored but form the basis for forming a new one, strengthening or building on it.

*2.1.5. The role of the researcher and connectivity with co-researchers*

The researcher is an educator and activist who fulfills a supportive and catalytic function who should avoid dominating research. Researchers should eliminate the power imbalance and put all their skills and knowledge at the disposal of co-researchers (Barnes & Rich, 2004: 6). The researcher should provide leadership, coordination and facilitation of the study. He will allow serendipity and experience to flow by building rapport and trust. The researcher should be able to handle chaos, conflict and tension. Furthermore, he should be aware of the culture, beliefs, values and passion of co-researchers at the research site (Lawson, Carngi & Loretta; 2016: 139-140). Heeding the call by Creswell as cited by Scotland (2012: 12), co-researchers should be fully consulted in all processes of research which may include designing questions, collecting data, analysing data and benefiting from research. The research conducted should have a catalytic validity which will enhance the lives of co-researchers. (Heusinger, 2013: 20). The whole group should also be allowed to set the parameters and direction of the study.

For the purposes of the study the researcher was conscious to use the context of the community where research took place to explain and describe the situation (Zuber-Skerrit, 2016: 4 of 10; Project 2061, 2016: 2 of 13). If correctly applied, this approach builds harmony in the study and members know where they stand. Co-researchers need strong social support and care from me as a researcher and mentor.

Co-researchers are subject to high expectations. The researcher should reinforce achievements and ensure that conditions are always enabling (Jennings, Parra-Medina, Messias & McLoughlin, 2006: 35). The recognition of the moral rights of co-researchers in the generation of knowledge and its ownership is important. If not assured they will never own any outcome from the study and remain untransformed. The spirit of democracy should flow easily to allow co-researchers to make inputs and suggest changes if needed. The researcher will have to keep reminding himself about the researcher-co-searcher relationship to ensure that there is no breakdown in that relationship which could threaten the study.

## 2.2 Conceptual Framework

In the Conceptual framework, an attempt is made to check the literature review on concepts that are the core of this study. Views from different scholars are interrogated. Their origin, definition, purpose, benefits and link to the theoretical framework will be explored. School-based mentoring will be explained, how mentors benefit from mentees and the bidirectional benefits of both. The success of mentoring starts with good planning. Mentor and mentees

have roles, principles that he/she should display while still respecting boundaries. The international trends indicating the success of mentoring will be discussed.

### *2.2.1 Mentoring*

The origin of mentoring is explained starting from the mythological period. Definitions from sources will be presented and compared. The researcher will also add my own definition. Mentoring does have challenges but they are out-weighted by benefits.

#### 2.2.1.1 Origin of mentoring

Mentoring originates from Greek mythology. The word ‘mentor’ appeared in an epic poem attributed to Homer, *The Odyssey*. Odysseus, the father of Telemachus, appointed his friend Mentor to look after his son when he left for the Trojan War. Mentor’s function was to act as a supportive figure and role model to Telemachus. He was to play a guiding role as the young man was growing from childhood to an independent intelligent and responsible adult (Bruce & Bridgeland; 2004: 14; Gordon, 1997: 1). Because of Mentor's relationship with Telemachus the personal name Mentor has been adopted in Latin and other languages, including English, as a term meaning someone who imparts wisdom to and shares knowledge with a less-experienced colleague (Wikipedia Contributors 2019).

#### 2.2.1.2 Definition of Mentoring

Mentoring has many definitions as cited in different studies and official publications. Some are defined close to the context of the topic under discussion. At the end of the definitions in this study, the definition will again be made as guided by the references made and also tailored in line with the research topic.

Mentoring is the development of a partnership between a professional with in-depth knowledge in a specific area and a protégé seeking experience and knowledge in the same area (Caela, 2006: 1). According to Wai-Packard (2004: 1) mentoring is a relationship between a less experienced individual called a mentee or protégé with an experienced individual called a mentor. She elaborates on mentoring as a process of assigning a junior staff member to the care of more experienced persons to assist (them) in their career. Parsloe quoted in MentorSET (2016: 1) believes that ‘Mentoring is to support and encourage people in their own learning so that they can maximise their potential, develop their skills, improve their performance and become the person they want to be’ The definition emphasises that the people being supported are not pushed but only encouraged on what they aspire to do. Their understanding agrees with the RSA DBE (2008: 15) which describes the ultimate goal of the strategy as a process by which knowledge, skills and life

experience are transmitted to another in the organisational system for the purpose of growth.

The following definitions shift emphasis from people to actions in the relationship. Caela (2006: 1) eliminates the power relation by saying it is a relationship between two individuals based on a mutual desire for development towards a goal or objectives. Addington and Graves (2013: 1) agree with Caela on the point of mutualism by saying seeing mentoring as the beneficial relationship with an intentional agenda designed to convey specific content along with life wisdom from one individual to another. Additionally, mentoring includes development, classroom instruction and on-the-job training. The beneficiaries in the relationship are highlighted by Faure (2013: 1) who states that mentoring is a long-term relationship that meets development needs, helps develop full potential and benefits all partners, the mentor, mentee and organisation resulting in multi-directional recipients. Mentoring needs certain conditions to thrive. They are well captured by Collin (2013: 1) as a protected relationship in which learning and experimentation can occur, potential skills can develop and results be measured in terms of competencies gained.

Based on the definitions provided, the researcher's understanding, and in relation to his study, he has formulated this definition: *Mentoring is a process whereby a person with in-depth experience accepts a call to partner with an underprivileged person in acquiring upliftment and accelerated skills to compete at the same level with the privileged*. In this study, the researcher will be alongside co-researchers in their pursuit of empowerment, transformation and emancipation. Meyer and Mabaso (2016: 1 of 11) share his opinion as they argue that mentoring is a way of transferring learning and accelerating empowerment.

2.2.1.3 Who is a Mentor?

A mentor is a person who knows more about a certain area of expertise (Caela, 2006: 1). In their own words, Bruce and Bridgeland (2004: 13) define a mentor as a "Supportive adult who works with a young person to build a relationship by offering guidance, support and encouragement to help the young person's positive and healthy development over a period of time". Because of their proclivity, they answer the call. Answering the call does not turn them into saints or saviours who are coming to rescue a sinking ship (Pawson, 2004: 8 of 81).The mentor also assists the mentee to find direction and be able to develop a solution to issues at hand. Mentors should strive to have empathy with mentees by understanding their perspective (Spencer, 2018: 2). The adult here referred to excludes a young person's parent. Daniel (2006: 5) adds that a mentor is an individual with expertise who can help develop a mentee. Daniel further distinguishes between 'protégé' and 'mentee' by arguing

that a protégé is in a relationship where a junior is under the wing of a senior while a mentee is an individual learning from another regardless of age or position. A mentor is a guide who can help a mentee to find the right direction and who can help them develop a solution to their challenges. This study will use 'mentee' when referring to co-researchers as its definition eliminates power dynamics. 'Protégé' will only be used if quotations are taken directly from other scholars. The wealth of the mentor and mentee relationship is based on their past similar experiences (MentorSET, 2016: 1).

Guided by the afore-mentioned definitions the researcher understands 'mentor' to mean *a professional person who willingly shares time, expertise, development skills and guidance on the journey of the underprivileged to reach their objectives.*

### 2.3 Definition of Expo for Young Scientists

Expo for Young Scientists is called a Science Fair in other countries such as the USA, Britain, Kenya, Ghana, and Turkey (Hogan, 2008: 679; Wheeler: 2007: 1; Tortop, 2016: 59; Mogoba, 214: 4). It is defined as an opportunity for students to apply the scientific method to conduct scientific research (What is science fair, 2016: 89). A completed project is presented at school or a sponsored fair. It is a competition in which students are judged on how well they have researched their topic and made proper use of the scientific method. In the study of Kahenge (2013: 2) Blain explains a Science Fair as a public exhibition of student's projects to recognise their work and to stimulate interest in their work. It is mostly done as an extra-curriculum activity. Alant (2007: 49) explains it as an event through which the South African youth can demonstrate their inventiveness and innovations in the fields of science and technology.

Assisted by the afore-mentioned definitions and the researcher's personal experience he sees Expo for Young Scientists as:

*A science event with the aim of building future scientists where learners expose their completed science projects to judges for adjudication and public viewing with the expectation of receiving special recognition and recommendations.*

### 2.4 Related Literature review on mentoring and Expo for Young Scientists

This section of literature review goes deeper into explaining the aspects around the two theoretical concepts (mentoring and Expo for Young Scientists) defined earlier in this chapter. Mentoring will touch on types of mentoring, its benefit on both the mentor and mentee, principles for a successful programme, challenges and examples of success

stories from three selected countries. During the discussion, mentor and mentees will be mentioned repeatedly. For this study, they will be representing researcher and co-researchers respectively.

The section will discuss Expo for Young Scientists in greater depth and will cover its origin, challenges, benefits, planning for a successful Science Expo as well as giving the trends as noted from across the globe.

### *2.4.1. Types of mentoring*

There are three types of mentoring that will be discussed in this study. They are Informal (Natural) Mentoring, Formal (Planned Mentoring) and Virtual Mentoring.

#### 2.4.1.1 Informal or Natural Mentoring

Informal mentoring develops spontaneously and is not managed but enacted by people with the same interests. It may occur between two people where one of them seeks to grow professionally and personally. This one may need on-going advice and support. The person with knowledge is willingly prepared to impart experience and information. It may be the mentor who reaches out to the mentee or the initiator can be a mentee (David, 2006:9;RSA DBE, 2008:20). Unlike formal mentoring, the programme and setting of the objective may not be available. It may respond to the need at the time.

#### 2.4.1.2 Formal or Planned Mentoring

Formal mentoring is structured and developed by the organisation and is specifically designed to facilitate programme objectives. A mentor participates voluntarily, as opposed to being coerced, by an inner personal call to reach out to the mentee. Goals and objectives are set. There should be guidelines for meetings (David, 2006: 10, 2012: 2).The matching process is managed. Hence in this study, a research clearance was sought. During the cultivation stage of the process, the mentee learns from the mentor. The mentor provides advice while exposure of the mentee is maximised (David, 2006: 5).The mentor approaches mentoring being open to learning from new experiences, challenges, the environment, the age of the mentee and the mentors background. It is not always possible to meet a mentee face-to- face hence the use of virtual mentoring.

#### 2.4.1.3 Virtual Mentoring or Electronic Mentoring

As we are living in a cyber-age communication should also be simplified. In Virtual mentoring the computer is used to mediate the relationship between the mentor and co-

researchers. The medium has no geographical boundaries. It can be beneficial to mentoring in rural areas where regular face-to-face meetings are difficult (Business Dictionary, 2014). Mentors are able to say things freely that they could not air during face-to-face interactions. They may include reverse advice to the mentor, especially at the early stages of the programme when they are still building a relationship. This reduces the power dynamics that are naturally built into the study. Challenges, questions and queries are therefore responded to timeously (Ntanga, 2014: 20). The researcher's fear is that this method, if not kept in check, can be relied upon more than face-to-face interactions. He also agrees with critics who fear that it kills the richness of face-to-face meetings; a message loses its originality through interpretation. (Bagley, 2011: 27; Rail mentoring, 2016: 2)

### *2.4.2. Mentoring and power relations*

From some definitions of mentoring (cf. 2.7.1.2 and 2.7.1.3), mentors seem to wield more power which is contrary to the principles of Critical Theory and Participative Action Research. They both speak against dominance (Cassano & Dunlop, 2005: 4; Higgs & Smith; 2006: 67). The other definitions do not put emphasis on power but more on activities that take place during the relationship.

In traditional mentoring, the hierarchy is observed. The older and experienced person is the one who dishes out advice to a younger and less experienced one. They assume what a young person needs. Freire (2000: 119) says mockingly that the mentor knows everything while the mentee knows nothing. The mentor just fills up a supposedly empty mentee with information (Hansman, 2005: 4). Research reveals that a mentor is always associated with power as a resource while a mentee is associated with learning power. Since a mentor influences and dominates how knowledge is constructed that creates inequality. Mentoring, if not well monitored like at schools, may reproduce a dominant power relation which will perpetuate discrimination in terms of class, ability and loyalty (Alison, 2008: 14).

If mentees feel that they have less power than mentors they can become vulnerable to the whims of a mentor and the dominant culture existing within the school. There should be an open discussion among mentor and mentees. If they develop a spirit of competition where they think they have superior knowledge than others they will exercise power thinking, ie, they know all that is best for others (Hansman, 2002: 45; Hansman,2005: 1). This will work against empowerment.

Ragins (1997:485) mentions that power is dyadic and is a reciprocal process in an interpersonal relationship. It is not always congruent. That is why Clutterbuck (2005: 1) argues that lack of longitudinal research of mentor-mentee can give one-directional definition. It is necessary to examine processes which will clarify the relationship. They further question who should define mentoring. The researcher concurs that the people involved are in a better position to explain their type of mentoring because they are informed on the roles played by each member. Dewey reminds us that critical pedagogy emphasises the democratic relationship between the mentor and mentees. Democracy balances power in mentoring as there is an open exchange and contribution of ideas. Alison (2008: 17) further argues that through the exchange of personal multiple narratives a democratic relationship is fostered among people. Exchanges may also involve a balance of power within the group, in which all contribute.

### *2.4.3. Benefit of the mentoring programme*

The mentoring at school needs a unique way to succeed and to be accepted by the intended recipients. Not only mentees benefit as mentoring has a reciprocal effect. The success is assisted by the principles and adherence to boundaries agreed on and ethical considerations. There are efforts that need careful execution to drive the process positively. Threats to the study or programme should be identified and mitigated. The international trends in areas and countries where mentoring was successfully implemented will be deliberated upon without hiding any challenges experienced.

#### 2.4.3.1 School-based mentoring

Mentoring can happen in a community by an independent organisation or by the company for workers or at school, either for learners, newly appointed teachers or newly appointed departmental heads or the principal and the deputy (Garringer & Jucoy, 2008: 4; RSA DBE: 2008:15).

Mentoring is not like a normal school programme where it takes the whole day daily. The benefit of rather doing the programme at school than in the community is that teachers and learners who could not have been reached benefit. It is less intensive and only a small amount of time is used per session. In many instances, only free time is utilised (Garringer & MacRae, 2008: 4). It also mitigates teachers and learners' feeling of alienation. When the learners and teachers at a farm school realise that there is somebody who cares about them they feel important and they become enthusiastic about participation. Their self-worthiness increases (Swong & Nguyen, 2005: 2). A mentee with a high self-esteem and

clarity of goal plays a leading role in the setting of an agenda that will steer the mentor towards appropriate responses. During the process, mentees acquire knowledge, skill and abilities. Besides an academic related benefit, they receive psychosocial development support, sympathy and constructive feedback. The potential talents and creativity are promoted (RSA DBE, 2008: 22). One mentee in South Africa has this to say after being involved in the programme “This is the best experience I have never had in my life. I have as well learned more than I have ever learned before” (Fricke, 2008: 18).

#### 2.4.3.2. Benefit for mentors

It is not the only mentee who benefits from the programme. The mentor also goes through learning. There is the development of an interpersonal relationship based on intensity, continuity and frequency of contact. Emotional closeness grows through interdependence (Nguyen, 2005: 2). The mentor develops new teaching and leadership skills. As a mentor the researcher will be able to use the experience gained in previous encounters and now change it to suit the conditions as needed by co-researchers. Co-researchers who are mentees will have their confidence boosted by the intervention. Mentors also start to see the world through different eyes. Their awareness of issues is increased to a certain level and they may receive challenges to their perceived wisdom (Clark, 2016: 3 of 10). There is that personal satisfaction when seeing a mentee achieving some of the goals. They are challenged to then set new goals. (RSA DBE, 2008: 39; NyS4H, 2010: 8). As a mentor I have to adapt to the situation without hurting the programme and mentees.

#### 2.4.3.3. Planning and executing a successful mentoring programme

The programme involves more than one person so whatever is planned should be considerate and accommodative for all involved. A buy-in from all stakeholders is vital. This is very important if the proposal of starting a programme is initiated by an outsider (Lucoy, 2008: 9). The benefits and objectives should be clearly spelt out. It may be intimidating if the programme or study is too academic rather than adding in fun. The study further adds that experience indicates that a study that is too academic ignores or undermines the quality of the relationship, frequency of meetings and length of the project. It is like a teacher who is only concern is completing the syllabus instead of the wellbeing and understanding of learners.

The mentor should be alert to potential ‘turf’ issues. It is vital to learn of similar operational programmes inside and outside the research site. If they exist the researcher will have to work out a working relationship and understanding. The mentor who is guided by Critical Theory should include as many relevant stakeholders in the decision as possible, which is

inclusive of the principal, teachers, parents and learners (Garringer & MacRae, 2008: 9). A structure which provides workflow will assist co-researchers to achieve productive learning and be able to reach defined goals. The programme should not be rigid on one-size-fits-all. Co-researchers and mentees though having a similar goal are not the same. Essential support should be created to give attention to individual needs and learning styles.

A programme for the study should be devised. It should indicate key actions like timeframes, resources and criteria for moving to the next phase (Chronus, 2016: 1). The work should be chunk-sized with key checkpoints indicated. A session for progress reporting should be established. When the study reaches its end there must be a formal process which may include thanking all co-researchers. It is advisable to assess the whole impact of the study. One idea of this study is to ensure sustainability after the end of the programme. The researcher should identify pre-existing, current and future trouble spots and opportunities and deal with them (Chronus, 2016: 6)

2.4.3.4. Boomerang Effect of mentoring

Both the mentor and co-researchers gain from each other. It is a collusive activity. Through the mentor's guidance and advice during the interactions mentees gain more insight into the challenges experienced by them. This experience will come in handy in future similar programmes .Mentors and mentees both participate in mutual sharing and reflection. As they continue working together the mentor should also build rapport. The relationship exposes both to emotional learning. It requires competency and allows the mentee to experience support and the feeling of being valued. Mentees also play an active role in assisting the mentor to be available for their own benefit (Clark, 2016: 1 of 4; David, 2006:7; Clutterbuck, 2005:1, 3). No one wishes to disappoint the other. They go all out pushed by mutual warmth. They share a relationship based on trust and commitment to developing one another. During interaction, they share thoughts, concepts and ideas. That gives a mentor a clear vision, better understanding and as such better inputs and suggestions. They gain insights into the best practices. Their confidence and leadership skills are sharpened (Smith, 2014: 32; Clark, 2016: 1; MentorSET, 2016: 2).

Mentors have a lot of contacts which they may refer co-researchers to for further assistance and networking. As a long time Science Expo activist, the researcher knows of a number of schools that are doing well in Science Expo, many being those that he also supported in the past. Some of these schools are always available to support any other school that needs assistance. The mentors again have more insight on the topic they are experts on. The research site as a new area gives those different perspectives and cultural values which

they have to adjust to. Critical thinking as an objective of Critical Theory warns researchers to be sensitive to the cultures of co-researchers. The new site means new resources which the researcher may never have encountered before. As the research site is a farm school, there will be new information on dealing with a farm community. (Clark, 2016: 2) Marissa Rahahan, a migrant from Pakistan to the USA has only praise about mentoring, “I have had a mentor who taught me to read. It opens doors to learning. To me, this is the best guidance I have ever received” The youngest Nobel Laureate Malala Yousafza also from Pakistan emphasised a thirst for mentoring by these words: “There is no way of stopping a hungry mind” (Designing mentoring, 2013: 8). In their work, Whitebook and Bellm (2016: 2 of 15) remind us that a mentor is also a learner who needs support. There are areas that may be encountering a mentor for the first time with a different ethnicity. The mentees will be exchanging new knowledge with this mentor.

2.4.3.5. Principles of mentoring

In order for mentoring to run smoothly and achieve the desired objectives with few or no undue challenges, mentors need to apply principles such as prompt feedback, respect for co-researchers and keeping the study atmosphere as relaxed as possible in their engagement with co-researchers. The researcher as a mentor should play multiple roles such as a motivator, friend, confidant and a good listener. Throughout the programme, he should also display the characteristics of commitment, being helpful, having high expectations and being a good motivator (Bruce & Brigdeland, 2004: 23: Fricke, 2008: 12) There are ten examples related to the study which will be briefly explained.

The first one is informative prompt feedback. Continuously during the study the mentor should keep on strengthening mentees. During or after a particular stage he should give feedback on the strengths and weaknesses of mentees without delay. Care should be exercised during the process otherwise it may result in negative results such as a walk-out or silent protest by co-researchers. Undue criticism may work against the theoretical framework of the study which gives co-researchers the freedom to air their views. The silent protest will also be against the spirit of PAR, in which co-researchers should have full and free participation. Weaknesses should be clearly explained and the next steps to be undertaken should be well discussed (Clark, 2016: 1)

Motivation is the second principle. Not all programmes run smoothly without challenges. Since the project will be undertaken for the first time in this community, there will be some discouragement if things do not go as smoothly as anticipated (Mabaso & Meyer: 2016: 2). It is the duty of the mentor then to inspire and stimulate mentees to take action. Despite

setbacks or lack of progress, after interaction mentees should have the zeal to continue with renewed vigour (Nguyen, 2005: 2).

A relaxed atmosphere is the third principle. Clutterbuck (2005: 1) writes that a mentor should create a setting in which the mentee has the freedom to experience. To create this type of condition, the mentor, should create opportunities for specific learning experiences. Turning the session into a military training session where orders are followed without questions should be shunned. Mentees should be allowed to explore different approaches as long as they are within the ethical considerations (Whitebook & Belln, 2014: 2).

The fourth principle is a being a good listener. There should be a reflective session between mentor and mentee. As a good listener the mentor needs to display good listening skills to determine how mentees experience the relationship. Responses either by words, actions or both should be effected to the benefit of the relationship and its purpose (Meyer & Mabaso, 2016: 2).It should further inform me and the mentees on areas that need strengthening or revisiting.

Creating high expectations is the fifth principle. High standards, a positive attitude and high expectations are some of the hallmarks of the mentor who needs to take his project seriously, setting high but achievable goals. He should never be discouraged even if progress is not as expected. At all times he should show the spirit of ‘we can’. The commitment shown will rub off on the mentees (Koki, 2016: 4).

The sixth principle of respect for all agrees with Garringer & MacRae (2008: 11) who advise mentors to respect others and provide objective but honest feedback. As a mentor, the researcher should remember that the whole team is learning and each member should be allowed to showcase their potential. A belief in others relaxes the atmosphere. When feedback is given the mentor should refrain from being personal or having a dressing-down show. At the same time weaknesses should not be hidden just to avoid seeing disappointment on a mentee’s face. Buying faces can have a detrimental effect at the end of the programme.

Clark (2016: 4) supports the seventh principle of remaining a friend and confidant to mentees. Co-researchers should feel free around the mentor. A free and friendly atmosphere allows the team to develop trust and the ability to express themselves. They will also learn that the mentor can be relied upon with confidential matters and challenges

The eighth principle is showing continuous commitment. There should be a will to commit spare time in shared learning (NyS4H, 2010: 5). The ` researcher should be willing to

sacrifice time for the programme and always be available when needed by co-researchers. When co-researchers notice this they will copy that style. While mentors should be fighters, they should challenge carefully and encourage appropriately. The programme is about building, not destroying spirits. We need to remember that mentees in farm communities need the empowerment and emancipation that were neglected for years. A mentor needs to provide acceptance, encouragement and moral support. The community could have opted for somebody else or not have agreed to be part of the study. In this spirit, we should enjoy the opportunities afforded to us to pass on our wisdom, knowledge and collaboration (David, 2006: 7).

Koki (2016: 3) supports the ninth principle of giving courage. It is emphasised that the mentor needs to boost mentees' confidence to believe in themselves. Time and again the researcher should pep-up the team especially when they are in despair, want to give up or are progressing too slowly. Pointing to the progress achieved as a sign that nothing will stop them encourages mentees. The researcher should demonstrate a wide repertoire of teaching methods, alternatives to learning modalities of learning and learning styles

The last principle is the effective use of questions. Wheeler (2007: 2) explains how questions are used to guide the study. Questions and challenges provide guidance and confidence. The questions used to assist the study should be (1) Reflective: To get mentees to say more about the issue. (2) Hypothetical: Introduce new ideas or angles. (3) Justifying: Seek further information. (4) Checking: Establish an understanding if someone is following or moving along. (5) Probing: Discovering motivation, feelings and concerns.

#### 2.4.3.6. Boundaries and ethical considerations for mentoring

Mentors and mentees are a group of people who are going to work together for some time. As such there will be a relationship between them depending on the duration of the programme, agreed time or until the set goals are achieved. The mentor should ensure that there are clear boundaries from the beginning and that the relationship remains appropriate. There are times to give advice and feedback. All of these should always be conducted without being overly critical. The Ivory Tower mentality should be shunned. In this study, there is a mentor and mentees or a researcher and co-researchers in need of support. The power should be balanced and never abused. The Critical Theory actually encourages all to be equal partners. If this is not put in place the relationship can be toxic (Smith, 2004: 32; Garringer & MacRae, 2008: 4; Fricke, 2008: 26)

When a mentor works with the school they should have an understanding of the culture, policies and procedures of the research site. Those have to be respected and negotiated. Despite what the researcher is bringing to the school, he should respect the programme of the school and never consume valuable teaching time. If there are outside programmes already running, he should learn about them. If a similar programme is already operating he should see if cohesion between the two programmes can be attained. He should also carefully check if there were previous programmes which harmed the school. This will warn the researcher not to make the same mistakes. The study should avoid adding pressure on the school and it should not be seen as an add-on to teachers who are already over-loaded (Garringer & MacRae, 2008: 11; Rarcher, 2010: 1). If confusion or conflict arises about the prior agreement, a quick solution should be sought to resolve any impasse. As a mentor, the researcher should at all times aspire to fairness, shun biases and have a deep respect for other people's rights (David, 2006: 14).

2.4.3.7. Positive drivers of a mentoring programme

We all start research with the aim of succeeding and achieving all objectives set. These objectives and focuses must be clear. Role-plays should be assigned with understanding of the dynamics, roles and responsibilities. The mentor should exercise sensitivity in understanding how the background will adversely impact on the relationship (Meyer and Mabaso, 2016: 10). For this to be achieved the mentor should understand and identify the positive and negative factors that will impact on mentees' participation. The goals and action plan should be drawn and agreed upon by all with accountability being stressed. The work should be divided into sections to make it less intimidating. The researcher has experienced that goals and time-frame reminders that are repeated keep people on their toes. Negatives cannot be canceled to zero but a mentor should be creative to overcome hurdles but at the same time create ways to reinforce positive drivers. The mentor should assist with resources where possible. There is a general lack of Internet access at farm schools. The researcher will have to assist them with Internet access, newspapers etc. In order to keep co-researchers motivated, there must be strategies to recognise and reward progress hence the last objective of this study of appraisal. Co-researchers should be formally rewarded. It can be done in front of others. Throughout the study helpful tips and best practices should be provided that co-researchers can tap into if they so wish (Chronus, 2014: 3; NyS4H, 2010: 5). The mentor should provide protection, nourishment, care and moral support. He should accept valuable input and assistance from the co-researchers. The mentor should not shy away from enjoying and acknowledging wisdom, knowledge and collaboration from them. (David, 2006: 7; Whitebook & Belln, 2014: 15).

2.4.3.8 Threats to mentoring

The mentees may develop a dependency on the mentor wanting to be micromanaged instead of being developed. They may apply emotional blackmail to press personal favours. If not careful, mentees can be a replica of a mentor who accept cultures and values without question (Hansman, 2002: 46). A mentor can drive the programme according to their own needs. They may want to relive their careers through someone else. Altruism can result in self-absorption thereby defeating the purpose of the programme (Clutterbuck, 2005: 4).

2.4.3.9 International trends on mentoring

There are countries where mentoring has been implemented with success. The examples discussed are all ones where mentoring was implemented at school level. Some are in communities, universities or government departments. Lessons can be learned these different experiences.

a. South Africa

South Africa does take mentoring seriously. The Department of Basic Education (RSA DBE) has introduced a module on mentoring. School principals are encouraged to study this towards acquiring an Advanced Certificate of Education (ACE) qualification on upon completion. There is also mentoring for under-qualified and inexperienced teachers (Fricke, 2008: 18). The Skills Development Act no. 97 of 1988 stipulates that the workplace should be used as an active learning environment. The Employment Act no.76 of 1988 states that employees should be provided with opportunities to acquire new skills. Mentoring is done depending on the needs of each school and teacher. The mentor is encouraged to be someone who is committed, able to work with people, sensitive, responsible and be able to provide professional and emotional support (RSA DBE, 2008: 39). The programme has inspired the researcher to follow a mentoring programme to the finish. He needs to be vigilant about what mentees of the community under study need.

The KwaZulu Natal Department of Works (KZN-DW) has developed a policy that encourages and guides a mentoring programme. “The purpose is to equip mentees with necessary abilities to cope with new demands… and demonstrate their newly learned abilities”. They are guided by the South African Qualifications Act No. 49 of 2000 and the White Paper on Public Service Training and Education, 1998. Mentors should inspire mentees to take action by encouraging their initiative and creativity. They clarify performance goals and development needs (KZN-DW, 2007: 4, 8). The South African Board for People’s Practices (SABPP, 2014: 9) has a guide for employees to manage the

process effectively and also be guided by legislation. The KZN-DW approach reminds the researcher as a mentor that mentees need to be given space to showcase what they know during the programme. It will provide information on areas that need more attention than others. Time will not be unnecessarily wasted on what they are capable of but rather be utilised where professional guidance and skills are most needed.

b. Namibia

O'Connor (2006: 28-29) posited about mentoring done during pre-service training for student teachers and also for beginner teachers in schools around Windhoek, Namibia. They form a collaborative partnership with experienced teachers. They are exposed to various duties. They are also exposed to different educational knowledge. These mentees are allowed to critique what they are learning and experiencing at schools against what they learned at universities. There are constant reflections to have better perceptions. Natanga (2014: 19-20; 114,117) reminds us that the relationship is reciprocal. Mentees possess skills in other specific capacities which may not be the main focus. The focus of the mentor should be on mentees' identified areas of need. The support is given on deeper subject content, daily planning, assessment, basic professional development, communication with parents and school culture. Out of those experiences mentees build their own professional knowledge. Both mentors and mentees have good stories to tell about the relationship. Mentors appreciate the help they give to others, their professional improvement, respect, developing collegiality and gaining fresh ideas. They also assist, guide and support. It tones down the temperament of mentors on unrealistic expectations, especially when the guidance meted is not all implemented. The lesson from this is that a collaborative partnership is needed irrespective of the status and experience of the mentee. The self-empowerment need is preceded by a needs analysis which will pave the way to providing appropriate support. The voices of the mentees should be heard as they also possess their unique skills which can enrich the programme. When working with human beings reality, not miracles, should be expected. The people we work with may have other frustrations which may not be related to the programme but do unfortunately have a ripple effect on their results.

c. Kenya

In Kenya there are three different areas were mentoring has been implemented with success. The first is in an exchange programme between students from Kenyan and USA universities. Mentoring is both dyadic and triadic. It started formally but has become informal in later years. Mentoring starts in Kenya where students are supported through their studies and research. This mentoring programme has produced a young generation of

researchers. Local mentors are a bit rigid as they inculcate their own unique styles of research which they hope will best address the needs of their country. Unfortunately, many of these local mentors are old and are not open to all the objectives of Critical theory as mentioned in this study. Some seem to display the “I have seen it all” attitude (Benett, Paina, Ssengooba, Wasa & M’Imunya: 2013: 183-185).

Beneficiaries of the US mentoring programme had only praise when they returned to complete the programme in their country. One mentee was very impressed by the one-on-one interaction. Others admired the freedom to argue and express their own points of view. These styles of mentoring were new and different. Mentees brought back a new dimension which revolutionises the approach to their studies. They are able to see Kenya as having other opportunities to approach transformation and empowerment. There are, however, challenges in transition between Kenya (Africa) and the US. The North-South tension causes a clash in different styles. A US-style may be good but not fully tailored for Africa (Kenya) while at the same time mentoring in Kenya does not evolve to meet the new challenges of the country. Even local supervisors (mentors) are resistant to new ideas (Ragins, 1997: 482).

Ochanyi, Twoli, Bwireand & Mauidu (2015: 313-317) report on the findings and recommendations of a study commissioned to formalise the mentoring of teachers. Mentoring is also done for newly appointed or beginner teachers. They are supported in instructional leadership. Most employ a collaborative model where a beginner and experienced teacher work together in terms of advice, support, lesson plans and reflective feedback. A mentor who knows the local needs may be best poised to respond to challenges. A mentor should not have a closed programme hence in this study a few other experts such as subject advisors have also been recruited. They will provide extra eyes and different dimensions. Care should be taken to avoid the spirit of a know-it-all. Mentees as co-researchers and the owners of the programme should be allowed to make inputs. The researcher’s many years of experience in the project should have taught him that he is a life-long learner. Inviting other mentors with their own fresh ideas should enhance the study rather than confuse mentees (Kenya KUSU: 2014: 2).

The third example is based in the offices of the Ministries of Development and Planning and of Health. They have a mentoring programme with youth as the main target. The programme for youth was started after discovering that the youth participated in political violence but were later inactive in social and public affairs (KNYP, 2007: 267-272). They are empowered to rebuild their communities in the building of houses of the displaced. As

everybody is involved, the blame culture has been reduced. This mentoring programme has been copied by neighbouring countries which passed through civil violence like Rwanda. The Health Department mentored youths to be HIV/RH ambassadors in their communities. With this mentees become mentors in their communities. Kenya is a typical example of success in the fight against HIV infection (Sherif & Kimani, 2013: 3-4). If mentoring is well rolled-out it results in a lasting legacy to the community. As mentioned in Chapter 1, the participators become proud pioneers. They become agents of change in their own communities. By extension, because they are always there, it will be easy for Science Expo to become an adopted tradition for generations to come.

d. Unites States of America

In the USA there are five million young people involved in the school-based mentoring programme. The mentor has to commit to creating adequate time to develop a meaningful interpersonal relationship based on intensity, continuity, the frequency of contact and emotional closeness. They must be ever vigilant about the interrogation of class, gender, ethnicity, gender, sexual orientation and largely alienated populations (Nguyen, 2005: 2, 3, 5). In 2003 former president George Bush set aside 50 million dollars to support mentoring initiatives. Several philanthropists pumped millions of dollars in what they themed a “Shared plan to rebuild the American Dream”. The positives emerging are the increase in high esteem, strong relationships with adults and higher academic achievement (Bruce & Bridgeland, 2004: 20). The Americans are showing that mentoring needs resources which should be welcomed from different angles with the government as the leader. A successful mentor has to be self-sacrificing while at the same time being cautious of ethical issues and mentoring principles. A new or honed positive attitude has to be achieved.

2.2.4.10 Mentoring and Critical Theory

Critical theory co-researchers possess power and set the agenda for the mentoring relationship. Learning is achieved through deconstruction. During interaction with mentees, space is created to deal with problematic and oppressive practices. As they become visible they are dealt with openly. In this way, transformation through mentoring is achieved (Gabrillo, 2011: 7).

The notion of a teacher as the only person having the truth has no room in both Critical Theory and mentoring. Hence Freire in Higgs and Smith (2006: 74) saw a school as a tool in the hands of the powerful. They used the school to oppress the poor. If mentoring is wrongly used it can hinder success. The constructivists view the teacher as accompanying the learners in their journey of knowledge accumulation. They are there to understand

individual and collective ways of knowing. They will then align themselves with common goals. A mentor a can act as an agent of change. Mentoring creates a sense of community among learners. Freire highlighted that this new community's contributions become collective. This as such builds a collective transformation. Critical thinkers who are comfortable with contradiction, complexities and configuration are created (Gabrillo, 2011: 17).

Freire in Chronus (2016: 1) proposes a critical dimension of consciousness that recognises human beings as active agents of transformation in their world. The only being who can reflect the fact that they are determined, are capably freeing themselves. Through action, reality leads to transformation. Concourses are impossible without the world that constitutes them. There should be a concerted effort to eliminate all injustices and discrimination as purported by the need for self-empowerment. Where teachers and mentees realise knowledge and skills gaps they should utilise many multiple pedagogical strategies to transform their knowledge of the subject content (Fortus: 2013: 2). A mentor creates an atmosphere that is conducive to development for all. The programme should cater for the needs of each individual despite the fact that empowerment and transformation are targeted for the community.

## 2.5. Expo for Young Scientists

How Eskom Expo for Young scientists came to be in existence in South Africa is discussed. The discussion examines the Science Expo aim, the benefit to learners and challenges experienced by learners, teachers and parents. Teachers are advised on how to plan for success. Trends in three countries (South Africa, Madagascar, and Canada) will indicate how different countries support the success of Science Expo.

### *2.5.1. The genesis of Eskom Expo for Young Scientists in South Africa*

The Expo was started in 1980 by Derek Gray. Presently there are 31 regions across the country. There are eight different types of projects: Investigation, Pure Sciences, Applied Sciences, Technology and Applied Technology, Engineering, Computer Science, Mathematics and Theoretical projects. There are twenty-five categories ranging from Physics, Chemistry, Life sciences, Medical Sciences, Psychological Sciences to recycled materials (Science Expo Project Guide Book, 2014: 5; 7-9)

The aim is embedded in its mission:
Mission: *We develop young scientists who are able to identify a problem, analyse information, find solutions and communicate findings effectively* (Exposcience, 2014: 2; Gray, 2014: 5).

Each region is headed by a Regional Director. The Free State Provincial Coordinator was appointed for the first time in 2015. The position is full-time. A Provincial Coordinator has the function of supporting regions and increasing school participation. The Free State Education Department supports the Science Expo though from where the researcher stands its support is inadequate. The Curriculum Section (Natural Sciences) follows up on progress. There are sometimes short information sharing sessions during provincial subject meetings. Between 2002 and 2006 the province took the initiative to transport a provincial team to national finals. That has since dried up. The only time the researcher hears from senior officials about Science Expo is when it has to be included in the provincial five-year plan or thrust. He usually receives calls where numbers are needed on schools participating, girl-children, blacks and Dinaledi Schools.

Preparations for this Expo Science competition start early in the year. It can be at the school level, science clubs or under mentoring. Learners explore the various resources they will need. They also research about what has already been done and the conclusions reached (What is science fair: 2016: 83). The event takes place first at the Regional level. Organisers are mostly volunteer teachers. In 2006 the researcher introduced a Cluster Science Expo Competition in Thabo Mofutsanyana District with QwaQwa and Harrismith schools as participants. It became a flagship event at the National Science Week first when it was still held in May before being moved to August of each year. The researcher is planning to include farm schools hence the study. Cluster Science Expo Competition is a buffer competition for disadvantaged schools that are participating for the first time. The mood is much more relaxed as most schools are at the same level. Winners are then mentored to upgrade their project for the regional finals. By the time they arrive there, they have a glimpse of what to expect and many become winners unlike before this initiative. This strategy has been copied by other towns and clusters in the Free State such as Botshabelo and Welkom.

The winners are given bronze, silver and gold awards (Alant, 2007: 3). Every participant aims for gold. Gold may mean passage to National finals, being a special prize winner and of course prestige the learner, family and school. Before 2014 gold was a definite ticket to national finals. Since 2014 things have changed as a team going to national finals should

be representative. Half of the delegates should be from disadvantaged schools and gender equality is also considered. At national finals, prizes range from bursaries, computers, laboratory equipment for the schools to the privilege to compete at International Science Fair. Each year since 1992 one learner attends a Stockholm final which coincides with the Nobel Prize awards. Delegates have a chance to interview a Nobel Prize winner. A lifetime treasure for the learners! (Gray, 2014: 7).

Learners from different schools from grade five to twelve bring their well-prepared A4 size posters ready to be mounted on backing boards provided to all regions since 2014.They arrive at the venue in the early hours of the morning using all sorts of transport. Learners from advantaged families are transported by their parents (Ndlovu, 2013: 2386). Most will be grinning from ear to ear while a few newcomers will be very tense. After observing Science Expo Short and du Toit (2015: 2) sum it up, “Standard of the projects is extraordinary, particularly considering their age”

*2.5.2 Constraints faced by learners*

Learners are expected to come up with something that is well beyond their abilities. The researcher realised that teachers may want their learners to outsmart learners from other schools with little or no support from them. Young learners have to use correctly all scientific science steps that include topic, hypothesis, conduct experiment, collect data, analysis, etc. It is ludicrous. In some schools, learners may choose a simple research topic but do not have the ability to get information especially online information (Schank, 2005: 1). These projects also need money for posters and typing. Learners have to juggle time between the project and school work. They are expected to think about science-related issues which are outside the classroom but are everyday life issues. Science challenges outside of school are more challenging as among others they are not as well-structured as in the science classroom. Getting relevant information is also difficult.

Sometimes learners have no clue on where to start or how to apply scientific investigation steps (Craven & Hogan, 2008: 680; Kahenge, 2013: 22). The researcher has observed learners at Science Expo when he was a judge who did not know the scientific question, hypothesis, variables, graphs and many key steps of the project. Learners procrastinate and are later frustrated with a deadline. Many openly say they wish they had more time and promise to start earlier the following year.

Teachers in Turkey, where Science Expo is compulsory, encounter many challenges when they are supposed to mentor learners (Torlop, 2016: 59-60).Their experiences are not uncommon to many teachers. Some of the challenges are:

2.5.2.1 Inability to come up with the best idea to start a project.

It is a battle to think of an idea which can be turned into a research project. Sometimes teachers themselves are bankrupt in ideas as there is no structured support to assist them. The best choice for some is to avoid assisting learners. It is however difficult for countries like Turkey where Science Fair is compulsory. Similar experiences are parallel to the CAPS Curriculum in South Africa where a science project is a compulsory part of SBA. Teachers also get frustrated if they lack clear and constant District and Provincial Curriculum support. The CAPS document only devotes one unclear paragraph to the explanation of a science project (RSA DBE, 2012: 87).

2.5.2.2 Writing a project report

Teachers also have a problem on how to write a project report. They are never mentored adequately. Teachers in South Africa have termed the type of short implementation workshop a “micro-wave approach”. Teachers are expected to implement proper work after passing through a micro-wave oven (Gray 2014: 23; Torlop, 2016: 60). Teachers then conclude that they would never at any point be able to mentor their learners with anything.

2.5.2.3 Battle for an appropriate topic

Learners either battle to find an idea or sometimes after finding an idea they struggle to come up with an appropriate topic. An unclear topic makes it difficult to start a project. If learners continue with a topic that is too difficult for them, there is a likelihood that they are going to drop it along the way (Cowen, 2015: 2).It is common to see learners doing a project that has included a number of other possible projects in it. When doing such a project, it becomes difficult to know which direction the project should actually take. This results in a hypothesis not corresponding with the conclusion (Torlop, 2016: 59). Responding to all ambiguities and possibilities confuses the whole project and nothing about the angle taken is clear. This confusion at times causes a project to drift in and out of the topic or be completely irrelevant.

2.5.3. *Unfair hold on Science Expo by privileged learners*

It has been reported that some complicated models presented as Expo projects are actually bought from an obscure store in the mall (Schank, 2005: 2). Some learners buy models or ask an artistic person in the neighbourhood to make a model for them. Parents pay for them. During data collection for their studies at the Science Expo finals, Craven and Hogan (2008: 679) relate how a father told them how he (the father) chose a topic and worked through a project for his daughter who by then was enjoying time with her friends. The researcher has experienced parents confronting judges after the announcement of results telling them of the time, energy and research they (parents) had put into the projects. It is also common for parents who are also judges to introduce themselves and their children to judges who are going to adjudicate their projects. Some would even give their credentials, maybe as a neurosurgeon and even mention a reputable medical journal that will soon be publishing their findings. This is a pure blackmail. How can a poor teacher-judge fail to give this learner a high score after such a free lecture! The researcher has also observed that some data is unverifiable or made up. It cannot be supported, does not fit into the research plan or is too accurate for any experiment done under the conditions mentioned (Bennet, 2015: 3; Schank, 2015:2).

Flanagan (2009: 3) has a feeling that Science Expo is a reward for the privileged. Most winners come from advantaged schools. Besides support from parents some of whom are scientists, their schools are also well equipped. They use sophisticated laboratory instruments like a spectrophotometer. Science Expo inadvertently weeds out learners from poor backgrounds without access. They stop participating as they see they stand no chance to ever win.

*2.5.4 Teachers' Science Expo Dilemma*

Teachers do not refute that Science Expo promotes enthusiasm among learners. They, however, experience a number of challenges. In many schools, it is the responsibility of one teacher to support learners. They face an overwhelming task. There are no mentors to support them and the learners. It is worse at farm schools were the teacher faces a multitude of challenges like multi-grade teaching and lack of resources (Alant, 2007: 54). In many instances, the work of this teacher is only to identify learners, check if they are doing something, register them and organise transport for them to the Expo venue. Teachers feel inefficient as they do not have time and are inexperienced in project mentorship. It is compounded by lack of training. Taylor (2014: 1) says the success of Science Expo amongst others depends on a knowledgeable adult. If teachers are found wanting, it has a

similar effect on the learners. They have to seek development. Several training sessions the researcher has attended are a PowerPoint presentation less than an hour long. Not even a single actual hands-on activity was done with no assistance on how to involve learners.

Since 2014 the researcher introduced six-hour workshops where teachers are supported to do a simple project from start to finish and later adjudicate it. When they leave that afternoon, they have a clear idea of what to do. Collaboration is not enough especially with universities who are centres of research in their communities. Some teachers do the project for learners or are over-involved. That is reflected by the level of some the projects which are very high and learners keep on referring to their teacher during a rehearsed presentation. As in the case of parents, Science Expo also becomes a competition among teachers. Teachers fail to remember that their roles are to mentor. (Torlop, 2016: 61).

*2.5.5. Parents' views and their expected positive roles*

There are mixed feelings among parents about Science Expo. Their feelings are influenced by a number of factors which are mentioned in the study. It can be their science knowledge background, environment, mentoring, and support from the school, resources and time. Some parents are indifferent to Science Expo. They feel their children should rather spend the time to prepare well for the examinations. They don't want their children to participate in competitions or any other extra-curricular activity. They worry more than their excited children. They also feel that after their children have put in hard work they are going to compete against dishonest parents, many of whom are experts (Torlop, 2016: 61; Choi, 2015: 6). Learners pester parents with the need for money to buy resources or type reports. Schools are not supportive even when learners proceed to national and international levels. Parents from disadvantaged backgrounds like farms ask themselves what the use of their children participating is when it has been observed that they stand no chance of winning. They lament about poor judging as well. These factors can make children hate science. (Mogoba, 2014: 8; Kahenge: 2007: 22). They say they are neither scientists nor intending to become scientists but are being forced to by schools (Cohen, 2000: 1of 4).

The researcher's experience over the years is that what is disappointing is when the learners come back from these finals with big prizes. The very school which failed to support them hijacks the limelight which should be enjoyed by the mentor and parents. They even use that success to market their school without the learners receiving any recognition. The psychological impact of constant failure may make learners feel worthless and not intelligent enough. In the USA a study was commissioned to assess how the study

should be handled from beginning to end (Wisely, Fineburg, Chew, Daniel, McCarthy, Park & Smith, 2016: 7-38)

There are parents who see Science Expo as a gateway for their children to the land of opportunities. They see it as improving the inquisitiveness of their children. Their children's grades increase as they are able to make inquiries independently and enthusiastically. Many children have won bursaries to study at universities (Gray, 2014: 7). Cieero (2014: 3 of 4) talks of the joy on the faces of parents when they see their children coming up with their own interesting ideas. It is a windfall for learners who come from poor families and a relief to parents who would never be able to pay university fees.

There is a study that says Science Expo does not improve grades as there are learners who are very good at Expo but poor in science. The study has failed to find out why the performance is poor. They have actually solved a problem but they are still not aware of it. The teaching and learning styles used for these learners are to blame. They need hands-on activities with the freedom to think and make decisions. They seek empowerment which gives them the freedom to make their own decisions with teachers guiding. At all times they should respect the role of the child in the project (Cohen, 2000: 3).

It is the researcher's view that parents can reduce family stress by assisting their children to plan ahead of time. They should schedule Expo steps. Their job should be to remind their children of dates the same way they are doing with all other activities. They should also encourage their children to do a project that is within their ability and experience. During parents meetings a briefing can be done about it. Just showing slide on what and how will give parents a picture of what their children are expected to do. They are happy that at a young age children are aware of the field they want to follow. It helps parents in giving them support.

*2.5.6 Science Expo, a competition between parents*

Because of the benefits and prestige around Science Expo, it has now turned into more of a parents' affair or a competition between parents. They get over-involved. The beauty, sophistication and perfection of the projects and backing boards are all signs of an adult brain and hands. They prepare children's projects as if it's a parent's Science Expo. Children just make appearances (Schank, 2005: 2; Torlop, 2016: 61).

Flanagan (2009: 4) suggests that to reduce too much parental interference, Science Expo projects should have three categories. There should a section that is done in the laboratory, one at home and one at school. This the researcher sees will provide a partial solution only

on the side of the advantaged but nothing will change on the side of the disadvantaged. We need to be careful that leveling the ground should not be done at the expense of the ever-rising standard of Expo. Parents, however, will always have a role to play in their learners' education. They act as mentors, committee members, judges and assist during the day of Expo (Kahenge, 2013: 20). Wilde (2016: 2) says that studies done at the University of Illinois suggest "…parents can best improve children's learning by refraining from becoming too involved. It encourages learners to do their own work" Interference has a long-term effect as children become ashamed of being praised for something they know they contributed little or nothing to.

### *2.5.7 Disadvantaging learners from disadvantaged backgrounds*

Rural and farm schools are seriously ill-equipped. Farm schools do not have sufficient funds to support learners even if they wish to do so. Those who finish their projects may not have money for registration fees and transport to the competition venue (Ndlovu, 2014: 2386). Some learners in rural KwaZulu-Natal had to transport themselves to the venue. (Alant, 2007: 53). When Alant was mentoring the learners she realised that the Science Expo is also an inconvenience at home as homes are littered with finished or unfinished materials. Some competition venues are hundreds of kilometres away. To participate learners have to pay up to R100. In Thabo Mofutsanyana learners are currently paying R30 if they participate as an individual per project but R100 if they are in pairs. There are three reasons for the high fee for a pair. The first is to encourage each learner to participate singly. Secondly, it was observed that in most cases one learner in the pair contributed nothing or one is too dominant. The last is that regions are allocated a number of learners to go for national finals. If there are too many pairs it will mean that only a few projects can be selected. If each learner participates alone it means the number of projects will be equal to the number of delegates. The chances of winning increase as well as exposure.

### *2.5.8. Preparing for a Successful Science Expo*

Preparation for science expo needs proper planning from the outset. Science Expo (2014: 6) encourages the drawing up of a research plan which should be submitted to the teacher. The researcher's experience has taught him that if schools in disadvantaged communities don't start as early as February, chances are high that not even a single learner will participate in that school. A research plan provides a timetable on how learners will pace themselves throughout the process. The teacher will be monitoring the learner against the plan. The teacher should not just accept the research plan as is but check whether the target dates are realistic. If not a learner should be engaged (Cohen, 2000: 2).

The research plan indicates dates of activities such as choosing a topic and phrasing a scientific question. The learner will again indicate when information about the topic will be gathered and then followed by writing the research background about the topic. The hypothesis will be formed by the response to the scientific question (Science Expo, 2014: 7). Dates should be set to test the hypothesis and challenges are also indicated. During this period data is collected through questionnaires, experimentation or making and testing a model. After collection, data should be analysed (Judging Expo Science, 2015:33). Data can be summarised on a table and then a graph. Many learners use a spreadsheet for the accurate drawing of a graph. All these steps need a number of days which will include consultation as well. The research plan will also indicate when the conclusion will start and finish based on the results (Chew, Daniel, Fineburg & Wesely, 2016: 24; Cohen, 2000: 2 )

*2.5.9. Benefits, rewards and learners recognition*

One scientist from the UK has observed two factors that encourage students to be scientists, namely (1) An inspirational and enthusiastic teacher, (2) A student research project. Science Expo is an exciting hands-on, competitive and collaborative venture. Wheeler (2007: 1) points out that Science Expo remains in the learners' memories for a long time even after they have already forgotten about the content they learned at school. In the *Limpopo Mirror*, Tshikhudo (23/08/2014: 1) relates the excitement of learners in the Vhembe District around Science Expo time. One learner is quoted as saying, *"Saving energy is the talk of the town but there are rural communities where the energy they are talking about is non-existent. They cannot access electricity. They are also not allowed to collect wood in the bushes as they have no alternative. Our solar oven is the way to go".* Teachers in the area give rave reviews about the ever-improving standard of learners' projects yearly. The researcher can attest to these teachers' comments as he had a chance to adjudicate learners from this District at national finals. Despite them being from a deep rural area with all the challenges they face, the researcher was impressed by the standard of their projects. Science Expo promotes the awareness of the importance of science, technology, engineering and mathematics (STEM) to the general public. Learners are motivated to showcase their independent inquiries. Many regular Science Expo participants end up choosing careers in STEM (Kahenge, 2013: 11).

Expo Science (2013: 13) says it aims to develop Young Scientists who are able to identify a problem, analyse information, find solutions and communicate information. It is a confidence booster for children who have always looked down on themselves to be neck-and-neck with the privileged. The spirit of competency and self-validity is fostered.

Sciencebuddies (2016: Online) states that some of these learners win big as they get bursaries to university which would have been a pipe-dream without Expo.Over the years the researcher has also seen professors scouting potential future students at the finals. Critical Theory, the lens for this study, encourages critical thinking which also espouses among others analysis of information and communication thereof. According to the British Science Fair guide as cited in Kahenge (2013: 21) learners are enabled to apply the processes of the sciences to develop organisational and project management skills, problem solving, technique and the application of skills. Science Expo encourages creativity and allows learners to explore individual interests.

Some learners who participated in Science Expo went on to become renowned scientists in the world. One of the first gold winners in South Africa is now a successful space medicine practitioner at NASA. Siyabulela Xuza who was a crowd drawer in the 2006 finals and the recipient of the Dr Gray Memorial Gold medal for the project: *Africa Space*: *Fuelling Africa's Quest to Space* went on to be a Harvard graduate in the same field of Space Science (Gray, 2014: 19).

Like South Africa, Ireland has also documented Young Scientist Exhibition Alumni who went on to be successful in their own right. The inaugural winner, Dr John Mohachan, was doing a project on the process of digestion in the human stomach. This person went on to establish a biotech company in California after attending University College in Dublin. Authors Sarah Flannery and Patrick Ellison developed the Baltimore Company which among others has an interest in volcanic eruption studies in Botswana. Flannery went on to write a book on algorithm and number theory (Green, 2016: 1). Expo is self-validating and exciting. It involves the discovery of little known or even unknown information

A number of studies claim Science Expo as an effective way of developing the scientific skills of learners. It improves science literacy levels, creative thinking, scientific processes and problem-solving skills (Torlop, 2016:59; 60). Science Expo encourages studies in science, technology, engineering and mathematics. It bridges the gap between scientific achievement and the public's knowledge of such achievement (Kahenge, 2013: 11).

### *2.5.10 Expo for Young Scientists and Critical Theory*

The Expo for Young Scientists links well with the theoretical frameworks of the study. The two theoretical concepts link to each other as well as Critical Theory. Self-empowerment should be an idea that motivates the oppressed. By realising a social need such as coming up with Science Expo projects they change the status quo of not competing. To achieve

emancipation there must be clear goals set. The team should have a programme of starting with the projects. The mentor then gives support where necessary (Kahenge, 2013: 11). Projects are appraised and due recognition is given for very little progress achieved. Socio-economic conditions of the community may impact on the smooth programme and quality of projects. The teacher needs to find additional resources or funding for the learners. Prizes won at the Science Expo events are but few indications of empowerment (Nguyen: 2005: 2; Gilmore, 2005: 20 of 14)

The community needs radical change to achieve transformation. In the affected community not only individuals should resolve to alter their lives. It is not the privileged who should decide for the underprivileged. Transformation happens through knowledge. The school needs the knowledge to do projects. They will need all the expertise available. In their quest they invite a mentor to assist them. Their desire will be boosted by the fair and just intervention from the mentor. The perpetuation of being disadvantaged cannot go on forever. The knowledge gained dispels any myths or removes any feeling being looked down upon (Ndlovu, 2013: 2386; Argherdien, 2006: 6; Heisinger, 2013: 6). Conscientisation propels the school to have confidence in starting Science Expo projects. They will be open to accepting support. They will look for a mentor who is the most appropriate to their situation (Meyer-Emerck, 20005: 510; Liu, 2012: 52)

If the school develops clear goals they will have the power to change their non-participation tag. While the mentor's support is used the relationship remains dyadic and reciprocal. Their freedom to make a decision should not be hindered (Cohen, 2000: 3 of 4). Empowerment changes lives. Many learners who participated in Expo for Young Scientists end up studying Science, Technology Science, Engineering and Mathematics (STEM) (Ciero, 2014: 3; Humphreys & Mertens, 2000: 5)

When doing projects, there should be among others a topic, hypothesis, variables and a conclusion. Critical thinking as an objective of Critical Theory needs similar approaches. The mentor should not domesticate mentees but they should question, argue and make proposals when necessary. The project can only succeed if there is a healthy relationship between the mentor and mentee. Freedom to air views inculcates a deeper understanding and love for STEM. (Kahenge, 2007: 22; Torlop, 2016: 59).

*2.5.11 International trends on Science Expo*

Support given to schools by three countries South Africa, Madagascar and Canada on Science Expo is explored. How mentoring by universities and independent organisations benefits communities will be visited and lessons derived from their support.

2.5.11.1. Canada

Fan and Westwell-Roper (2010: 1-3) are members of the Science Fair Foundation BC Alumni Mentorship. The organisation is manned by former Canadian-Wide Science Fair (Science Expo) participants with post-secondary education experience and it matches successful learners with mentors. Mentees, depending on the type of project, are matched with university or industry experts in their field of interest. They support a discussion with questions, technical advice, access to journals and laboratories. Mentees are also invited to a networking dinner which is designed to increase networking with academic and industry researchers and other mentees working on similar projects. Ethical considerations are strictly adhered to. The Youth Science Canada also use those established in the Canadian scientific community as mentors to support participation in Science Expo. It nurtures the scientific impulse and creativity through project-based science. Mentors and mentees should constantly communicate over an extended period of time. Contact is done either by face-to-face, phone or email. The mentee is an active participant who enjoys the freedom to give an idea, argue and ask questions (CWSF, 2016: 1-3). There will be ex-Science Expo alumni used in the project. Some may be current learners who are regular participants while others have post-secondary qualifications.

2.5.11.2. Madagascar

The Science Fair Mentoring Project (SFMP) is an organisation that assists learners with Science Projects. The main goal is to increase the enrolment of learners in Science Expo. It is reliant on volunteers from the community. Volunteers, besides being trained as mentors, also learn about the origin, goals of the project and scientific methods. Project orientation can be done online with virtual mentoring and is the sole or method most often used. Mentors draw up a flexible schedule with the mentees they are working with. They give support and guidance throughout the programme. Mentors also inspire young people to build confidence, grow personal skills and expose science to learners in a way they may not have otherwise have been able to experience before. Learners are provided with the opportunity to develop a personal relationship with adults in their own community (SFMP, 2016: 3). In this study, co-researchers volunteered to avail themselves according to an

agreed flexible schedule. The idea of using online communication with teachers will also be implemented to monitor progress between scheduled meetings as the vast physical distance between the mentor and mentees has to be taken into account.

2.5.11.3. South Africa

In South Africa mentoring is done by among others universities, independent organisations and Science Expo itself. One example of a university which has a researched document at its disposal is the University of Cape Town. Swingle (2016: 1-4) adds that the institution has a new science mentorship project. Postgraduate students are assigned to guide young aspiring scientists. Organisers prepare them for mentoring. They assist with resources, colour printers, internet and project materials. The English language is another challenge to these learners. They are assisted and practice presentation of their projects in English (Alant; 2010: 8). There are learners from the programme who go on to win at Regional and National Science Expo finals. There are other universities doing good work in mentoring learners such as the Universities of Stellenbosch, Venda, KZN (Durban) etc. These examples of mentoring by universities encourage the utilisation of the wealth of knowledge and skills available at local universities. They also have resources like the Internet, journals and laboratories which can be of great help. Hence in this study, local university students are part of the co-researchers. If possible further assistance will be sought from senior lecturers sometimes indirectly through the co-researchers who are students.

The General Motors South African Foundation (GMSAF) helps teachers and learners around the Uitenhage District Offices on how to undertake scientific basic research projects. They help learners to formulate a hypothesis, undertake an experiment, collect data, analyse and interpret data, write reports, do poster presentations as well as presenting findings. Teachers attend a series of workshops. They are put through their paces and conduct hands-on science experiments. Learners are also given activities to try without the support of teachers. A mini Science Expo is held to choose learners who will represent the district at a regional Eskom Science Expo (GMSAF, 2016: 1). The projects are also made available to other interested organisations which may not be directly involved in education. Some of them may be organisations that are already rendering assistance to the school.

In 2016 in Thabo Mofutsanyana, Eskom Science Expo appointed University of the Free State (UFS) final year education students as mentors at eight schools. The students were given brief training. A small stipend was paid at the end of each month after reports were submitted. There were a number of challenges. Some of them being inadequate training as

the programme started later than scheduled. Some of these students were overwhelmed. Secondly, as the programme started during the impasse between the teachers' unions and the Free State Education Department, some schools refused to participate. Thirdly, mentors did not have adequate support as the coordinator was responsible for the whole province. The fourth was lack of support from teachers at assigned schools. The programme succeeded in four schools. Mentors would work with learners after school or over weekends. Learners came up with magnificent projects. There was an increase in participation from those schools where Science Expo had died. The schools and learners were very appreciative of the gesture and have resolved to keep it alive. Mentors alike were excited to be part of the opportunity they never had a chance to engage in while still learners. They also resolved to be active with Science Expo when they had an opportunity to be employed as teachers from the beginning of 2017. In this study, university students are going to be part of the co-researchers. As they will be part of the team they are going to receive adequate support and have a say in how the study can be improved.

## 2.6 Farm school

### *2.6.1 Definition*

During the apartheid era the Bantu Education Act of 1953 defined a farm school as being a school built on a farm privately owned by a white farmer. The policy was amended in 1979.

The South African Schools Act of 1996 does not use the words "farm school" but rather refers to a school on private property without further explanation (RSA SASA, 1996: 14).

A Farm School is a school located on a privately-owned commercial farm. It primarily caters for children of black farmworkers while accommodating learners from neighbouring farms (Gardiner, 2008: 27). Minaar (2006: 8) views a farm school as a school that serves the educational needs of children from the surrounding farms. It is termed as an educational institution built on a farm by Mojapelo (2008: 14). There is a high prevalence of farm schools in the Free State. According to the researcher:

*A farm school is a school built on a privately owned farm for children of black farm workers in and around the farm*. *Farm schools are usually situated far from towns.*

### *2.6.2 History and legislations on farm schools*

Section 29 of the constitution declares, "Everyone has the right to basic education (RSA Constitution, 1996). The Ministerial Committee on Rural Education (MCRE) in their report (MCRE, 2005: 13) warns that treating unequals as equals is actually meriting different

treatment. They see the integration of community-based education provision as the sine qua non. The South African Schools Act (SASA) of 1996, section 14, endorses that all schools and their continued existence are the duty of the state (SASA, 1996: 88; Gardiner, 2008: 27).

The 1953 Bantu Education Act (RSA, 1953: Act 47; Moore, 2015: 73) was established and promulgated to control the minds of people more specifically the Black majority. The establishment of an educational institution for Africans would only be done if it would contribute to remunerative employment on the farm and provide useful labourers. The then minister of Bantu Education had this to say about the value of education at farm schools: “I have tried to isolate the concentration of Bantu Education and disguised ambiance of economic realities, we should try to locate the instruction and character of a farm school” (Harvey, 1988: 16). The farm schools were used to forever enslave the Blacks. This practice was in opposition to Critical Theory applied in this study which states that education should propagate empowerment of local people (Mercer, 2000: 17)

In the 1970s farmers had the power to determine when the schools were needed and could also close them at any time they wished without getting into negotiation with anyone including the government. They could appoint teachers and had power over teachers (Gardiner, 2008: 27). It was after the publication of the SASA act of 1996 that the state had muscle on farm schools (SASA, 1996: 12) Most of these schools are small and multi-graded. There are few that offer tuition up to grade twelve. The Act provides expropriation of a portion of land on the farm if there is a need for a school.(NCOP, 2016: 1 of 5).

*2.6.3 Need for farm schools*

There are many good reasons for the establishment of schools on farms. Despite the ill-intention of the then apartheid South Africa, these schools would reduce illiteracy to some extent. Parents on farms were facing the dilemma of separating from their children who were sent to town schools. A study done in the USA indicated a reluctance among parents to send their children off the farm to study as most of them did not return to make meaningful contributions to their communities (Gardiner, 2008: 27; Harvey, 1988: 17).Human Rights Watch (2014: 45) encourages the state through its primary servants, the teachers, to promote the enjoyment of the right to education for farm school learners.

*2.6.4 Challenges faced by farm schools*

Farm schools have many challenges that threaten their very existence. The MCRE (2005: 17) states that a school should be rooted in the social fabric of the community in which they

are sited. The happenings at farm schools contradict the Free State Education Department motto which states: *"No child left behind"*. Farm school learners are vulnerable to a high drop-out rate, retention, failure, and absenteeism, economic and social problems which affect their optimum performance. These schools struggle financially. The model used to determine the intra-provincial allocation of funding does not assist these schools based on their uniqueness (Rich, 2004: 11; Mojapelo, 2008: 18). It is common practice in the District and province due to dwindling numbers of learners that some schools are closed, others are merged, and that some learners are transported to distant schools while others are moved to hostels. The transport is sometimes not reliable and at others not available owing to the province's failure to pay service providers. When transport is available the number increases along the route of transport but is the opposite on the other side. Farm schools are not well attended to by District Officials (Minaar, 2006: 14; MCRE, 2005: 20; Gardiner, 2008: 19: NCOP, 2006:14)

There is a lack of resources like science equipment, ICT facilities, photocopiers and libraries. One teacher has to phase many grades in one class (multi-grade teaching). These teachers have no formal training in multi-grade teaching (MCRE, 2005: 20). They are either staying around the school or travel long distances daily. For teachers staying close to the school, it means leaving early on Fridays for home and being late back on Mondays. For those who travel it means that if there happen to be transport problems for a day or more, there is no school. A number of farm school teachers are not adequately qualified. Like public schools, farm schools use English as the only language of learning and teaching (LOLT). While the home language has a pedagogical advantage, parents still insist on English (Gardiner, 2008: 19). At one farm school in South Africa, a farm school introduced the teaching of the foundation phase in Home Language. There were visible improvements. However, the school experienced an exodus of learners to a neighbouring school which used Afrikaans as the LOLT with dire consequences (Rich, 2004, 11: 47; NCOP, 2006:14; Mojapelo, 2008: 18). Parents felt that home language would never emancipate their children. They sacrificed their children which in turn enslaved them worse than before.

*2.6.5 Threat to existence of farm schools*

Prior to 1994 farm owners wielded too much power at the school. They even interfered with the smooth running of schools as learners had to stop classes and assist in harvesting. They would sometimes pull learners permanently out of school if there was a shortage of labourers. Parents would themselves, due to poverty force their children to assist them in augmenting their income (Mojapelo, 2008: 18; Harvey, 1988:17). There is poor sanitation at farm schools with learners having to relieve themselves in the bushes or use very

dangerous makeshift toilets. Everybody seems satisfied as at home conditions are the same or worse (Rich 2004:17). According to Critical Theory, sometimes it needs a person who has lived a similar life to conscientise people to be aware of the inhumane situation they live in. This will be a step to transformation if concerned people take appropriate action to liberate themselves (Agherdien, 2006: 6; Berg, 2004: 1).

*2.6.6 Ideal farm school*

There should be an increase in the controlled organisations that work with the schools. They may assist in methodology, science experiments, content teaching, optimally utilised community centres, Internet connectivity and improvement of the buildings. This study is responding as it will transform the community not to accept their oppressive past to remain forever (Gardiner, 2008: 19). When the agreement is made between the provincial government and a private landowner, there are several meetings taking place which are outlined in a memorandum of understanding. A similar meeting with all stakeholders should be periodical and concrete action should follow immediately (SASA; 1996:12; Rich, 2004: 24).

**2.7 Summary of the chapter**

The proper and careful implementation of Critical Theory as a theoretical framework assists in shaping the approach to the theoretical concepts of mentoring and Expo for Young Scientists. Implementation of the objectives of Critical Theory ensures that the theory fully benefits the community under study. Objectives are implemented through mentoring as a theoretical concept. Mentoring allows mentor and mentee to collaborate with both learning from each other. If principles and ethical considerations are respected there will be no problem of power relations. Expo for Young Scientists projects need proper planning by the researcher and co-researchers. There should be a programme they are all are fully committed to. Obstacles need to be anticipated and resolved. These projects need time and resources which are scarce commodities at a farm school. Support with resources is needed hence the research team is made up of members from a variety of fields. Appraisal and objective feedback is necessary.

# CHAPTER 3

# RESEARCH DESIGN AND METHODOLOGY TOWARDS MENTORING FARM SCHOOL TEACHERS TOWARDS EXPO FOR YOUNG SCIENTISTS PROJECTS

## 3.1 Introduction

In this study, Participatory Action Research is used as an approach that will support the study in explaining and put into successful practice the strategy of the study while at the same time connecting with the theoretical framework as explained in Chapter 2. This chapter will start by looking at different historical definitions of PAR. These will be reinforced by examining the ontology and epistemology of the study which will then be linked to the background of the community under study. The reason why PAR is preferred in this study will also be reasoned. PAR has participatory, reflective, collaborative and emancipatory objectives. While a good approach, its weaknesses and limitations will not be hidden. One of them is the power relation which will have to be argued about how it negatively impacted on the study, which in turn collides with Critical Theory as a theoretical framework. The selection and profiling of co-researchers will also be visited. At the same time, a SWOT analysis will be used to give a better picture of the path that will be undertaken. Planning and monitoring of the study will help in keeping the study on track.

## 3.2 Participatory Action Research (PAR)

PAR is used as a research approach that involves people who are being researched. It is done with local people with the aim of improving their lives. The lives of the vulnerable are changed for the better. Co-researchers are involved in all the steps of the research. That includes planning, data generation, data analysis, reflection and conclusion. The ontology of PAR is affected by historical and social context. It is also influenced by social and economic factors. Its epistemology highlights that knowledge has never stayed the same but evolves as it sometimes has to keep pace with the world. PAR has its distinct features which are participatory, empowering, democratic, active, a social process and critical consciousness.

### *3.2.1 History and Definition of PAR*

Kurt Lewin fled Nazi Germany for the USA after the Second World War. It is his Action Research that contributed to PAR. His aim was to achieve a collective goal which is inclusive of the people directly affected. Khan and Chovanec (2010: 35), however, attribute

PAR to Marja Liisa Swants of Tanzania, Orlando Fals-Borda in Columbia and Rajesh Tandon in India. PAR, as cited by Bergold and Thomas (2012: 3), is closely related to other Action Researches. It spread from Action Research (AR). Chambers (1994: 1) relates PAR to Rapid Rural Appraisal (RRA), Participatory Rural Appraisal (PRA) and Participatory Learning Appraisal (PLA). All of them have the common goal of bringing about social change through participation with the aim of first gaining insight into everyday practices of the community. It is better to understand as many as possible and how they overlap. It will help in focusing on the correct path while one knowingly can visit other types of Action Researches if so needed to strengthen the argument. A reflection on the practices and situations bring a better understanding of situations in which they occur (MacDonald, 2012: 4; Masters, 2014: 1 of 9). Its cyclical nature is achieved by involving local people in data generation, interpretation, analysis and external support. It is opposite to positivism which is structured with a detailed method. It should be flexible and responsive towards co-researchers and the research process (Chovanec & Khan, 2010: 35). It is also viewed as a social research with the aim of taking action resulting in positive change (Goodhall& Barnard, 2015: 5 of 13). The researcher is of the view that there was a significant change as the situation was different from what it was from the beginning of the research. Hence each step needs to be applauded.

PAR is a way the community can improve themselves in all aspects of their lives. It brings together community brains with each individual open to making a contribution. Since it is all-inclusive, more specifically of affected people, it fosters capacity, community development, social development, empowerment and social justice. MacDonald (2012b: 36; 38) further believes that people can be more motivated by the research if they are involved in the decision making on how their place of work is run.

Robert (1994:953) highlights that PAR “focuses on the poor and powerless, investigating and analysing their condition and taking action…” It also focuses on research, production and diffusion of new knowledge through accessible communication. Amaya and Yates (2014:15) have agreed with other scholars that PAR is mainly used to produce knowledge which directly benefits the vulnerable, disadvantaged and oppressed. It means it gives a platform to those who really need upliftment so they too become equal partners in knowledge production. Malebese (2014: 88) summarises PAR as a link between theory and practice. The members of the community have more interest if they are involved in taking decisions on matters that impact on them. McTaggart cited in Malebese, (2014: 89) believes that co-researchers should themselves be full partakers in all facets of the study.

The researcher should not use co-researchers as information fodder but as equal partners who will have an important contribution to make to the study.

Freire in (Malebese 2014: 89) saw PAR through its objective of liberation and empowerment of marginalised communities. Baum, McDougall and Smith (2006: 2 of 16) posited that research promotes collective work where the researcher and co-researchers want to understand the area of research with the aim of changing and improving it. Wadswords in Crane and O'Regan (2012:6) used its collaborative nature by describing PAR as [research] which involves all relevant parties in the activity, examining together current action which may be experienced as a problematic, in order to change and improve. The mindset and rhetoric should change, as they say, from "I ask…You answer" to "We explore". It is beyond a researcher observing objects. It actually involves community members reflecting on themselves and their communities. These sentiments are echoed by Bengu and Mbokazi (2005: 173) by saying this collaborative process has the aim of producing knowledge with the most affected. Those affected should be prime partners who better understand the context of the community. They will also have a greater thirst to see their lives transformed. Their involvement from the outset gives them knowledge of the paths transcended. At the completion of the study when left on their own they will not struggle to take the community forward. They will also avoid falling back into traps that they have already avoided with the support of the researcher.

Christian (2011: 1) defined PAR as a method that supports and is intended to instigate and adopt change within the sociological structures of human community. It responds to sociological dilemmas that have failed to achieve desired results. According to Bergold and Thomas (2012: 3) at the end of the study there should be something positive the community can write home about. Mabuuke adds that PAR is a form of research that focuses on the effects of a researcher's actions on routine practice within a particular context. While Mabuuke is not explicit about the co-researchers but the mention of the context has an implication of considering all factors which should include the community (co-researchers). PAR is engaging and also reframes social issues. It challenges ways of thinking and acting while at the same time questions those in power. Blair and Minkler (2009: 652) add that PAR is a systematic inquiry with the participation of those affected by the problem being studied.it is done with the purpose of education, action and effecting change. It is a method that changed the face of research by taking research from the universities to the community who are affected.

Thomas and Bergold (2012: 3 of 12) highlighted that co-researchers are involved in the knowledge production of new knowledge or insight. McTaggart in Khan and Chovanace

(2010:35) includes the primary contributors when he says that PAR is “a systematic and collaborative project between the academic and marginalised oppressed members in collecting evidence on which to base a group reflection and planning a change”. Freire warns of academic imperialism. He further agrees with other authors with their mentioning of the characteristics of PAR as being democratic, equitable, liberating and life-enhancing. Binet (2016: 3; Freire, 1993:2) highlights that PAR “counters scientism by grounding knowledge in human agency and social history” It aims to transform the society after having understood it. It does not study and observe from the side with the hope that what they will conclude will influence the society. Binet agrees with Macdonald (2012b: 36) that “PAR liberates from the conventional prescriptive approach to traditional social linear research”

### 3.3 Ontology of PAR

In PAR people are allowed to retain their own identities. They, however, should be accommodative to other people who do not share their views. It is believed that people can work together even if they do not always agree. An example is in multi-nationals where big governments have successful partnerships despite the differences in political and economic ideologies. We need to recognise differences. There must be great efforts and hard work to reach consensus on points of view. Each one of them needs to have the courage to speak and act in the often contested view (McNiff& Whitehead, 2002: 17; Dworski & Langhout 2010: 216; Novins, Freeman, Thurman, Dogs, Allen, LeMaster & Detters, 2006: 3). If I so want to hold onto my point of view I need to check how much it will contribute to the empowerment of the community. I will need to dig deep into convincing others without them feeling forced to accept my view only to avoid unending arguments. Subjectivity and objectivity have a place. While objectivity can be favoured, the reality of what is happening locally cannot be ignored. A community or individuals are affected by their environment. However, the environment influences the way people comprehend their new knowledge. It means as we engage in a research study, it is necessary to dig into the historical background and social context that affect them. Reality will also not viewed outside of social factors and economics as their existence may add the problems of equity and hegemony (Masters, 1995: 2 of 9)

### 3.4. Epistemology of PAR

Through epistemology, we study what we know and how we come to know it. In PAR the knowledge local people already have is not set aside. We need to be aware and realistic in that knowledge is not static. It is evolving over the years. The views shared by our fore-fathers decades ago may need tweaking to keep up with the times. Even our

understanding becomes clearer as people grow from inexperience and gain other related knowledge. Before Copernicus discovered that the earth is not the centre of the universe people of his era had different knowledge. Their reasoning had to evolve in accordance with new reality. Even today we have to base our scientific reasoning on an acquired eye-opener. It needs to be emphasised there is a wealth of knowledge which has been relevant for years. The community as its custodians are best positioned to lead in how it can be utilised and understood. Our understanding of events is also understood in terms of social and economic hindrances to true equity. The knowledge we have now is not obsolete. What was relevant then may not be relevant later or today. After each new knowledge gain, we make new connections with what we already know. It will make us reconfigure our thinking (McNiff& Whitehead, 2002:18; Masters, 1995:6 of 9). For instance, previously the best and most reliable mode of communication over great distances was by post but it is not the same today when we are living in the cyberage. Likewise cyber communication may not be that reliable and relevant in the future. A new knowledge can cause disturbance before calmness is reached. It relates to entropy and enthalpy in Thermodynamics. Entropy relates to microscopic disorder which will be balanced out by enthalpy. A newly acquired knowledge will of course cause temporary turbulence.

### 3.5 Characteristics of PAR

PAR as a research approach is preferred in this research study due to its inclusivity. The researcher included adults, youths (as learners) and parents. It also accommodates expertise from other areas. PAR is addressed through its characteristics. In this chapter nine of them are briefly discussed. The first is *participatory* which encourages people affected to be active players in the planned action plan. The second is *collaborative* which relates to the first in that the experience of local people will assist to better inform the study on the local context which will inform change. *Emancipatory* is the third and it is through knowledge that people feel liberated as they are able to stand on their own. *Reflective* being the fourth reminds us that there should be constant reflection throughout the study to make a change or reinforce it when so needed. It is through capacity building that people are able to be positive contributors to attain the *emancipatory* characteristic. This was the fifth characteristic which is followed by the sixth being *democratic*. If people are treated as equals and are free to voice their opinions, they contribute energetically. The eighth characteristic is *active*. There should not be talk without action. To achieve a change we need to walk the talk and get our hands dirty. When people have gained knowledge they develop *consciousness* as they will be able to face oppressive obstacles bravely.

*3.5.1. PAR as participatory*

PAR is best addressed if the people affected are involved and lead the process where possible. In PAR co-researchers are not mere spectators or cheerleaders but are fully involved. Their interest increases if the issue under research is local. Realisation that participation would bring direct benefit to the community spurs them on to be more devoted. With their enthusiasm, zeal and character the programme is bound to succeed. In order to maximise participation, after identification of needs and profiling of co-researchers, an action plan should be drawn, implemented, evaluated and revised if need be (McTaggart, 2016: 2 of 2016 Wagner, Moody & Dumond, 2004:7). Goldstein, Ick, Ratang, Holomoan & Blesia (2016: 463) apply a circular process which includes identification of co-researchers, the issue to be researched, agreement on a roll-out programme and reflection. They reiterate that an action plan should be realistic, rather than emotional. Threats and challenges should be factored into the programme. These will assist the team to reduce or manage the problems. In the beginning some may lack confidence but their involvement inculcates in them abilities related to Critical Thinking such as analysis, generation and application of gathered information (Malebese 2016: 91). Chovenece and Khan (2010: 36) remind us that each member should be assigned roles and responsibilities to play in the study. In this study, all co-researchers had specific agreed roles assigned to them. Each person was given team support to improve on the assigned roles which will be discussed as per action plan.

*3.5.2. PAR as collaborative*

Collective inquiry in PAR builds ownership of understanding in the way PAR unfolds. In PAR no-one is lost or has misgivings. It is because each step taken is involving. A space for reciprocity is developed. We at all times avoid having one person such as the researcher as being the only source of knowledge. All of the affected are included as they are experts in their own rights. Farm school teachers have vast experience in dealing with their school environment. They are privy to the background of each learner. They will provide information which will assist the team to exercise maximum patience when dealing with each other and the learners (McTaggart, 2016: 1 of 3; Khan & Chovenace, 2010:36). Lenie in Crane and O' Regan (2012:6) sees it as working together with the purpose of making things and lives better. A lived experience in an indigenous context generates a particular unique knowledge. It is through this knowledge that people can shape their sense of identity. Its other objective is to put heads together on a common challenge that should be collaboratively solved. Through activities people research for themselves and collectively they are able to change their lives. (Kemmis & McTaggart, 2007: 281).

Mabuuke (2013: 2 of 8) states that PAR focuses on bringing about change. It also revolves around unique needs. Researchers and co-researchers work as a team and collaborate on analysing a problem, taking action, data analysis and coming up with a solution. If the truth be told, it is not always local people who become initiators of the research but the researcher will collaborate with local people on matters that will benefit the community. Locals accept being co-researchers as they realise the positive impact that will result from the activity. They collaborate and use their different skills to enrich the study. There is mutual learning in the process (Cornwall & Jewkes, 1995: 1666). MacDonald (2012b:40) affirms that people as individuals bring along their own knowledge and expertise which is put in a bigger basket where everyone can benefit. Similarly people take new knowledge from the pool. It is give and take in a harmonious way.

*3.5.3. PAR as emancipatory*

PAR contains in itself an emancipatory characteristic has is liberation through knowledge gathering. Those that are the most affected by issues under investigation are principal players. Freire (Crane & O'Regan, 2012:8) had a vision of fighting the system of schooling which relies on experts and academia. Freire wanted to see lay persons having influence in shaping their own liberation by producing indigenous experts (Higgs & Smith, 2006:74). The farm community under study had a wish to be able to stand on their own. They were aware that with the correct knowledge they would be able to be equal participants with their counterparts. From participation, they would gauge their level, identify and study areas of improvement. Binet (2016: 3) explains PAR from the angle of involvement of people in the redistribution of power through the development of emancipatory alternatives. Co-researchers are given freedom to question acceptable realities as they will compare the present with what will be experienced. Newly gained knowledge would be constructed and assimilated for utilisation in making improvements. Freire believed that it is through involvement that people can be built up to be better (McDonald, 2012: 8; Freire, 2000: 193). Freire's thought agrees with that of Kemmis and McTaggart (2007: 282) who see PAR as striving for self-development and self-determination. People free themselves from the constraining bondage of irrational, unproductive, unjust cultural and social structures. The community should strive to ensure that their lives are better after engaging in the study. They need to influence the direction of the study so that they will be able to carry themselves to higher achievable goals. All that stood in their path for development is questioned, substituted or improved.

*3.5.4. PAR as reflective*

When a programme is undertaken, there must be time to look back to check if things are going as planned. PAR, as has been alluded to, is cyclic as it has room for reflection where researchers will afford themselves space to critique the perceived legitimate source of knowledge. Freire had a strong belief that personal change can only be realistic if there is a critical reflection (MacDonald, 2012b: 36). During the process of a study the team will further and deeper understand how history, culture and local context influence the community. The understanding is achieved through a reflective cycle of data generation and data analysis (Baum, McDougall and Smith 2006: 2 of 16; 17). As the study is action orientated it will influence, strengthen or sharpen the way forward which will again generate a new spiral cycle. Unlike traditional researchers which inquire about other people, generate data about them and make a conclusion without their inputs, in PAR the researcher is also in line to be studied. As I study co-researchers, they too, study me. Learning is done in and through taking action and constant reflection. In a spiral action of critical, self-critical action and reflection people will investigate reality in order to change it. The transformation that it will bring should not only be a theory but must put into practice (McNiff & Whitehead, 2002:15, Kemmis & McTaggart, 2007: 283). I even assist them to study me. No one is given special status or is untouchable. That is why a good planning is needed before the study commences. The researcher has also realised that the most challenging part of research is the planning. One has to address all challenges, be clear and make it acceptable to all. In the roll-out, it is only necessary to execute, reflect, refine and act again. The action goes through a reflective cycle of data generation, its analysis and thereafter reflection on actions to follow.

*3.5.5 PAR as empowering*

PAR emphasises grassroots empowerment and is preferred by marginalised communities. Hall in Khan and Chovanec (2010: 35) remind us that PAR combines social investigation, education, work and action. This is different from traditional social sciences methodology. Co-researchers are capacitated if they are lacking in other areas. During their involvement, young co-researchers gain critical awareness about social, cultural and contextual factors in their own lives. During interaction, they again learn how to develop new resources and strategies for social change. New knowledge gives birth to a new society which is empowered to act in accordance with the new knowledge. Capacity building results in achieving the ultimate aim of PAR which is empowerment. Every member feels empowered if they are contributors towards commonly desired goals. Empowering always yields acceptance and it also fosters teamwork. Co-researchers take control of their learning

needs (McTaggart, 2016: 1of 3; Mabuuke, 2013: 4 of 8; Wagner, Moody & Dumind, 2004:7; Burns & Cooke). This creates members who are not just there as knowledge absorbers but as fellow creators and innovators of the body of new or refined knowledge. People are empowered through knowledge production, their direct involvement in instructing and using their own knowledge (Amaya & Yates: 2014: 17; Burns and Cooke, 2011: 18).It liberates the oppressed by challenging any oppressive elements. It also empowers the oppressed to be able to stand by themselves as they contribute to social change (MacDonald, 2012b: 36). PAR involves a co-learning process. It creates conditions for working together for all. Everyone should feel an increased sense of control and in decision making (Blair & Minkler, 2008: 652). Capacity building of co-researchers will achieve the ultimate aim of PAR which is empowerment (McTaggart, 2016: 1of 3).

*3.5.6. PAR as Democratic*

PAR is not nomothetic which can be carried out under any social conditions. It operates effectively under democratic conditions. A clear democratic and political framework gives people space to function freely. The study is easier to carry out if there are political laws that allow for smooth operation in the underprivileged community. An illustration of this is what happened after the collapse of dictatorships in Latin America. An increase in democracy saw a rise in general participation of populaces in matters that would improve their lives. Their growing faith in democracy has a bearing on the extent to which people become absorbed in research, question formulation, data generation, its analysis and results (Bergold& Thomas 2013: 1; Christian, 2011: 3).

What has been planned cannot be adhered to if it is not working. Its elastic quality will allow changes to be made to the programme that will assist in the achievement of goals that will best benefit the indigenous community (Crane & O'Regan, 2012: 10). All involved share equally in the democratic process. People happily sacrifice themselves in a democratic environment. Each has ownership of the programme. There is a spirit of self-discipline which will galvanise all to be fully engaged. The researcher and co-researchers are involved in aspects of the study which include a definition of a problem, data collection and data analysis. It levels the playing field so that all have equitable roles to play in their liberation (Macdonald, 2012a: 35; 39).

Democracy in practice is seen also by the inclusion of people who will be impacted on by the study. It is a good chance to listen, test and include the rhetoric of the community members (Baum, McDougall & Smith, 2006: 7 of 16). Exposure to research allows an individual to develop a relationship with the society (Burns & Cooke, 2011:18). Active

participation in societal matters gives an individual a good chance to learn through the strength of others. One has a door of opportunity opening to share expertise, leadership qualities, the ability to listen, to develop patience and work as a team (Burns & Cooke, 2011:18)

*3.5.7. PAR as an active process*

A big challenge requires a combination of solutions. Hence PAR draws expertise from a diversity of all people especially in the community involved. Other people from institutions and interested organisations are also involved. All these will come up with a wide range of values which are practical and inclusive to enrich the solution (Crane & O'Regan, 2012:8). Some of the co-researchers are young people. Kim (2016: 45) warns that young people can easily be bored if the study is not a fun activity. The planning needs to accommodate their strengths and fun activities (Kim, 216: 45). After assessing the need in their community, the community will be able to come up with an action plan on how to tackle it. They should come up with solutions that will directly address the challenges. They cannot parachute a solution copied from elsewhere. It is true references can be made but the solution will have to be tailor-made for the specific community. It will mean that they should come up with resources and strategies for their task. Politics is unavoidable in PAR. It challenges the powers-that-be in trying to involve all in the community. It also challenges the power that usually resides with the researcher in decision making (Wagner, Moody & Dumond, 2004:7). People have to have a look at their social practices. The deductions made will have them shape the future way they communicate and do things. Necessary changes should be implemented through consensus (Kemmis & McTaggart, 2007: 282). The politics and practice of existing knowledge are also scrutinised. A new action is taken after coming up with social alternatives (Burns & Cooke, 2011:18).

*3.5.8. PAR as a social process*

Other approaches are blamed for turning researchers into tourists as they only come to 'sight-see' and are satisfied with 'souvenirs'. PAR, unlike other approaches, contributes to society as the co-researchers are active throughout the process of seeking direction for their path. PAR wants to change the social reality of co-researchers (Malebese, 2016: 100). It is positively accepted as a method which neither exploits nor harms the underprivileged because they have an equal voice on what affects them (Baum, McDougall and Smith 2006: 5 of 16). At the end of the study, it is not only the researcher who gains at the expense of the community but the study has left a rich impact behind. It is acceptable that individuals shape the socialisation as much as socialisation does the same to the

individual. It is because the realms of the individual and society are being studied (McTaggart, 2016:2007: 279). The skill to communicate for better understanding is inculcated. It unearths discourse grassroots and reconstructive action (Burns & Cooke, 2011: 19)

*3.5.9. PAR as an inculcator of critical consciousness*

There are communities which are asymmetrical (Dworski & Langhout 2010: 216). When doing a study it needs to be observed what the impact of the study will be. For instance in rural areas a farm owner or a village chief or parents may still indirectly fight for dominance rather than mutual respect. The people depending on such a person may be unwilling to present arguments as these may be viewed as disrespect. Research must enable people to challenge all the evils of asymmetries such as undue submissiveness. People need to acknowledge its oppressiveness and the need for it to change.

## 3.5 SWOT analysis of PAR

There are four areas PAR can be analysed on. Its *strengths* are accommodation of knowledge from all members without degradation. It has been observed that if care is not practiced is has the *weaknesses* of focusing on changes which may have roots beyond the area. It focuses on the community which can be at the expense of each and every individual. All have *opportunities* to put their ideas across and each member is involved in decision making. People may look for quick results and if not satisfied they may start to withdraw from the project which will be one of the *threats* to the progress.

*3.6.1 Strengths of PAR*

Binet (2016: 1 of 1) reminds that in PAR there is no inferior knowledge. Each piece of knowledge has space and as such should be given space. It uses Freire's conscientisation by breaking down mechanical thinking of looking on one side for the body of knowledge. No knowledge is graded inferior because it does not come from an academic but from the grassroots in the community of study. All involved in the study have the right to determine their own development. They are becoming champions on the path to sustainable development by being active in the analysis of their own solutions which they have control over (Macdonald, 2012b: 36). They can contribute so much to the analysis as some may have first-hand experience of when the situation changed or deteriorated. They are the first to notice the one step forward movement. People, the community and their issues were valued as active contributors in all facets of the study. As opposed to weaknesses, each individual was supported in capacity building. Each of them provided strong support that

resulted in all owning the whole research process (Macdonald, 2012b: 39). The researcher was never alone but was part of the collective. The knowledge gained in the study did not end in the archives but was critical in adding to their new improved direction that would be taken (Cammarota & Fine, 2008:2).

### *3.6.2 Weaknesses of PAR*

Cook and Katherine in Khan and Chovanec (2010: 37) criticised PAR for its obsession with a local challenge. Some challenges are much broader. They may be systemic challenges before being local. It may happen that we need to have an understanding of the global challenge and its impact on a local community first. For instance, the problem of learners with mathematics and science is global as revealed by a study like TIMMS. When studying a local community, one needs to have a broader picture and a broader approach to challenges. This approach is the antithesis of top-down development approaches. It may be understood to mean that there is nothing the researcher can introduce that the community was not aware of. The group in PAR operates as homogeneous even though it consists of heterogeneous individuals with independent thinking. It may ignore empowering each individual but be happy about group achievement. Contestation and resistance arise as people push back against what they perceive as oppression and power within the group. The war is not waged inside only as there may be external negative forces encroaching as well. Defensive complacency may cause a delay in taking action against unhappiness and complaints. Kim (2016: 47) argued that PAR does not have a fixed method of research but that it is decided by mutual agreement. There is no guarantee of tight confidentiality as people work as a group. There are occasions when a member makes a presentation in front of the group. It is dangerous in a small community like a farm where everyone knows each other if confidentiality is breached.

Amaya and Yates (2014: 4) noticed the lack of communication and traveling as a big challenge. Some of these studies were conducted in poor communities. They reported about studies that collapsed in Burkina Faso and Bolivia due to afore-mentioned challenges. The aggravation was that facilitators were outsiders who had to travel around to meet teams. The team needed to meet constantly for research and briefings or they had to use another mode of communication between sessions. Communication was poor as there was inadequate Internet connectivity. The two authors also noticed scepticism and lack of commitment by co-researchers. They made an example of the study that collapsed in Bangladesh due to loss of interest by co-researchers because of many similar challenges. PAR allows the freedom to terminate participation at any time without any consequences (Amaya & Yates, 2014: 4). Some co-researchers, as a result, may not be committed from

the beginning while occupying space and being assigned duties they do not perform thereby adversely affecting the project. The team needs to be formed based on commitment and interconnectedness in the research process. The study needs to include local people who are prepared to take their community forward. They need to be made fully aware that their empowerment can only be realised if all are fully committed.

As PAR is too inclusive there are challenges of others piggy-backing. They are just there to add numbers or cunningly pretend to be busy while not. They only wait to get glory without sweating. Time may also be wasted with long arguments on consensus. There may be those who will always want to be dominant if these issues were not clearly ironed out in the beginning. There will be a misunderstanding on perception, social issues, interpretations and analysis of research. If all are not pulling their weight unnecessary data can be generated which adds further to conflicts (McDonald, 2012b: 40; Baum, McDougall & Smith 2006:6 of 16). Another factor is power asymmetry among stakeholders (Dworski and Langhout 2010: 227). Time is needed to develop together a group dynamic which may take a long time. Members may be holding different positions outside the study which they want to bring into it or people regarding themselves as subordinates may also carry those tags into the study. This behaviour is contrary to PAR and can retard smooth operations. Young people and adults are part of the team. Adults may discourage young people to be part of the decision making process or argue with them (Riggs & Day, 2010: 222).

### *3.6.3 Opportunities for PAR*

PAR reduces the strength to resist. People do not have to struggle in thinking about the outcome as the generating and gathering of data is in the open. There are a variety of people who have the opportunity to be part of the study. It is from these diverse people that rich and credible data is generated. (MacDonald, 2012a: 7).Young people have a chance to also study social challenges. That allows them to discover injustices and their sources at first hand. They stand an equal chance to have an opportunity to change the situation for the better. Their acquired knowledge becomes a launch pad of ideas, plans and strategies. Identified problems or challenges are studied so that all stakeholders can come up with solutions. Adults who participate with young people are happy to learn new skills from the young ones. They may learn how to use the Internet which will be helpful to them (Riggs & Day, 2010: 222)

### *3.6.4 Threats of PAR*

One of the first battles Goodhall and Barnard (2015: 10:13) highlight is finding people who want to be part of the research. It happens that people may not be interested. Convincing

and coercion may be necessary. These should not be viewed as tricking people into the study but as something that is going to benefit the community. As much as PAR wants locals to own and run with the study, it is common that they may lack the self-confidence to do so. The study can as such collapse or take very long while trying to build confidence. They may want to rely on the researcher for direction. The community's interest wanes over time due to preconceived ideas. They become despondent when they realise that the study will not reach their dreamed of destination.

A farm community may be looking to a study as something that will transform their lives in the wink of an eye without sweating (Cornwall & Jewkes, 1995: 1969; 1673). The researcher observed that when a group of people are working together, especially when coming up with a new body of knowledge, it is unlikely that they will fully agree on everything. Each person may see their idea as the best that should be accepted by others. However, MacDonald (2012a: 9) says that employment of PAR requires people to be in accordance with all steps including what will be the final document. It means they have to reach consensus or have a convincing debate. The researcher must recognise that there is potential for tensions in the team that may be caused by diversity in traditions, culture and rural-urban reservations.

The spirituality of the co-researchers will have to be managed. People may have different views based on their spirituality. Each group should be accommodated without offending the other. Co-researchers may be quick to complain of time and resources as soon as they don't see quick outcomes. They may also want to be made constantly aware of the long-term benefit of the study.

Teachers may complain of having too much work to do. Learners may raise the pressure of homework and the lack of reference materials. Power relations between members and communities can limit full benefits (Dworski & Langhout 2010: 216; Novins, Freeman, Thurman, Cloud, Dogs. Allen, LeMaster & Detters, 2006: 3). Research needs funding to run smoothly. The study will need funding to travel to the site for meetings and data generation. Lack of it is going to limit meetings, which in turn impacts on the amount of data from which analysis and conclusions will be made. Internet connectivity is also not easy as only a few members are connected (Goodhall & Barnard, 2015: 10 of 13). It has been realised that young people do not trust adult researchers as allies. They feel they will be stifled when speaking openly. The study needs time which learners may not have it in abundance. The lack of time will cause some to miss meetings which will increase mistrust (Kim, 2016: 45).

### *3.7. Balancing Power Relations in PAR*

Dworski and Langhout (2010: 215) define power as “a network of social boundaries that constrain and enable action for all actors” Laws, regulations and the different positions held by people build boundaries. If people are strictly controlled they become docile and they feel being constantly under surveillance (Sheridan, 2016: 12, 47). In this situation people have been denied power. The reader is reminded that PAR challenges any unfair boundaries that put one person above the other. To balance power the research team make their own inclusive boundaries which amongst them include ethical issues. Researcher and co-researchers should talk about boundaries if any. They should, after identification, dismantle those that are unjust (Person, 2011: 61). New inclusive ones which are influenced by contextual factors can be agreed upon. PAR opposes these ways of controlling people. People become empowered and powerful if they are part of the control in the process of research.

Power is balanced by adherence to a code of ethics which emphasises respect for human rights as one of the main requirements. It advocates doing the right thing concerning one’s fellow creatures (Craven & O Regan, 2012: 46). In PAR there is no inferior knowledge as it fosters empowerment for all. The notion that only academics have knowledge has no space. In PAR power is relational as it is shared with others rather than over others. The community is given space for enhancement through inter-subjective discourse in the public realm. The researcher valued contribution from the farm community as they have more knowledge about their environment. Their voice will inform and strengthen the study. Hence the research and action must be done with people not for the people (Binet, 2016: 1; 3 of 3). Dworski and Langhout (2010: 216) further reiterate that PAR arouses consciousness. People become aware that they equally possess power as all others. They are equals in the relationship.

Dworski and Langhout (2010: 223) posit that it is the community that determines power. In balancing power, all stakeholders in the research take part in all stages of the research ignoring the followed norms. All are included from selecting a topic, data generation, data analysis to the action to be taken and decision making. There are objectives in PAR. It advocates power-sharing between researcher and co-researchers (Baum, McDougall & Smith, 2006: 2 of 16).

### 3.8 Perception of Negative Power Dilemma of PAR

One may ask how PAR is applied to mentoring as mentoring gives the impression of one person with power working with a powerless one. People feel that they are being exploited. In a team, some adult co-researchers may not have the same knowledge of scientific reasoning. This situation can be exploited by academics and others who may believe every word they are saying. After all, academics will not keep quiet from the fear of being judged as hijacking the study. They should calculate when to come in like when they stimulate communication if it is lacking. They have to be taken into a process of them remembering that they are equal partners. These adults may take advantage of young co-researchers as the latter may have insufficient skills in doing inquiries. The youths again unintentionally can surrender to adults or give them more power to lead. They will passively follow any instruction by parents (Kim, 2016: 46).

PAR advocates for people to stand against anything they see as oppression. The young people especially learners who are taking part in the PAR may take this too far (Kim, 2016: 41). During or at the end of the study they may oppose any form of leadership at school which they may see as suppression. The researcher envisages them challenging the school code of conduct and rules where they feel it puts an adult (teachers) in charge. If they are not involved in any action that affects them they are likely to oppose it. They may also want to co-manage the school.

The words “radical change” may be mentioned a number of times (Khan & Chevanec, 2010: 39). It may be misinterpreted to mean stubbornness and forcing an individual to accept what the group believes is right. An individual can be alienated or conformism can be created in the name of acceptability. The study needs to be careful not to fertilise a field of delinquency. To avoid these unfortunate events it needs to be clear to all that challenging injustice is done with responsibility.

Bengu and Mbokazi (2005:177) decry the conventional practice that does not publish the names of co-researchers. Researchers even give them the assurance that they will remain anonymous. This inherent thought is not always right. There are co-researchers who may want their identity to be known. There are some co-researchers who have carried the study but at the end only the name of the researcher gets recognition. Hiding their identities perpetuates the notion that “wisdom” only resides with scholars or in university corridors. Making people sign the consent form without asking them how much they need anonymity is insulting to their intelligence. There needs to be flexibility. The fidelity of findings sometimes put a question mark on the accuracy and bias of the final conclusion. The team

may decide to make public only what they think the public wants to hear and hide very important but unpopular findings. These very unpopular findings would have a far-reaching effect after being explained to people who were thought not to accept them. It will be difficult for the study to be sustainable if not all the findings are brought to the fore. It will not be a good source for other studies as it won't be the complete truth.

The opinion expressed by Kim (2016: 47) is that research will cause harm to those who feel socially excluded. PAR encourages people to stand up for their rights. It could happen that learners oppose any school leadership from teachers and even parents. This opposition could then cause those holding power to resist without any compromise. To keep the peace, the dominated group may refrain from voicing their opinion. During discussions, people may be verbally abused in the name of *"robust debate*".

## 3.9 SWOT Analysis of the Study

In the previous constructs, we looked at facets of PAR which are in fact a general explanation of a SWOT analysis. In this section, the focus is on real issues at the research site. We look at how a farm environment is the best resource. The weaknesses caused by the lack of resources like Internet facilities, learners staying far from school and overloaded teachers, impact on the study. However this farm school benefited from working with different people and mentors in their quest to gain knowledge and skills of Science Expo. Lack of time and too much school work are some of the threats to the study.

### *3.9.1. Strengths*

The study happens where people at this farm school have indicated a desire to change. Their willingness will make them eager to make a contribution. This group will be looking forward to being champions of change in their community. Working as a team does not mean they are too weak to go it alone. There is an English adage that says "unity is power'. By putting heads together more is achieved (Binet, 2016: 1 of 1). They have in their power solutions that will make a lasting impact for years to come (Macdonald, 2012b:36). Their achievement will be made references, either for them or others. Other groups may want to take it to the next level (Cammarota & Fine, 2008:2).They will need resources for the Science Expo project. They will realise that they have a rich farm environment at their disposal. The open veld, vegetation, farm animals, agricultural activities and many others are freely available in abundance. The other positive factor is the relation between Science Expo and a NS project. Doing a NS project is an SBA requirement. The National Policy on Assessment (NPA) states that failure to present on formal assessment will result in a

learner being retained (RSA DBEb, 2014: 10). Both teachers and learners are eager to make a contribution. Though at the beginning they may feel tense, knowing that they are working as a team alleviates fear. Assistance is freely available for each member (Macdonald, 2012b: 39). Taking part in the study will do more than contributing to the study but will also be an incentive to progress to the next grade. So for both teachers and learners, the study is support they do need.

### *3.9.2. Weaknesses*

Even though the strengths have been laid out, it does not mean there are no weaknesses to be faced. It is not only the open farm environment needed for the study but there are also references needed. At the school, there is a no well equipped library or free access to the Internet. Even if Internet access is made available very few learners have devices that will allow them to download the information they need. The information resources are in English. It is not a big challenge to teachers but it is for learners. Information from the Internet is not school grade specific. Understanding and interpreting information is not easy for them. The lack of teachers with Physical Sciences background limits their free participation in conversation in a group. The other weakness is that of unavailability of all learners after school. Most of them have to hit the road immediately after school either on foot or by bus.

### *3.9.3. Opportunities*

The team has an opportunity to work together as equals. The spirit of teamwork assists each and every one to benefit from one another. A workshop was held on the basic requirements of Science Expo. The familiar example of a farm environment was used. They were able to share experiences from different farms around the school. Teachers and learners from different farms possessed rich data addressing the same topic (MacDonald, 2012a:7). The team works together to tackle what has been a sore point for them. They assist each other from the inception of the Expo project. They used different sources to find information. Each challenging step is discussed together until a direction is found (Riggs & Day, 2010: 222).

### *3.9.4. Threats*

The researcher realised that both learners and teachers are frustrated about getting a good topic. Some start to show signs of frustration. Hitting a snag so early is a non-starter. Lack of Internet access for information can evolve from a weakness since co-researchers can lose interest in the study. Since some may miss sessions as they have to hurry home, they will lag behind and see themselves as a burden or slowing progress of the team. Both

teachers and learners still need time to do other school work which will be challenging to juggle with the study (Dworski & Langhout 2010: 216). We may reverse what we aim to achieve at this school, namely, a love for Mathematics and Science. They may see these subjects as “punishing” and too demanding. The lack of understanding of English by learners makes them reliant on teachers, which is against the principle of PAR of being equal contributors. They are able to play a role only after somebody else’s interpretation. The distance to the research site is also a poser. It is costly and time-consuming (Kim, 2016: 45). It reduces the amount of interaction which may be very useful in reducing unnecessary frustrations without immediate interventions. Because of a lack of Physical Science teachers learners also have very little understanding of Science Expo projects. Learners become aware of this and as such do not believe in their guide. They all wanted assurance from the coordinator. This resulted in a session with teachers to discuss and demonstrate what will be done with the learners. When meeting with learners we are all equally able to guide and engage confidently with learners in groups or as individuals.

### 3.10. Minute Data/ Data Analysis

Thematic data analysis should be used which will not wait until the end for analysis. This method allows refinement, revision and inter-activeness using codes. Working with data during the study gives researchers time to start classifying findings according to codes. Where necessary, the code is clarified, a new one added or information as taken under the most appropriate codes. Established categories of data are classified as themes (Mabuuke, 2013: 3 of 8).

### 3.11 The role of the Researcher

The main function of the researcher is to facilitate the programme. Kemmis and McTaggart (2007: 285) question the connotative meaning of the word “facilitator” as it implies that this person is neutral. This will disqualify the researcher in PAR. However in PAR a facilitator is an integral part of the research. The researcher possesses activism dualism and is a part of the collective. The researchers become partners with co-researchers as they develop a collaborative relationship. They will display faithfulness during interaction, observation, note taking and data collection.

### 3.12 Relation of co-researchers with the study

Co-researchers as the ones most affected should be deeply involved. Exploration of the challenge at hand should be inclusive of those seeking assistance. Their thoughts, ideas, voices, stories and issues need space. All these need to be researched, analysed and

compiled in a way that will be beneficial to them. An example is research done about the Aborigines. Their inclusion as co-researchers gave them a platform to express their preferences. They also shaped provision and as such shaped the programme that will at the end of the day positively influence their lives (Crane & O'Regan, 2012: 7). Khan and Chovenace (2010: 36) added that co-researchers are engaged in theorising and gathering compelling evidence for validation of their practices. The Photovoice method can be used by taking photographs and capturing reality. The photographs are then used in data analysis (Blair & Minkler, 2008: 656).

### 3.13. Selection and profiling

The research site is well suited to the study. It is a farm school. The study consists of forty-two members. The coordinating researcher facilitates and coordinates the study. Co-researchers are teachers for Natural Sciences (two), Mathematics (one) and English (one). Thirty grade nine learners are involved. Subject Advisors of Natural Sciences and Mathematics are also involved. Four final year prospective teachers are part of the study as well. Two former Science Expo finalists use their experience to motivate teachers and learners (Jansen, 2007: 31).

### 3.14. The research site

Based on the Free State DoE EMIS record of 2017, the District has 236 rural farm schools. The school is situated ninety-eight kilometres (98 km) from the Education District Office on a deep rural farm. It offers grade R to grade 12. It is one of the only two farm schools in the District offering up to grade 12.There are a few girl learners who stay in a small school hostel on the premises while the rest of the learners commute or walk to and from school. The school ceased to offer Mathematics and Physical Sciences from grade ten to twelve (Jansen, 2007: 31). They felt they did not have 'material good enough' to do the subject. The second reason is due to the pressure placed on grade twelve schools to produce good results especially in the so-called 'get-away subjects' such as Mathematics and Physical Sciences. The school then decided to choose only 'takeaway' subjects which include Mathematics Literacy. Another aim of the study is to reverse that perception of inferiority in the near future. The school will realise there is indeed great potential in their learners.

McMillan and Schumacher (2008: 342) highlight that having a research site involves negotiations to obtain permission to have access to the site. The site is also identified as the one that will be most suitable and feasible for the study. In this instance, the researcher heeded the call for support from the community. The principal actors, access to the people, power alignments, interest and information obtained informally in advance made it easier to

accept the challenge. At this school the principal and teachers have a will to succeed and passion as do other stakeholders.

## 3.15. Researchers

### *3.15.1 Coordinating Researcher*

The researcher has functioned as a Natural Sciences Subject Advisor for the Free State Department of Education for more than fifteen years. The initial years on this job included focusing on Physical Sciences. Part of his job is to encourage learners to have Physical Sciences as a subject of choice when they choose subjects in grade 10. This is done through different activities that demystify science from an early age. One of the most popular activities in the annual calendar is Expo for Young Scientists (Gray, 2014: 19).

The researcher became involved with Science Expo in the late 1980s while still a Physical Sciences teacher. While his school participated regularly, he also supported teachers and learners in neighbouring schools. He took this enthusiasm along him to the District in his next move. During these years he revived the spirit of participation in schools which had stopped participating while traversing all corners of the District to support, teach and mentor both teachers and learners. The number of schools and learners participating skyrocketed within a short space of time. His house resembles a bee-hive around Expo time, with throngs of teachers, learners and parents seeking support.While this exercise is fulfilling it has many challenges. Some of the challenges are a lack of support, experienced teachers leaving the system or gaining promotion, loss of interest due to the overloading of teachers and learners with curriculum activities.

Over the years the researcher's concern was that no farm schools ever participated in Science Expo. He waited for an opportunity to mentor farm school teachers. It was during an informal conversation with the research site's school principal that she indicated her desire to see her school participate in the Science Expo. He then invited her to the regional finals where her son was a finalist. While in conversation with the school's Natural Sciences educators, they made a "Macedonia call" to which the researcher responded in the affirmative.

### *3.15.2. Co-researchers*

Mabuuke (2013: 4 of 8) has observed that sometimes good innovations fail because the primary users are never involved. Any report given must be accompanied by comments. Comments motivate co-researchers to know how far they are or where and how they need

to improve. Each member should be certain that the information and their identities will remain protected even long after the study. Any deviation should receive the blessing of all.

Co-researchers in this study are categorised into five groups. The first group is two Natural Sciences teachers of the research site school. They are the ones together with the principal who have shown an interest in their school being included in future Science Expo events. Two other teachers are an English teacher to support the group with language editing while a Mathematics teacher will be of help with mathematical concepts such as the representation of data with graphs and their interpretation. Two other Science teachers from two neighbouring farm schools will be part of the team with the aim of them learning from the process. Their farm school experience will be handy.

The second group is the thirty grade nine learners. The UN Convention on the Rights of learners gives learners powers to have a say on decisions made for learners on their behalf (CSIE, 2013: 1; Mavimbela, 2001:11). Grade 9 learners were identified as they are the last group before learners go to grade ten where they will choose subjects which for many will determine their future career choice. This will encourage them to choose science as it is a need in the country. The majority of these learners are girls. The study wants to make a profound impact on the girl-child. The group also showed enthusiasm more than other classes. The third group consists of four final year university trainee teacher students. Their inclusion is twofold. Firstly, their science expertise will be handy, while they are also learning about mentoring learners in Science Expo which they will use at their future places of employment. Secondly, a few university learners who were involved in the past have gone on to start Science Expo at schools in their home towns which never took part in the Expo before. There is a dual relationship for younger co-researchers in the study. While they are valuable members, they also receive training and support to be able to take responsibility. They will achieve a sense of accomplishment if what they contribute is acknowledged, implemented and also has an influence on the study (Mabuuke 2013: 4).

The fourth group is comprised of two former Science Expo gold medallists. One is in grade twelve while the other one is a qualified engineer. They will motivate and share their experiences with the team while they are also learning to work in a different environment.

The fifth group will be two teachers who are experienced judges at the Science Expo finals. Their schools are regular participators. A Provincial Science Expo Coordinator will also be invited as and when available. The whole group including the coordinating researcher is made up of forty-two members.

### 3.16. Ethical Issues

There should always be respect, justice and beneficence for all humans. All should be protected from harm, any discomfort and inconvenience. The researcher needs to ensure that all are protected from physical harm, discomfort, injury, illness and pain. We need to avoid the slogan of “no pain no gain” in research. The researcher needs to understand to some extent the psychological feelings of co-researchers lest they make the worst of the situation. These may add to the distress, guilt, anger and fear which the co-researchers were battling to overcome. No one should feel devaluated of personal worth, humiliated, disrespected and manipulated. As far as possible, co-researchers should not end up carrying the cost of the study either directly or indirectly (O’Regan& Crane 2012: 46; Burns, Cooke & Schweider, 2011: 10).

The right to informed voluntary consent and rights to safety are a priority. Co-researchers should have the conviction that their information will be kept safe during and after the study. In the group, a spirit of openness and transparency should prevail. That includes using pseudonyms instead of real names. Risk assessment is recommended before and during the study O’Regan & Crane 2012: 46). The voice of the community needs to be loud in the study. They should have full ownership of data generation and analysis. Any study needs to ensure that it does not reinforce social stereotypes in presenting communities (Burns, Cooke & Schweidler, 2011: 10). Each member should feel being worthy by being given a duty to play.

### 3.17 Scheduling and monitoring of the study

The study was divided into phases or sessions. It stretched from meeting the school principal, teachers, learners and all other stakeholders. Agreed reflection sessions included the team reporting on progress at different stages of the study.

Table 3.1: Research schedule

| SESSION | ACTIVITY | REFLECTION |
|---|---|---|
| 1. Principal and NS Teachers | Meeting the school to introduce the study and seek consent | The school accepted support. We also agreed on a schedule |
| 2. Brainstorming | Talking about the programme, challenges and threat to be overcome. | 1. They have never been to Expo.<br>2. They left feeling confident they can give it a shot. |
| 3. Meeting all stakeholders | Meeting with all co-researchers to listen how they intended to approach their programmes. | They were given a chance to say which topic and approaches they are thinking about. |
| 4. Working on a project with | A hands-on activity with teachers on | 1.Struggled a lot at the beginning |

| | | |
|---|---|---|
| teachers | a mini Science Expo project. | of science investigation skills<br>2 Became much easier if done step-by-step with them. |
| 5. Progress monitoring | Assessing progress and listening to presentations. | This was done to choose the best projects for regional finals. |
| 6. Mini-Expo at school | Judging projects to select finalists. | |
| 7. Supporting finalists | Working with other co-researchers including teachers to fine-tune projects. | Learners are supported to eliminate as many mistakes as possible and practice presentations. |
| 8. Open day for projects | Community viewing, presentation by learners and study closure. | A stamp of approval is given by the community as they view and acknowledge the projects. |

The first meeting was with the principal and teachers concerned. It was done to introduce the study and level the playing field on when to meet and how. The subsequent meeting was with the team to brainstorm the whole study and our expectations. It was at this point where more facts were deduced from the threats as well as anticipation of the challenges. A meeting with learners followed a similar format. Reflections were done during every meeting. Reflections assisted all of us to assess whether we were still working within agreed objectives and plans. Where there were challenges that hampered progress we had to agree on how to remap our programme. The study wanted to ensure that the school would be able to continue independently in Science Expo participation in the coming years. Inculcation of self-reliance was encouraged. A few interactions were added which were not part of the initial plan. Two former Science Expo finalists were involved as motivators and co-researchers. One was doing their first year at tertiary while the second is a qualified engineer. Their interaction with teachers and learners had a positive influence. They were easily approached by all. Learners could relate to them due to the narrow age gap.

### 3.18 Data generating techniques

Data generation used should be credible, reliable and valid. They are cyclical and include data collection, reflection and data analysis. The researcher realised that not one technique can fully close as many gaps as possible. He has also realised that the human factor and subjectivity play a role when data is generated hence the use of many different techniques. The techniques used were (1) Observation: an observation made was mainly focused on areas that link with research. Contextual factors were taken note of as they may impact on the study. (2) Anecdotal notes: Objective and meticulous brief descriptions of what was taking place, what was being observed and said. Notes are important because as the process unfolds one is able to refer back to aspects which were not addressed, not clear or

needed further probing. (3) Free Attitude interview: It is used in probing. When responses were not clear probing questions were used to elicit a clearer response. It was also used to make a person think of solutions. They were also used to check whether a member was still on track (Maree & van der Westhuizen, 2008: 85; 89). (4) Photographs: There is a saying that ‘a picture is worth a thousand words’. Photographs were taken during the study. They were analysed in conjunction with other techniques. Learners took photographs while working on the projects. Commitment, shyness, dominance, team-spirit and enthusiasm were detected from pictures.

### 3.19 Data Analysis

Like data generation, a variety of data analysis was employed. These were also used to try as much as possible to close any gap in the analysis. Researchers had varying strengths in one form or another. Critical Discourse Analysis (CDA), also called Critical Linguistics, was used. CDA is used to address questions of power inequalities between individuals or groups. It further examines the creation of social power construction. Researchers are assisted to avoid undue stereotypes as individual perception is verbatim posted on the relevant person. Language or spoken words are used as spoken in ordinary interaction (Giorgis, 2015: 1). To analyse words one has to first read them uncritically before doing the opposite when repeating. They need to be put in its genre before sorting in the perspective from which they are being said. Through deconstruction phrases, sentences and words are analysed (van Nieuwenhuis, 2008: 112). The data collected was coded based on the objectives of the study. These were done after each session. The analysis was revisited during the study when data generated increased. It was also revisited during deconstruction of data (Sargent, 2005: 296).

### 3.20. Relation of PAR with the study

Whatever was discussed needed to be gauged against the theoretical framework and theoretical concepts. PAR was interrogated. The characteristics of PAR and that of Critical Theory have many similarities such as empowerment, emancipatory and collaborative. These are some of the key Characteristics observed when mentoring was discussed. Without PAR and Critical Theory it is difficult to achieve the ultimate goal of mentoring. Activities of Science Expo need the collaboration of different stakeholders. Many people with different expertise are involved.

### *3.20.1 PAR and Critical Thinking as a theoretical framework*

There is a strong relationship between the two. They share most of their principles. They are both empowering as they focus work on involving local people to take part in their own change. Through Conscientisation they are emboldened to take a stand in challenging all enslaving policies. It is only through participatory action that people are emancipated from oppression. All need to collaborate throughout the process of the study. They are involved in data generation, data analysis and conclusion. Even though the study involves different members from different backgrounds and life experiences they operate democratically.

### *3.20.2 PAR and Mentoring as a theoretical concept*

These espouse people working together and supporting one another. Each person is supported if the need arises. The dignity of people is held uppermost. Their voice is given a hearing as each person has knowledge that will contribute to the team and to the upliftment of the community. All are equal as they have experienced life differently.

### *3.20.3 PAR and Expo for Young Scientists as key concepts of a topic.*

In Science Expo people are encouraged to think liberally without unnecessary borders. It empowers participants in gaining knowledge to research, apply scientific investigation, generate and analyse data, and draw conclusions. It also opens a space for collaboration with those in a group or allows for cooperation with those that can give support. When people are engaged with projects they come to realise that they are emancipated from the inferiority complex they may have had. This occurs particularly when they realise that they are equally as capable as anyone else if they receive proper mentoring.

## 3.21 Conclusion

PAR is relevant to the study as it aims to uplift the oppressed through involvement in the study by being leaders in the research. PAR teaches us that all knowledge is vital. It should be local people who should show the desire and willingness to fight an unequal society. Therefore each team member in the research should be given a hearing especially if it is from a person directly affected. It is through mentoring that co-researchers will be empowered. In the end, the community will have been emancipated from standing at the periphery while other schools are shining at Science Expo year-in-year-out. The researcher and co-researchers should never allow the community to struggle alone when there is a host of people who may be co-opted to assist either throughout the study or only when and where their expertise is needed. Research has its challenges. Using PAR does not mean

they are totally eliminated. It has its own strengths which we need to capitalise on like including as many people as possible. More heads ensure that all gaps are closed which is not always possible with only one. Debates that arise during the discussions should not be taken as negative but should be used to assist the team to think broader and deeper and come to a conclusion that can be understood by even those who are not directly involved at the time.

# CHAPTER 4

## DATA ANALYSIS AND INTERPRETATION OF FINDINGS

### 4.1 Introduction

In this chapter data that has been generated will be presented, analysed and interpreted to better understand mentoring of farm school teachers in preparation for Expo for Young scientist's participation. This study as a whole is the researcher's contribution because he did not find clear evidence of mentoring of a farm school for Expo for Young Scientists during his literature review. In the literature he perused there was no focused simultaneous equal support for teachers and learners as was done in this study. The study shows how, with support, teachers as a team of co-researchers can succeed in working with learners. Different sources that include different legislations and findings from previous studies will be consulted. Comparisons and contrasts in cross-referencing not limited to chapter 2 were made. Each of the five objectives of the study assisted in building a better understanding of how the strategy of the study benefited the targeted community. The deterrents gathered were highlighted and explained. The way in which an attempt was made to address them was unpacked. Actions were taken in anticipation of threats to the study. These actions were interpreted and indications made of how that benefited the study. Any signs of progress was appraised and rewarded. Benefits thereof will be organised and different modes were used to give meaning to them.

Multi-disciplinary issues of CDA were used to analyse data in order to study and understand social problems and issues. These may inter alia include social cognition, politics and culture. In this study, three analysis levels which are textual, discursive and social imperatives were employed. In order to avoid monotony, there won't necessarily be subtopics that highlight textual, discursive and social analysis but the reader will be included in the flow. Semiotic dimensions of discourse such as pictures and gestures (van Dijk, 1995: 17, 18) were utilised to give emphasis. Rajabi (2017: 2) summarised CDA as 'language beyond sentence, behaviour or thought', textual spoken words, written pictures and observations. Discursive analysis seeks to understand underlying factors which lead to trends. Social exclusion and inequalities are examined and brought to the fore. However, the opposites where they arise were spotlighted. Similarities and differences as discussed earlier in the opening paragraph as well as in discussion from literature review were raised.

### 4.2. Determination of deterrents to the school's participation.

The first objective analyses the factors that are obstacles to the strategy of the study. It is divided into different constructs. Each construct will have an opening paragraph that may relate to best practices. Policies, laws or scholarly articles will be used. Texts which will be spoken words, written texts and pictures will be used to prove data. The texts are written without changes which may include grammatical errors and statements in any language that was used. Words spoken in another language except English will be translated after each statement or sentence. It will first be explained what it means before being interpreted. This data will be analysed using CDA. The analysis should show cohesion and coherence (Wang, 2008: 3). It is analysis of language beyond what the sentence is saying. CDA opposes power differences but strike for equality (Malebese, 2016: 133; Qhosola, 2016: 135). Comparisons between opening paragraphs, literature and text discussion will be used to draw similarities and differences. The conclusion is made for each construct.

*4.2.1 Inability of the teachers to start Expo for Young Scientists projects*

Teachers are frontliners, leading and coordinating a process of learning in a classroom. They are expected to be specialists in many fields and in activities being constantly introduced along the way as curriculum and politicians so demand. In an ideal world, they should be knowledgeable and be up to a date with the demands and trends that affect learners. Ideally, they are expected to manoeuvre through complex obstacles, especially where the teacher is responsible for the majority of the entire curriculum (UNESCO, 2009: 39).Knowledgeable teachers with passion have transformative power and play a big role in helping to shape learners (cf.2.1.2.2). Their fresh collaborative approach makes schooling exciting for the learners (cf.3.4.2). The objective of PAR being collaborative indicates that people doing research are as well researching themselves (cf.3.4.2). They discover their strength, weakness and knowledge gaps. Where teachers as co-researchers found areas they were lacking in, it was their opportunity to uplift themselves to be able to mentor learners. With their newly acquired knowledge, they will inspire learners to be thinkers that easily come up with brilliant ideas. Their passion for their work inspires learners to be high achievers (Tucker & Stronge, 2005: 2; 4) as motivated learners will always want to emulate their teacher. The school manager influences all in their care. The action on Sub-Outcome 5 of NDP (2014: 10) compels school management to take full control of the instructional leadership. The team needs to create an atmosphere conducive to learning. They should use other means such as motivation to keep their teachers invigorated. Positive conditions motivate learners to do extra work without always being policed (cf.3.3.5)

In order to encourage learners to study STEM subjects teachers are expected to implement extra-curricular activities (cf.2.5.9).Teachers in most cases receive some training which as teachers try by all means to further seek their own empowerment which will equip them for challenges ahead. It is through empowerment that teachers are able to influence both their lives and those of the children in their care (cf.2.1.2.5). When teachers read further with the understanding it arouses consciousness in them. They will then understand the real need for the community to share and receive awakening (c.2.1.2.3).

These extra-curricular activity programmes are good and of benefit to learners' future career choices. They expose the talent leaners have and assist them in having better career choices at an early age (Osborne, Simon & Collins, 2003: 1053). They are likely to follow career paths they have been passionate about since their school days, crafted by teachers' support on Science Expo (cf.2.5.8). Though these programmes benefit learners, teachers in most cases only receive the micro-wave type of training which is far from being adequate. Hence some teachers in the study felt inadequate (cf.2.5.4). Returning from these workshops, teachers are expected to do wonders with the learners. Teachers use Science projects as a contribution to social justice. Their wealth of general knowledge and life experience inspire learners to become agents of change using whatever little they have at their disposal. RSA DBE (2011: 9) reiterates that with Science, teachers support learners to fast-track social development that includes themselves and the environment. These learners' acquired skills and knowledge equip them to be active players in a democratic society that values and promotes responsibility. Teachers as co-researchers stand up to strive for self-emancipation of their community which they themslelves are primary benefactors (cf.2.1.2.1). They, together with learners subconsciously say "Change for us starts with us".

A successful Science Expo at school is the one that is inclusive. It needs to include a variety of local stakeholders such as an English teacher to assist with correct language use, a Mathematics teacher with manipulative skills, even scientists and engineers in the community. Including a range of people, ensures that a range of skills to mentor learners are covered (ACS, 2017: 1 f 5). Nothing beats teamwork hence by putting heads together more is achieved (cf.3.2.1)

During my introductory visit to the school, I met the principal Mrs Padayachee and her husband, Mr Padayachee, who is Head of Department (HOD) as a courtesy call and introduction of the study

*These are what flowed during the meeting when the researcher and School Management Team were discussing the official launch of the study.*

*Mrs Padayachee: "I wish to see my kids at this school be at the level of what I observed during the last Science Expo finals you invited us as observers. I only saw beautiful things. I could only say 'wow!'. But if someone can say to me, 'Mrs Padayachee helps your learners', it's a blackout"*

*Mr Padayachee: "Oh, me with my Commerce and English, I have no cooking clue where to start. That's Science stuff"*
*Myself: That is how many people feel when adventuring to the unknown. But I believe in our team.*
*Mr Padayache: Our school has participated in a number of researches from your University with success but this one seems challenging.*
*Mrs Padayachee: Oh, let's hope both teachers and learners do not disappoint.*
*Myself: Where there is a will there is a way. Together as they say we can achieve more.*
*Mrs Padayachee: Yes, we have many achievements with the same group. Look at our grade 12 results.*

When analysing the text it was evident that at the beginning the Mr and Mrs Padayachee as school management, did not believe in their ability and that of the school in so far as Science Expo is concerned. Mrs Padayachee pointed to her *'blackout',* meaning she totally had no idea about doing the project. Mr Padayachee called it '*science stuff*' as an emphasis that it was beyond his league. The principal said as the school *'has participated in a number of researches successfully'* it might work for them. She, however, had some reservation with words '*but this one seems challenging'* as she referred to Science Expo. The history of good grade 12 results of this school for a couple of consecutive years added to some hope for the teachers and learners.

Analysing the conversation discursively clarifies the power being used. Both Mr and Mrs Padayachee felt powerless to be of value to the study. For instance, the principal felt she could not meet the challenge and that she was unequal to the schools she observed at the Regional Science Expo Finals. Her sentiments were seconded by Mr Padayachee, who on top of that believed that he was disadvantaged by his school subjects' background, being Commerce and English. With his words, he wanted to justify his inability. What they said made them accept being powerless. However,conscientisation in Critical Theory exhorts people to take action to change oppressive situations as soon as they are aware of them. Need for change resides inside the people who long for a difference (cf. 2.5.10). There is no room for romanticising inefficiency with palatable words. They do not have to be content that something that would change their lives is insurmountable (cf.2.1.2.3). PAR questions the thinking of those in power like labeling the study as challenging just because it includes science approaches in it. (cf.3.21).The management tried to humble themselves too much thereby expressing too much desperation. The managers should display firm commitment

to strive for quality. They should help with the focus on challenges and solutions at hand while supporting staff to achieve satisfaction. After assuring statements from the mentor, the principal was able to realise the ability the school possessed based on their participation from previous studies and the remarkable achievement in grade 12 against all odds. That changed the trends by managers of not fully believing in the ability of others. This is supported by Ghias and Ahmed (2012: 1) when they warned that managers need to discern the ability teachers have and help to nourish it. In so doing they would be able to assist in optimisation of human resource in the task at hand. The change in the community demands each person to get stuck in as both actions and words are infectious to those around the battlefield (cf.3.2).After having admitted toughness of the task ahead and the commitment to go on they then should spit out fighting spirit statements. People with Consciousness need to show by their actions that they are primary agents of change (cf.2.1.2.3).

When using discursive analysis, Mrs Padayachee felt excluded by not doing the so-called right subjects. Her injuncture gave an impression that she felt things would not change for her hence as depicted by her utterance of the darkness she was in with Science Expo. Her husband Mr Padayachee shared her sentiments by referring to his academic background as a factor that eliminated him. The findings of NSSP (2013:3) caution against this behaviour since what the principal or a person in school leadership does or says has an influence on the school. Management should be leaders of any turnaround strategies. Their body and verbal language have resonance with the staff. If their effect is negative, teachers and learners alike may feel that it is okay not to know or not to strive for self-development (cf.2.5.4).

Self-exclusion should be avoided and never be allowed to rule minds of those fighting for empowerment (2.1.2.4). Mrs Padayachee indirectly felt that out of her own observation she stood no chance seeing her school produce the outstanding projects she saw at the Expo finals. Her desire to see her school being at the same level as others was a positive seed of longing for her school not bejng dominated by other schools. The earlier excuses of school managers are an epitome of them smoothly staying away from any extra-curricular activity. As much as many of them played a big role in changing the academic performance of their schools they should be prepared to dirty themselves and play a role in Conscientisation of their immediate society (cf.2.1.2.3). The school management was involved in the initial meeting to start with ground work as well as anytime were progress and challenges were discussed. Teachers' dilemma in Science Expo would indecisiveness support of the

management (cf.2.5.4) which in many cases is as well displayed by the superiors who should be there for them. This as well agrees with Bartoletti and Connelly, (2012: 3) that "Leadership is second only to classroom instruction among all school-related factors that contributed to what students learn at school" Their unwavering support strengthened the hands of both the teachers and learners. It is easy to persuade other teachers for support if they are aware that even the leadership is on the same page on the Science Expo matter. The initial low esteem of the school management was a threat as it would have had a ripple effect on the teachers who were looking at them for motivation. They should inculcate enough desire to use any opportunity to fight for their emancipation rather than wanting to remain in oblivion (cf.2.1.2.1). The principal initially felt she had no positive role to play in the study. This study indicated that the positive attitudes of management have positive effects on teachers and learners' performance and personality developments (cf. 4.1; It was previously as well mentioned how the school managers' behaviour have a ripple effect on all around them (cf.4.2.1). What leaders say in challenging times must be seasoned for the occasion.

I later met NS teachers Mr Ntshala and Teacher Thandeka, English teacher Mrs Setho and Hloni, the Mathematics teacher. It was part of team that team we were going to go through mentoring. I was eager to dip-stick the ability of the teachers in the task that would be part of us from then until the end of the study. The meeting would also give us an indication of where to commence. Very interesting discussions took place.

*Teacher Thandeka: When I am at the meeting, ke utlwa hantle, but ke tshwanela ho aplaya what I learned jo!..its' a problem. Ebile ha ke a etsa Physics sekolong. (When I am at the meeting, I understand very well, but when I have to apply…its' a problem.*

*(I even have not done Physical Sciences during my school days).*

*Mr Ntshala: Nna meneer ha ke tsebe nkare bana bana be etseng. Ha ke tsebe hantle how to start. (As for me Sir, I have no clue what to tell these learners to do).My Physics is rusty. I as well don't know where to start.*

*Miss Setho: Nna, I know nothing about Science. Ha bana ba ka mpotsa dipotso tsa Science I won't be able to answer them.(If learners can ask me Science related questions.(won't be able to answer them).*

*Mathematics (Maths) Teacher Hloni: Nnaha ke so bone Science Expo but am willing to step in only where mathematics in needed haeb a nka bolellwa hore ke etseng(Myself, have never seen Science Expo but am willing to step in only where mathematics in needed if I can be told what to do).*

*Mr Ntshala: We are also going to have a problem with resources, ke utlwile ba re you must have internet, lots of science equipment, o be o reke dintho tse sebetsang, le bana ba ye hole ba ilo etsa research. Sekolo ha se na tjhelete, le nna nka se kgone(I heard that you must have internet, lots of science equipment, you also need to buy lots of resources and learners have to travel far for research the. The school has no money, I as well cannot afford).*

*Teacher Thandeka: Ntho ena rea e rata empana ha re ikimetse? Lea hopola hore bana bao re nang le bona ba jwang? Ba maplasing!(We like this thing but are we not overloading ourselves? Do you still remember the type of learners we have? Farm dwellers!).*

The analysis of text indicates the struggle of the teachers with starting Science Expo. Teacher Thandeka justified her lack of ability and power in the study. She blamed the difference between her understanding and application. She said she comprehended everything at the meeting where Science Expo projects were discussed but it was a different ball game when she returned to school, '*…when I have to apply…it's a problem*'. She felt unable to mentor learners (cf.2.5.4). She reasoned her inability as non-exposure to Physical Sciences during her school days. She felt a different background would have given her a better weapon to mentor learners to start projects. Cohen (2016: 1 of 6) discouraged the notion of 'I am not a scientist' when teachers had to mentor learners. Teachers should find solace in that they are not alone in this dilemma. So many are in it or started at that same level as well. Encouraging, inspiring and supporting learners to do hands-on activities come before being a scientist (cf.2.2.1.2). She regrets with scepticism that they would be doing injustice by burdening themselves. Her words '*We like this thing but are we not overloading ourselves?* denoted her feeling. She felt the adding of Science Expo was an extra burden on their already heavy load. The learning process that happens by doing Science Expo project is immense for all involved. Mentoring encourages the mentor to commit, provide professional support and have a clear understanding of the role they have to play (cf.2.4.3.9). Positive action taken by all involved especially those learners looked up to, sow a consciousness that the task at hand is surmountable (cf.2.1.2.3).

Mr Ntshala was forthright when he said he had no idea how to guide learners from the beginning of the project. While he is an NS teacher, he still felt the inefficient gap of inactivity in Senior Physical Sciences for so many years. He said he was "**rusty**", which means he had forgotten many of the content in the subject. Many of Science Expo activities need a general knowledge of science, not a structured curriculum one. So anybody like Mr Ntshala with the knowledge he acquired over the years he could share a lot of it. Students of Science like Mr Ntshala should be fully aware that science constantly brings in new discoveries which add to the ever-changing body of scientific knowledge. He should make a comparison and develop new understanding (cf. 2.5.4; Stronge, 2017: 14, 16). Co-researchers put high expectation on their learners. They expect their learners to dig for new body of knowledge. Since they are dealing with learners, they should as well be exemplary

by showing zeal to get and gain skills and knowledge which are principles in both Critical Theory and mentoring (cf.2.1.5; cf. 2.4.3.5).

Ms Setho, an English teacher, is further worried that '*If learners can ask me Science related questions I won't be able to answer them'.* She was afraid that learners would put her on the spot if they asked her Science related questions exposing her lack of power over them. To her, these projects are only on one side, of a teacher regurgitating knowledge while learners are passive swallowers. Mentoring requirements caution teachers in remembering that the activity is mutual learning and teaching activity (cf.2.4.3.8).The positive and negative behaviours exhibited by teachers determine the impact they have on learners' seriousness on the Expo project (Stronge, 207:1 of 16).The teachers should be prepared to learn as well from their learners (cf.2.4.2).

Teacher Hloni gave an impression that though he had not been previously exposed to Science Expo as his colleagues he was however prepared to give it his best shot. He was not prepared to be deeply involved so as to learn but would only come in on concepts that required his Mathematics expertise. Hloni set limits on himself which is a tendency that could stifle a fight for emancipation from the legacy of watching from the sidelines (cf.2.1.2.1). Mr Ntshala was worried about the costs that '*you must have internet, lots of science equipment*'. He had accepted their situation and felt they should as well fold their arms. He based his argument on hearsay which he had not tested nor had he sought alternatives. People should not be content with what they have. To achieve transformation the affected people like these teachers should realise the situation that is holding them back. They should as such strive to move out of the oppressive situation (2.1.2.1). Teacher Thandeka called it *"this thing".* It sounded as a sign of not fully owning it, hence her feeling that it is an 'overload'**.** She lamented that their leaners were not the material to do Science Expo. Her facial expression emphasised how she looked down on the farm people. She expected nothing excellent from farm school learners. There is an English adage that says 'attitude determines your altitude'. These teachers had low morale and expectations from the learners. They were creating mountains out of a mole hill. One principle of mentoring is the ability to motivate (cf.2.4.3.5). While the statement is in reference to the secondary person, the researcher wants to make an input that success in Science Expo emanates from inner self-motivation. Mentees need to cultivate that spirit in themselves. However the researcher could not crucify them for airing their feelings otherwise they would be great pretenders. The researcher's good listening skills gave him a clear picture to understand

the mentees. It also assisted him to have better inputs on a plan of action (cf.2.4.3.5; cf.2.5.11.1).

Anyone in the supportive role should as much as possible shun any unpremeditated comment as it might kill the spirit amassed and as such threaten the study (cf.3.8.4). Edgerson and Kritsons (2006: 3) agree that they should never forget they are the instructional leaders of their schools. The researcher has attended presentations at gatherings by principals from well-performing schools in the District. Amongst the things that made their schools tick were motivation and self-confidence gained by learners through participation in Science Expo. It is the duty of this school management team to contribute to keeping a positive vibe and plant the spirit of 'I can', especially if you had voluntary external support like a mentor. This school even though at a farm and inadequately resourced, has on numerous occasions obtained up to 100% in matric results. It is a display of the potential that is untapped. They need to transfer their curriculum performance in chosen subjects to other activities which include Science Expo. It is a strong indication that a journey to self-emancipation is all-encompassing but not one-sided (cf.2.1.2.1).

Teachers with no Physical Sciences background like Teacher Thandeka felt disempowered. Her attitude if not curtailed would be toxic. Scholars, de Souza and Elia (1998: 3) defined it as "… outward and visible postures and human beliefs. Attitudes determine what each individual will see, hear, think and do". The researcher's observation concurs that attitude breeds either positive or negative tendencies. The teachers should keep a profile of being people who strive to strengthen their capabilities in all areas. As soon as teachers become aware of their inability, they should have new postures to better deal with the world around them. Learning and doing of Science Expo is not the responsibility of Physical Science teachers alone but includes the contribution of all teachers (cf.2.5.4). Like her colleagues, Ms Setho took her non-exposure to Science as being unfit to stoutly stand infront of the learners. She felt powerless without what she thought was the only requisite needed. Science learners are very inquisitive by nature and can threaten the teacher who lacks self-confidence. They fear to be out-thought by their learners (cf.2.5.4). One of the responsibilities of co-researchers, as embedded in Critical Theory, is that they should avoid dominance. Nothing is wrong if they learn together at the same time with learners in some areas. While they mentor they should as well be open to learning as they as well are empowered (cf.2.4.2; cf.23.6). One of PAR objective is to be collaborative. Teachers should be open to receive as much as they are giving (cf.3.4.2). Ms Setho did not understand her role in the study by then, being to support learners with correct language speaking and writing as the final project should be in English. Doing her role without overreaching

unnecessarily on other co-researchers' roles would have made her enjoy her part from the planning part. She would little by little understand science inquiry steps without putting herself under undue pressure. Cohen (2015: 1 of 6) has these calming words "The great news is that you do not have to be 'a scientist' to do hands-on science... encourage, inspire and support.

Mr Ntshala lamented the lack of resources as one of the stumbling blocks. He sounded convinced that without those resources they would be limited. The researcher observed that this rural farm school, like others, are the first victims when the government experiences financial challenges. Most have no laboratory, library, internet facilities and budget to support learners with extra-curricular activities. Skewed support for resources is well documented with farm schools always receiving crumbs (cf.2.6.4). There are very few NGO's that support them seriously, except those that give them hand-outs or just seem to seek publicity. As this farm schools seeks transformation it should challenge these inequalities by demanding to be recognised as equals with urban counterparts (cf.2.1.2.). While at war for fair recognition, they should in the meantime maximise what they have at their disposal (cf.3.4.7). What they have should be optimally used to fight the injustice meted out to them. People like Mr Ntshala should use their experience in teaching to change the cause of the unjust trend.

However, Mr Ntshala had not determined what Science Expo projects would need, except information from hearsay. He shared similar sentiments to those of parents who complained about the number and the type of resources needed with some needing money they did not have (cf.2.5.4). They have rich context as the biggest pool of resources. They could research about crops, cattle, soil, farm health and many others which equal them to anyone. Only minor external resources would be needed if open discussion is held. The researcher's conviction is that Science inquiry does not solely depend on equipment-intensive laboratory exercises (2.2.4.8). His tested opinion is that it depends on what the teacher and the learners plan to do with the little they have or with the abundance they are not aware that they have. Planning and doing of the project should balance on the means at disposal.

The study observed that this society of farm school teachers associated Science Expo with Physical Sciences as even Mr Ntshala openly pronounced that. They are blinded by the name given to the project which emphasises the word "Science". Ms Setho had built fear in herself to the extent that even before being engaged by learners she excluded herself. Her worries were based on the perception that science learners would exploit her vulnerability

and dominate her as she would not be able to answer myriads of inquisitive questions (cf.2.1.2.4). Teachers felt socially excluded without the so-called relevant school subjects. Even NS teachers Mr Ntshala and Teacher Thandeka still felt the knowledge they always teach in their classes as very inadequate to support learners. If people have these perceptions they build a worthlessness mentality and are overcome by self-pity. Developing confidence creates a positive attitude which has mental preparation for action. Their utterances needed to be arrested as it would manifest in accepted attitudes which would be a definition of their outward and visible postures which result in the feeling of exclusion. That would as well create beliefs that they are unable and as such would determine how they would continue with the project (cf.2.5.2.2). These teachers should not be content with their fate of exclusion. They should try to transform themselves through a number of opportunities made available through different agencies to increase their knowledge content, pedagogical and practical investigations skills (cf.2.2.4.10). They needed to realise that the activity was a shared responsibility that includes mentor, other co-researchers, learners and the community. That view would remove a heavy weight from an individual and create freedom within the classroom community (cf. 2.1.2.3)

Mr Ntshala felt inadequate. His perception was that 'big ideas' would be needed which would require him to dig deep into his reserves which seemed suspect to him. He perceived that his important role as a science teacher was to help learners become familiar with the myriad of facts and concepts of science. Participating as a mentee in Science Expo projects was the right platform to refresh himself and receive social inclusion in the later activities. Self-emancipation elucidates that people should be aware of their inabilities. If situations are not up to scratch, they should never be content with them (cf.2.1.2.1). They have to use opportunities and situations as a springboard for change. Science Expo needs everybody to be learning. During the period that teachers would be working together with learners that would also create another opportunity to collusively learn from them as well (cf.2.4.3.4). Completely new information or a new direction of understanding could be gained from the learner. Hunger for attaining self-emancipation encourages people to take the initiative to seek support (cf.2.1.2.1). In the application of PAR, people are advised to work as a team to strengthen each other (cf.3.4.1).

As cf.4.1 highlighted, there is also a tendency of looking down on farm people. The sarcastic statement of Teacher Thandeka attested to this. She said '*Farm dwellers*'. The name is itself belittling and degrading. It also entrenches bias against people staying in the farms to say that nothing better can be expected from them. The mentality created by the

apartheid system about farm schools which was excluding them is perpetuated by reckless statements (cf.2.6.1). Her feeling was that while the intention was good it was however applied to the wrong place. Low expectations of these learners generate poor output from them which then seemingly affirms her negative perception (cf.2.5.10).A teacher can increase students' perception of self-efficacy by making attributional statements that help learners to feel self-worth.Our thinking about farm schools should be different from what the thinking was when they were established, namely, to produce inferior people (cf.2.6.4). The teacher should take protective measures to prevent frustrating the enjoyment of learning. Teachers should take steps to assist individuals and communities. The teacher should at all times inculcate a positive spirit by supporting learners (cf.2.5.4). Learners on the farms are aware of what people feel about them and any confirmation of their observations can be enough to break them forever. The study aimed to uplift each and every soul that was involved.

The similarities between data and literature were visited. The team was comprised of teachers with varying knowledge and skills. Teachers such as Hloni were similarly reluctant at first to take their knowledge to a higher level. Hloni was willing to participate only in the areas that would need mathematical computations. He and other mentees later realised through PAR that self-empowerment also rests on their shoulders (cf.3.4.2).They immersed themselves in the task at hand, stumbling as they made progress. Despite their inability and reservations, they never talked of pulling out. Many had an unquestioned commitment to the task (cf.2.3.4).

Hloni's openness in seeking assistance was a sign of a teacher who wanted to be developed for the benefit of his community. Initially, it was confirmed that there was a feeling that it was an add-on on top of the overload they already had (cf.2.4.3.6). One of the cornerstones of succeeding in mentoring Science Expo is to have a positive attitude and high expectations of mentees. That reduces stress on the mentor and creates a relaxed atmosphere in the team as well (cf.2.4.3.5). Inculcation of the right attitude of mind develops endurance, which is a need in dealing with mentees. When teachers exhibit the right blend of expectation, showing belief in them, they will respond positively (Redding & Walberg, 2000:14). Teachers should try by all means to source support for these learners who are economically disadvantaged or excluded (cf.2.5.10).Farm school learners will achieve at higher levels if they are provided with sufficient educational resources (Malhoit, 2005:12).

Differences can also be drawn from the study. It cannot be denied that many projects chosen by learners for Science Expo need Science background knowledge. Both NS

teachers, Mr Ntshala and Teacher Thandeka admitted being inadequate. Constant curriculum changes since 1994 challenge teachers to adapt as soon as possible to keep relevancy and correctness of the prescribed body of knowledge and skills that are useful for the project (cf.2.5.1; Horn, 2014: 2). It would be expected that these teachers would catch up were they lacked knowledge. Research on how to carry out their tasks would assist them rather than relying solely on hearsay. They should also collaborate with institutions of higher learning like universities or TVET colleges which have specialists in different fields (cf.2.5.4; Gardiner, 2008: 12). In the researcher's informal interaction with local HET institutions, they complained that they have a duty to support the local community but do not know how as no one seeks assistance unless they initiate a few projects which they assume are priorities for the community. Teachers had however confessed that they could not implement what they had learned from the workshops nor do self-study as well as source assistance (cf.2.5.2.2). Unless intervention is sought, they will not be a good agent of social change (cf. 2.5.1.1). While they have misgivings about the task at hand they never easily abandoned their resolve. It needs to be reiterated that the study has been the first done in the area that focuses on a farm school participating in Science Expo. It should be taken as a big step to change the lives of the community to view science differently and positively.

### *4.2.2. Indifferent attitudes towards their community-related Science Expo projects*

This construct displayed the feeling of the learners about their own area of the farm and the feelings they think others have about them. It brought to the fore one of the obstacles that stalled them. The attitude makes heavy work about nothing as they wanted to engage in projects that were difficult to understand and collect relevant data. Teachers' perceptions also do not help as they harbour similar sentiments. Through peer pressure, learners can influence one another. The dominance of one learner is not in the spirit of PAR and Critical Thinking. The school had a rich environment and co-researchers should tap into it.

*The following conversation transpired during the second visit to the school. The discussion was on the choice of topics of interest for the Science project. Learners made their feelings known of the direction they intended to take.*

*Sebabatso: (With a Model C English accent). I want to do Expo on mining. I want to design something that will reduce the amount of dust inhalation by miners.*

*Modiehi: I also want to do about mining (while most in the class were nodding their heads in agreement)*

*Myself: Tell me why such an interest in mining?*

*Boy-Boy: Menneer, ha dikolo di kwetswe re ne re tjhaketsemmaeneng Welkom. Re ile ra kena ka tlase mokoting (Sir during school vacations we toured mining plants in Welkom. We went underground).So we are very interested to know more about mining.*

*Mr Ntshala: Yes Sir, during our tour these leaners got very fascinated by mining. None of them ever visited a mine including us teachers. It was our first.*

*Myself: I still have to hear anyone being interested in a topic about the farms and the environment around the school or both rural and urban alike.*

*Poppie: Nna ntate (Me Sir)I have been thinking about a topic that will change our lives around here. I was just worried whether that will be acceptable. There is so much to investigate about around here.*

*Teacher Thandeka: Appreciated Poppie, there are many things you can tell us about where you are staying or things that affect everybody. I also had doubts as I have never been to Expo before. Ntate is making us think broadly.*

Sinhle *(giggling): Ka diplasi Sir! Na batho ha tlo re tsheha?(About farms Sir! Are people not going to laugh at us?)*

*Tshidi: Yes, there is nothing to say about things around here. If I can leave the farms, I will never come back.(The whole class burst into unison laughter)*

*Boy-Boy: Ke batla topic e buang* ka *science-sciencenot these…(I want a topic dealing with science-science, not this…) (Pointing around with disgust.)*

The text indicated that most learners were in agreement that they wanted to do a project that did not relate to the farm. Their one-day visit to the mine made some such as Sebabatso and Modiehi want to associate themselves with mines or a mining town rather than the farms they are from. Sebabatso was emphatic as she said '*I want to do Expo on mining'.* Modiehi added her voice in agreement. It was surprising that most learners were in unison as they were nodding their heads. They convinced themselves that they were staying in the wrong environment and the wrong school that undermined them (cf.2.1.2.1; Human Rights Watch, 2004: 28). Sebabatso has a good command of English as LOLT of the school, so she adopted an accent that classified her outside her community (cf.2.5.11.1). Boy-Boy further clarified where this newly acquired mine enthusiasm came from; their recent educational tour. They got more power as even their teacher Mr Ntshala was in cahoots with their opinion as he retorted '*leaners got very fascinated by mining'.* Their self-created epistemological belief was that a mine is better than a farm. They now have created a new belief that if they want to be recognised in the world of Expo, they have to run away from farm topics (cf.2.1.4) or general topics that may be regarded as common and simple. From the beginning, no-one was prepared to do any farm-related project. The researcher threw a probing statement about a farm school related project that would make us open our thinking horizon (cf.3.8.1). It dawned on Poppie to think about the wealth of

science they have in their community as was indicated by her statement '*There is so much so to investigate about around here'.* She could see that their place could provide opportunities for projects. That also influenced Teacher Thandeka's thinking. She added '…*there are many things you can tell us about where you are staying…)*. Sinhle was worried that they were going to be turned into a laughing stock if they dare bring a project that indicated they were from farms. The words of Tshidi echoed the sentiments of the group as she said '…*there is nothing to say about things around here'.* She meant there nothing good enough to be taken to Science Expo. Boy-Boy was emphatic by saying he wanted to talk *'science-science',* meaning that farm environment projects will not go deep into the science he wanted. He looked down on a farm community as he even called it '*this*', with his hand signaling something of a low standard. They argued why they made a particular choice (Fredericks, 2000: 2 of 2). The Apartheid government established farm schools with one purpose, being to locate the instruction and character of Blacks (cf.2.6.2). It, unfortunately, succeeded for centuries to enslave the minds of the farm community. They have created an ontology which is a reality of the perceptions many people have about the farms, including the very people living on them (cf.2.1.3)

Sebabatso was the first to speak using her command of the English language to influence others. She used the power of language to dominate her peers (Weiß & Schwietring, 2017: 1 of 4). The team needed to apply the PAR principle of democracy to allow each person to operate freely without any direct or indirect restriction (cf.2.4.3.7; cf.3.3.5). Teachers needed to intervene softly but swiftly to balance the situation. However, as a mentor, the researcher did not stifle mentees as it was important to hear their voices as learned from the Namibians. It opens up the concerns which should be addressed or managed (cf.2.4.3.9; Thompson, 2017:1 of 3). Hence the researcher's probing statement that engaged mentor and mentees (cf.3.17). Critical thinking also encouraged open engagement which can assist one another to rethink or built a new belief or thinking. It also allows one's belief to be questioned as was done of the group that based their hopes outside the farm (2.1.2.5). It is not surprising that these learners did not wish to have a project that related to farm life due to the stigma attached to farms. They took farm life as being lower than that of town. They felt that it made them lesser human beings as even Tshidi felt that the day she left the farm would be her last time on a farm. Her feeling supports the fears of parents both in South Africa and the USA cited in this study (cf. 2.6.3). Studies have indicated that farm learners can compete equally or out-perform urban

schools learners, because of small classes that improve the teacher-learner relationship (Lawless, 2017:18). The researcher has realised that with correct confidence boosting the level of some of the farm school learners is at the same level as all the other learners he has assisted over the years. Learners like Sinhle and Boy-Boy thought that to do projects, they needed difficult topics that go deep into big ideas of science. They wanted to have a 'wow factor' which would attract others to visit their work bench (cf.2.5.2). They can still be like the example of youth in Kenya who agreed to be mentored into making a change in their own communities ravaged by strife and HIV/AIDS. They felt that change in their own communities could not be realised if they stood aside (cf.2.4.3.8). The mentees had to fight the stereotype that they would be looked down upon if they went to the finals with the so-called shallow science. If they insisted on going to the finals competing with the urban schools with an urban-based project like mining they would be playing their opponents' game (cf.3.14). Their strength is what they know best.

While English was not the name of the game in the project, it had succeeded to exclude the ones who did not possess a good command of the language. It became evident that some were just following what was said by Sebabatso as they could not debate at the same level. It became evident that when another option was suggested some were able to break away from dominance. Sebabatso did not dominate deliberately, it is because presentation at Science Expo finals and report file is needed in English and she wanted to be relevant from the outset. There was also nothing wrong in using English as it was not banned during sessions and all languages were allowed (cf.2.5.11.1). The first generation of Critical Theory had the aim of creating a non-dominant society (cf.2.1.1.1). Delimiting the usage of English would, however, encourage others to participate freely as it can significantly improve their mental ability. The expressions of Sinhle and Boy-Boy's rejection of the farm-related topics became an admission that unless they rejected themselves, they would never feel included in the Science Expo community. They had to fight against enslaving themselves in mental bondage (cf.2.6.2). Boy-Boy had to change the mindset that *'science-science'* or true science would never come from the farm (Flanagan. 2013: 2). Poppie and Teacher Thandeka had an opinion that while they thought of something that was relevant to them, their concern was that it might be despised as not good enough for Expo (cf.2.4.3.3; cf.3.4.2). Even if they chose what seemed simple, what would be important would be to apply scientific investigation steps correctly without having to also worry too much about researching an unfamiliar topic (cf.3.81; Cohen, 2015:1 of 6). When they are used to how it is done they can then explore deeper. They need to apply the principle of 'less is more'.

It has been repeatedly mentioned in this study how farm learners leave their domicile. For them a farm will always be synonymous with backwardness and non-intelligence, hence their thinking that any projects from the communityare not good science. At the beginning learners in this study wanted to stay away from anything that was associated with farms. Some openly expressed their feelings. Their feelings are based on the negative history of how Black people received inhumane treatment over the years (cf.2.6.2; Cook, 1991:2 of 8). According to Critical Theory in order for people to be emancipated they need to develop consciousness about their social needs and reality. The researcher and co-researchers applied PAR to allow learners to air their views freely. This atmosphere builds a strong and close working community (NAD, 2017:91; Lambert, 2011:1 of 3).They also needed to understand where they are and why (cf.2.1.2.3). Learners were allowed to voice their opinions without the researcher imposing his opinion based on what he knew best. They should be encouraged to develop self-esteem to popularise their area and their plight (cf.2.4.3.9).

No one will bring respect to this farm except its community on its own behalf. The researcher was present in the late 1980s when former self-governing states (homelands) in South Africa started competing at multiracial events. He was also at the forefront after the 1994 change to democratic rule when Black children had to compete equally with formally advantaged learners. While their projects were frowned on as their standard was questioned, their unrelenting participation has now earned many of them plaudits. In cf.2.1.1, the researcher committed himself to getting dirty along with this community in their fight against oppression and their battle to be empowered, which is in accord with Critical Theory. Some of these leaners achieved as Siyabulela, mentioned in cf.2.5.9, did and went on to become prominent scientists. The researcher is prepared to collaborate with the farm schools as their mentor again to support them in popularising farm schools' participation in Science Expo and ensuring that from the onset a high standard is maintained (cf.2.5.9; cf.3.5.2). Leaving a mark on the first participation would make an indelible dent. A study done by Spring (2009:19) found that rural farm school learners outperform the urban ones if given proper support. Due to their small numbers, they always receive proper attention. Through PAR the community received the lasting support they needed to be emancipated from self-created bondage (cf.3.4.3). PAR created an opportunity for them to change their non-participation, being undermined and feelings of worthlessness (cf.3.5.3). This study prides itself with its contribution to active and vociferous girl-children who made their minds known. When building a community, women should not be left behind. Including girls in the study was a sign of removing patriarchal tendencies that anything new and startling should

come with men. In the community both men and women needed to be emancipated from all forms of injustices such as being ignored in participating in Science Expo for so many years (cf.2; cf.3.14.2).

This group of learners was not just open to accepting their earlier decision of doing Science Expo on mining. They freely aired their views. It has been argued against creating human robots, which would be against critical thinking that people have rights to put their views in the open and defend them (cf.2.1.5). These learners were allowed to put their arguments across without being pushed to swallow anything from the researcher, co-researchers or any other adult (cf.2.2.1.2). That allowed them to put across their own ontology about farms, which viewed as places where nothing serious about science could come from (cf.2.1.2.5). It is these crooked realities that the study had to change through Conscientisation (cf.2.1.3).

It has been mentioned that in many schools only one teacher may struggle with learners. When teachers have a problem with the project, they avoid supporting them for fear of exposing themselves (cf.2.5.2.1). They also put blame on the lack of training they received (cf.2.5.4). In this school, however, though these teachers were themselves struggling with the project ideas, they as far as possible made themselves available to learners, especially at the beginning and towards the end (cf.2.5.11.2). PAR and mentoring preach that all in the study are learning. It is time for these teachers to grab the opportunity to learn as well (cf.2.2.1.1; 3.8.1). Success is expected as much from their mentoring as is expected from learners (cf.2.5.8). The researcher realised that if teachers and learners are both learning together, the atmosphere becomes relaxed for learners hence all groups becoming part of the study from its inception. While there was a general interest in the Science Expo leading to their request for mentoring there was a lack of immediate general interest in doing projects that directly related to their daily lives. There should be a reminder that PAR is known to be responsive and is tailored to local needs (Crane & O'Regan: 2012: 12).

Active involvement in local activities and deliberations helps learners to develop their social skills, social understanding and their understanding of the values of the community (cf.3.8.1; Schaps, 2017: 2 of 12). In their quest for human emancipation and liberation, there should be activities which create a world that appeases the needs of and empowers the community. Space was allowed for the community to have mentees entertaining differing opinions about their priority (cf.2.1.1.1). One of the initial steps for success was development with understanding that so many local topics can make very good science projects if given space. If correct science investigation steps and in-depth research are

done, an emerging product can compete at any level. McIvor (2017: 1) quotes Desmond Tutu "We think of ourselves far too frequently as just individuals, separated from one another, whereas you are connected, and what you do affects the whole world. When you do well, it spreads out, it is for the whole of humanity". The actions were taken by learners and co-researchers. If focused on where they are most needed they would have far-reaching implications for the community. They are most likely to own it more as their product.

*During the third meeting at the school the researcher and co-researchers meet the learners who are also part of the study:*

*Kopano (Who a few days ago promised to take a topic on stock farming):Nna le Bongani re se re tjhintjhile. Re ilo lo etsa ka pollution ya Secunda. (I and Bongani have changed. We are going to do about pollution in Secunda)*

*Teacher Thandeka: Empa le tlafumanakae information ya Sasol, Secunda? Haeba ho hlokahala le etse survey or questionnaires, le tlakopanakae le batho ba moo? Ho ntse ho ena le pollution mona ho rona. (But where are you going to find information on Sasol, Secunda? If you have to do survey or questionnaires were are you going to meet those people? There is pollution here as well as rivers and soil!*

*Bongani: Mistress, re tlo ya moo ka school holidays. That is not a problem. Re batla ho advaesa batho ba moo ka air pollution.(Teacher, we are going there during school vacations. We will advice people in the area about…)*

*Petty: Nna project ya maplasi ha e ncasi hantle mistress (I myself a farm project does not interest me).*

*Ms Setho: Who else has thought about another topic?*

*Dikeledi: I will do about Magnetic zipper. I want to design a dress zipper that usesa magnet to close easily.*

*Teacher Hloni: That's interesting girl. Let's see how you will approach it.*

*Mosa: I will do about dangers on not having proper toilets around here in the farms.*

*Pule: Nna ke batla ho tseba influence ya di difatemobung. Tse ding ha honantho e melang pela tsona, why? Empa ha ke tsebe hore ke tla bea topic ya ka jwang (I want to know the influence of trees on the soil. Some of them there is nothing growing next to them. But I don't know how to phrase my topic).*

*Teacher Hloni: That's interesting. Re tla thusanang guys. Ba bang lelona le nahanne ka eng?(We will help each other guys. What have others thought about?)*

*Poppie: Boy-Boy, there is science-science. Here at the farm (The team burst into a loudlaughter and clapping hands in acknowledgement towards Pule).*

*Teacher Hloni: Vusi, ha ke so utlwe o buawena. What's your idea? (Vusi, I still have to hear you say something.What's your idea?)*

*Vusi(A very timid boy): Eich! Sir… nna ha kena idea ho hang .Nthoena e thata. (Eich! Sir…I have no idea at all. This thing is difficult).*

*Mr Ntshala: That is the reason we are working as a team Vusi. We are here to help each other. Don't despair. We are all here learning as well.*
*Teacher Thandeka: Le ho rona ho ntse ho le ho tsho monna.(Even to us it is still dark man).Hence we sought for mentoring.*

In the text even though Kopano and Bongani had promised to try a different project from their first choice, they had changed their minds, *'We are going to do about pollution in Secunda '*. They felt they better settle for a topic dealing with a town far from their school, Secunda. Their words still indicate their strong desire to stay clear of their area. Petty was not willing to settle for anything that relates to her community. She felt no interest at all. Despite being indirectly sensitised by Teacher Thandi about the proximity challenge of their choice, they still clung to their choice. They were far from being persuaded (cf.2.1.2.2). Bagley (2013:1) warns that before the start, the mentee should have an understanding of what of the bigger picture is. It shows informed that the purpose went beyond only participating but also the transformation of their own community (cf.2.4.3.3). All hints should be noted and ideas scribbled down before proceeding. The children were eager to change lives of people in a town far from theirs (cf.2.5.2.1). Dikeledi, Mosa and Pule had topics that cut across all areas which included designing and health issues. There are a lot of bread and butter issues in their areas like Mosa's concern about the lack of sanitation in their area that she wanted to do research on (Mjoli, 2010: 8).Mosa felt that charity begins at home. Pule brought a refreshing idea about the many trees just inside the school campus. He wanted to determine the influence of their falling leaves on the soil pH around them as he realised that different selective plants were growing around them. Boy-Boy was led to see that there was actually deeper science at the farm as he wanted (cf.3.3.5). The team seemed to slowly get the message of the bigger picture as indicated through uncontrolled laughing and clapping of acknowledgement (cf.2.3.6). Teacher Hloni is trying his best to involve Vusi and get his opinion as well. It shows he had been taken to heart by the teacher (cf.2.4.3.1). Vusi was frank in saying he had no idea of what to do. It is necessary for all mentees to have an understanding of some sort to be able to move with the project (Banner, 2000: 1 of 2). If they are not taken along they can be lost forever and as such lose interest in the study (cf.384). Mr Ntshala and assured Vusi of support. Teacher Thandeka also calmed Vusi by stating that they were all swimming in the same pool of darkness. She added by pointing to the researcher as the mentor who was offering a helping hand.

Kopano and Bongani reverted back to a project that was not farm-related as they felt that it gave them power. They considered people living in towns as being better than them. They

also thought they would win the respect of their peers if they came up with a topic that related to a ‘big town’. They needed to understand that conscientisation can change their own situations rather than running away from them (cf.2.1.2.3). The gradualism of disrespecting people based on their background should be arrested and corrected at any level. They cannot just be criticised but need an adult who can listen to the reasons why they opted for that topic (Thompson, 2017:2). That was the action taken by Teacher Thandeka to engage with them without twisting their arms. Mentor-mentee power relations should be guarded against (cf.2.4.2). Their action was a manifestation of an escape mechanism. Critical Theory teaches that the change belongs to the people who are mostly involved. They need to fight the mentality of bondage with the belief that change should be imported or exported somewhere (cf.3.4.3).

Dikeledi opted for a compromised topic which caters for both farms and towns. Every human being everywhere can be interested in a stressless zipper, especially women who have dresses with zips at the back. It is true that she chose a topic out of the need in her immediate area which is fortunately a worldwide need as well. There is, however, a tendency of girls choosing either so-called life sciences or less challenging projects. Her choice is influenced by the social context of the community of the school (Bo Wang. 2014: 1 of 4). Persuasion has assisted her to have a buy-in which is one the signs of successful execution of mentoring (cf.2.4.3.3). Girls are advised not to box themselves in as that will be a form of injustice that can result in mental slavery which needs to be fought at all costs. Boys and girls are equal human beings. Studies in OECD (2014:3) reported a test done in Shanghai China where girls outperformed boys in Mathematics. However, studies also point out that 38% to 53 % of girls to boys pursue studies in Science and Mathematics. PAR as well advocates equality for all (cf.2.4.3.6).Girls should also do projects on engineering, chemicals and mathematics. What was appreciated about Dikeledi was the deeper application of her mind in designing.

Mosa and Pule oozed with confidence as they shared thoughts common to many of the co-researchers. Their choice was more out of an understanding of the bigger picture than to appease the adult co-researchers. They were conscious of the local needs and how they could be agents of change in the big theatre of their community (cf.2.1.2.3). In PAR the influence of adults should be kept in check. Their patriarchy should not weigh on the decisions taken by young ones (cf.3.7).Their presence was there to assist and support learners to take well thought out steps while they themselves are also learning. Poppie, Bongani and Kopano, do not see the role they can play in bringing change in their area and

being proud of it. Though Poppie may seem negative with reservations about the farm, she should be applauded for her openness. The study is about doing an Expo project. Despite encouragement to be local, no total restriction is made on where to find the topic. She can choose any topic as long as she will apply the correct scientific investigation steps. The advice is only to be simple in approach and be careful about the availability of resources (cf.2.5.2). Vusi echoes the sentiments of many people who are facing the Expo project for the first time, the feeling of helplessness. Choi (2015: 2) observed that is a big challenge for learners to figure out where to start. Earlier even some of his teachers had similar feelings (cf.4.2.2.1).The purpose of the study is to support learners like Vusi by mentoring. The fact that learners as mentees came up with their own topics, gave them equal power as their mentor and made them play equal roles going forward.

Kopano and Bongani were afraid of being excluded by fellow regional competitors hence their change to a project that is outside their domicile. They wanted to be part of the majority and be seen as streetwise by opting to choose pollution in Secunda, not their home. The choice of topic was among others prompted by an area of science which the learners were interested in, a hobby or an intriguing question (Science Buddies, 2017: 1 of 5; Cowen, 2015: 3 of 6). Pule and Mosa shared the thinking of the adult co-researchers as such they feel more part of them than others as seen by their choice of projects they wanted to choose. Mentees such as learners avoid vulnerability of feeling having less power than adults (cf.2.4.2). The mentor depends on learners to get a better understanding of what was really in the minds which prompted their choice of topic (cf.2.4.3.2). Teacher Hloni's comment of saying *'we will help each other guys'* would have lulled any doubt and fear they had. Constant encouraging words are empowering. The assurance of continuous support will boost the morale of mentees to soldier on knowing that they are not alone (cf.2.2.4) Dikeledi opted for a compromised topic which caters for both farms and towns. Her well-thought topic is bound to enjoy general appeal to all and sundry.

The similarity has been picked up that learners opt to choose a topic that is unique and that will also win them admiration. That is the reason Kopano and Bongani chose the effects of pollution in Secunda. The researcher is in accord with Flanagan (2013: 2) that we should not "favour complex project topics over the soundness of experimental design". It is important that a project has access to resources and connections. There should also be access to the professional scientific world on top of scientific understanding (cf.2.4.3.7).They have an indirect support from Petty who is uninterested to settle for anything the farm. These learners did not shy away from their opinions. PAR ontology

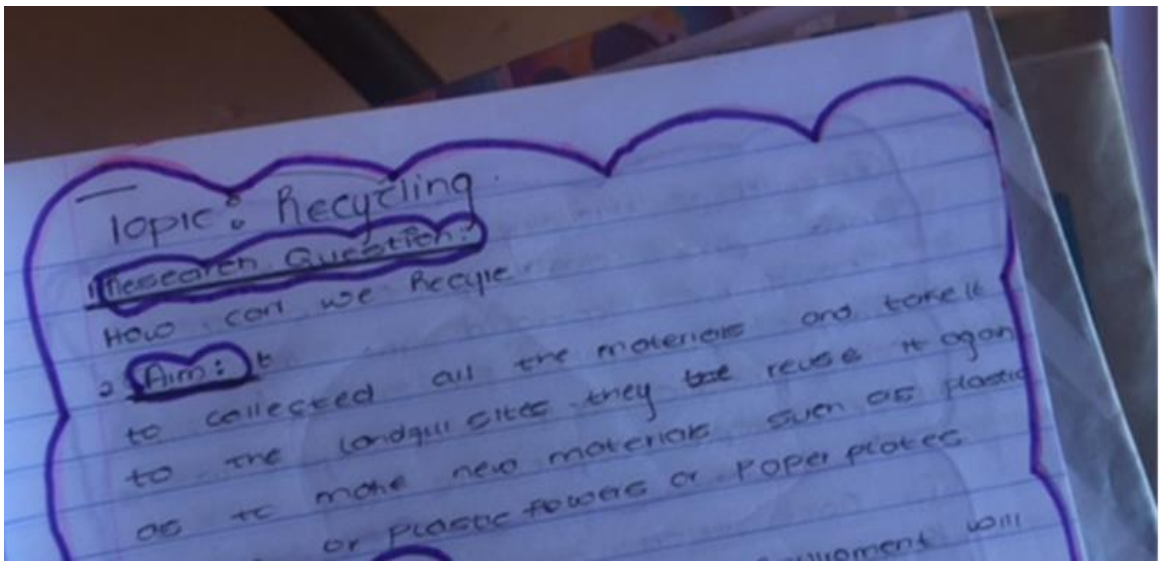
encourages people to air their views which Petty did (cf.3.2). It is through speaking that the mentor and co-researchers can know how deeply support is needed. Teacher Thandeka admitted that she had a serious challenge, ‘darkness, ‘on Expo projects. The self-effacement as alluded to should be improved as it boosts effective domain (van Aalderen-Smeets & van der Molen, 2013: 5). Besides co-researchers being responsible for their own empowerment, the researcher as mentor needs to pick this up as one of the areas where co-researchers need enlightenment. She was open to say they are prepared to accept mentoring. While Pule was willing to try a farm-related topic he admitted to struggling to phrase a topic. It is common that learners do not only struggle with the topic but the whole scientific method needed (cf. 2.5.2). It is better if a learner is guided by asking what the goal of the project is as this will help a learner in phrasing the topic (Bagley, 2013: 2).

In the study, the difference was that not all learners wanted ‘wow’ projects. Mosa and Dikeledi opted for simple but relevant projects (cf.2.5.2). Any project was acceptable as long as it was a learner’s interest. Simple projects in most cases did not need too many resources (Murie, 2015: 71). It would give them the chance to understand the scientific processes as first time Science Expo participants (RSA DBE, 2012: 11).As early as possible Pule was open about seeking assistance. The teacher as mentee did not want anyone to be left behind. She gently asked Vusi’s progress. Vusi was then able to air his frustration (Stronge, 2017: 1of 16). A well-structured question by a mentor would elicit a voluntary and honest response (cf.2.4.3.5).

### *4.2.3. Science investigations steps conundrum*

The meaning of conundrum in this study is as defined by the Collins English Dictionary (2017) as “A problem or puzzle which is difficult or impossible to solve”. It has been chosen due to the challenges faced by both teachers and learners alike in carrying out projects. However, this one is surmountable when people work together. A Science Expo project needs the correct application of scientific investigations steps in a project. However, it has been observed that there are challenges starting from the choice of an appropriate topic. With juniors, it is easier if a topic has explicit variables. In some schools, learners choose topics from a list provided by the teacher. However, at the beginner schools, both the teacher as mentor and the learners are in the same pool. They are not privy to applying and understanding the scientific steps.

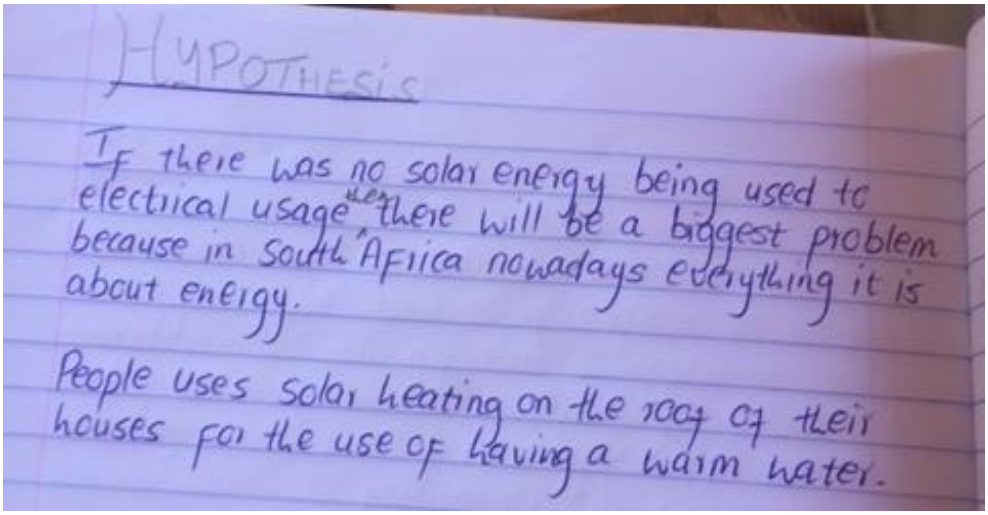
4.1: Showing a topic on recycling



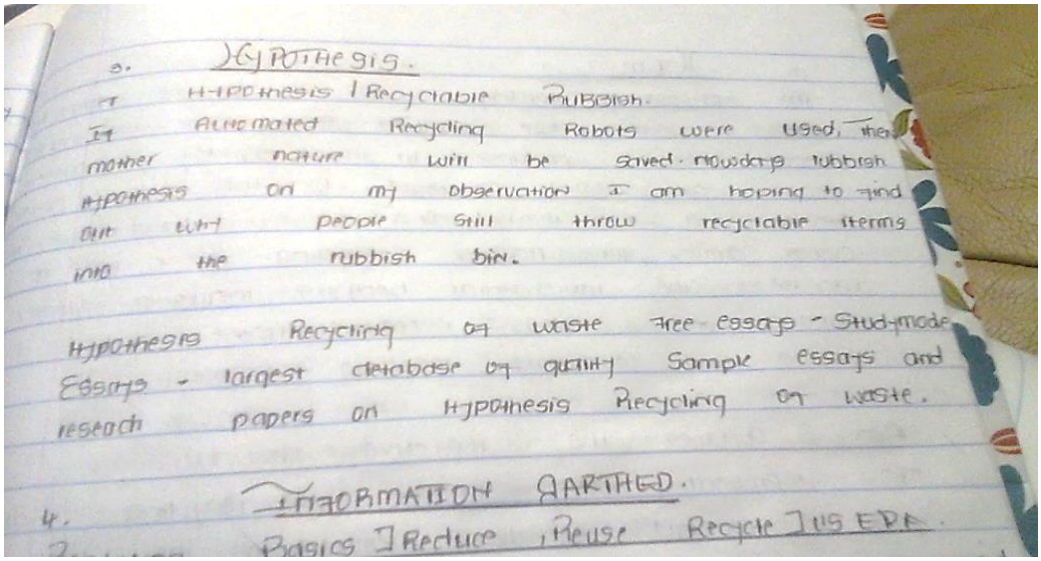

The text shows that choosing an appropriate and well-phrased topic was the genesis of the conundrum as seen in the example in Picture 4.1. The topic is only indicated as "*Recycling".* It was not specific to what should be investigated as it did not include at least one variable especially an independent variable. When learners were working on the projects, co-researchers noticed that some learners would only write a one-word topic such as HIV or Pollution. Learners were then given the go-ahead by the teachers mentoring them indicating that the problem was not only from the side of the learners but from both components.

A topic without boundaries is too open. It will mean if correctly persuaded all possibilities covered under the topic should be researched. It is not possible as the boundaries will be guessed. It will be a never-ending process. Both dependent and independent variables should be clear on a topic especially for junior classes such as this grade 9 class in the study. A few additional words would give it a better researchable meaning (cf.2.5.2.3). Let us coin a related topic: "*Recycling junkmail from home to fund a school garden".* In the topic *'recycling (junkmail)'* is an independent variable, '*fund (school garden)'* dependent, while *'from home'* is a constant. The topic informs us what action has to be taken or be investigated.

Picture 4.2 Attempt done by learners on Hypothesis




Picture 4.3 Hypothesis by beginner learners




In picture 4.2, Petty's group had a topic "Solar Energy". Their hypothesis read:

*If the there was no solar energy being used then electrical usage will be the biggest problem because in South Africa nowadays everything is about energy.* The statement is characterised by 'If' at the beginning of the statement and 'then' in the middle of the statement. Their statement inclined to say the present electrical usage problem in South Africa depends on solar energy. They further added:

*"People use solar heating on the roof of their houses for the use of having warm water"*

The second statement has no 'If' and 'then'. It is not clear if the statement is a second hypothesis or a continuation or added explanation to the first one.

In Picture 4.2, the Hypothesis was not preceded by the research question, as such it (hypothesis) did not respond to anything. They had drawn two statements. In the first statement, learners started the statement with 'If'. The first part of the hypothesis: *'If the there was no solar energy being used'* starts with *'If*". The '*electrical usage will be biggest problem because in South Africa nowadays everything is about energy is about energy,'* is a report about dependency on electricity. In the second statement: *People use solar heating on the roof of their houses for the use of having warm water,* the statement states what people use solar heating for, namely, to warm water.

Picture 4.3 was from Modiehi's group on the recycling of rubbish, copied with its mistakes: *Hypothesis (1)/ Recyclable Rubbish*) as well. It is written:
*If the automated recycling robots were used, then [mother nature](sic) will be saved. [Nowaday](sic) rubbish.*
*Hypothesis (2) on my observation I am hoping to find out why people still throw recyclable items in the rubbish bin.*
*Hypothesis (3) Recycling of waste Free (sic) essays- Studymade*
*Essays- largest database of quality Sample essays and*
*[reseach](sic) papers on Hypothesis(4) Recycling on waste*

The group used 'If' and 'then' as well which they seemed to have grasped as a need for the hypothesis. They added automated recycling robots which the topic is silent about. It can be interpreted as implying using robots to collect rubbish. The word 'hypothesis' appeared four times. The group had no idea of the purpose of the hypothesis and its link to other scientific steps (cf.2.5.8). Unfortunately, teachers had accepted that as the correct way of writing it until they received a reminder on how to write an acceptable hypothesis. The group was requested to rephrase a topic with variables and then do the same with the hypothesis. However, the hypothesis does not link with the topic (cf.2.5.8)

The trend demonstrated by learners is that they wrote a topic which did not have a variable. It was one word like 'Recycling'. This denied them the ability to formulate the hypothesis that would inform how to tentatively answer a research question (2014:2;cf.2.5.10; cf.2.5.2). A hypothesis is also described as a well-proposed explanation or solution to a problem (Jain, 2016: 2 of 8). In pictures 4.2 and 4.3 hypotheses are not preceded by any research questions or problems. Again both do not relate the specific formats of a title (cf.2.5.2.3; cf. 2.5.2.2).They are not clear on what should actually be tested and how the test should be

carried out. The hypothesis should be clearly testable by science (Mularella, 2007: 3 of 20). For instance, automated robots are mentioned but it is not explained how they will be used to save Mother Nature. It should have both clear independent and dependent variables (cf.2.5.2). In the topic on recycling, independent and dependent variables are absent. The *"If…then"* in picture 4.3 indicate that they had some understanding of the characteristics of hypothesis despite not fully and correctly implementing them. They continued to try to compare solar energy usage to electrical energy. They further state what solar energy is used for. The hypothesis should have a clear link between the topic and the scientific research question (cf.2.5.2). The spelling for research was wrongly written as *reseach (sic).* The Study-Mate written looked like a reference from which information was sourced.

Each project should have a topic around which the whole project is built. In most cases, it comes from what interests the learner. A project should, however, be authentic and well-planned. The researcher agrees that participants sometimes fall into the trap of cut and paste. Their own creativity and ingenuity should be encouraged. A smooth link from the topic to the end is an indication that they understood what they were doing (cf.2.5.2). In some schools, learners choose topics from a list provided by the teacher. In a background research or introduction section, a topic and the purpose of the project are explained. The two selected examples in 4.2 and 4.3 were dealing with *recycling.* One could have a topic such as: *Re-using recycled plastic to produce energy*. A number of references should be consulted for information. A research question is also needed. It asks what should be investigated. The question should follow certain rules of which one should be that it should be answered by research. For example, on the aforementioned topic, the research question would be: *How can recycled plastic be re-used to produce energy?* The question points to what should be investigated as being energy production from re-used materials. A statement that presupposes the answer follows a question. This tentative answer is called a hypothesis. The hypothesis should be clear, specific and testable. It also tells how the independent and dependent variables relate (cf.2.5.10; Mularella, 2007: 3 of 20). It would then be: *If recycled plastic is re-used in boilers then energy will be produced.* In the Hypothesis, '*boilers'* has been added even though it does not appear in initial statements. It was done to give limits to research. If not, it would mean researching all possibilities where plastic can be used to produce energy. The researcher would advise learners to include limiting words that focus on action on one particular activity in a topic rather than be too open. It is also better at junior level for learners to choose a topic that has explicit dependent, independent and control variables as that will assist them when they formulate

a hypothesis (cf.2.5.1). A dependent variable is a factor that is changed during the process while an independent variable is the one being observed. In this topic, recyclable papers are independent variables while energy production is the dependent variable. Most of the projects are quantitative researches while some also include qualitative researches. The apparatus or materials to be used are listed. Under method or procedure, explanation is done on how each of the apparatus or materials will be used during the investigation. Data collected is recorded on the table and the type of graph to be used to interpret and analyse data is also listed under method (cf.2.5.8). Where possible pictures or diagrams are included to support the data collected.

Most of the groups did write something on the background of the study. What was deducted was the following:

With the exception of few groups, the information was a long copy and paste from only one source. No attempt to consult an extra source to support the primary source was made (cf.2.5.2).Background information should have served as a bridge that links the reader to the topic of the study. It needed to be so informative that readers should have a better understanding of the topic. They looked at few words that related to the topic and just copied the paragraph as is. The background should have clarified concepts, terms, theories or ideas that were carried by the topic or would be constantly referred to in the study (cf.2.5.8). They should be related to studies already done on related topics. A good background is also a roadmap to a research question (Labaree, 2017:1).From them, it was a struggle to figure out a good research question. The English teacher Ms Setho was requested to guide learners on how to read with understanding and how to write a summary.

- Where more than one source was used, no attempt was made to make meaning from the combination of information gathered but rather information was put one below the other with repetition of similar information. For example, a group on the topic HIV copied and pasted Internet information on the CD-4 count. Nadia, a university student co-researcher in Labaree (2017: 2 of 2) hinted that the information would be stronger if two pieces from different sources were summarised together as each of them had some gaps that could be easily closed by the other. Similarly, teachers and learners in this study made many mistakes. Rather than waiting until the end of the project, teachers and learners were made to realise their errors. I realised that achievement of self-emancipation should be supported by identifying

errors such as avoidance of copy and paste. Correcting errors assisted the group to achieve their independence on how to make meaning of what they are reading (cf.2.1.2.1).

- In other projects material copied was irrelevant to the topic. As long as they saw one or a few words referring to the topic, they copied them without understanding. The example is the Recycling one where learners found information on automatic recycling robots. They took everything on recycling without taking only information relevant to the topic. Unfortunately, ontological understanding cannot be enhanced on a poor understanding of the correct path to be taken (cf.2.1.3). Only sources most relevant to the topic of the study should be utilised. The information should clearly respond to the information that is being clarified (Martin-Meyers, Stephen & Young, 2010:7).

- Co-researchers tried to get understanding of the learners by asking them to explain the information written. Critical thinking as an objective of Critical Theory allows learners as researchers to be questioned (cf.2.1.2.5). I observed that they could not explain what they had written as they had just copied without understanding. They just wanted to fill spaces as required. In the background research, the researchers needed to demonstrate how far they comprehend their chosen topic by critically analysing the topic. The gaps that existed needed to be highlighted, hence the research (cf.2.1.2.5; Potvin &Hasni: 2014: 7).

- There were those who tried to put information in their own words but the problem was poor written English and sentence construction especially Vusi, Bongani and Modiehi. Sentences did not make sense. The whole activity was full of spelling mistakes and grave grammatical errors. In some statements, it was clear that the thinking was done in home language and an attempt was done to translate directly into English which is one of the threats in the study (cf.3.8.4). That resulted in a terrible loss in explanation, translation and interpretation. An approach should be found in this study to enhance understanding of what is being read (Philippoff & Baumgartner, 2016: 4 of 5).Learners themselves attest to their challenges and requested a simpler approach. It was pleasing to realise that teachers and learners were aware of their shortcomings and were hungry to overcome them (cf. 2.1.2.3).

It is better to first grasp an understanding of all scientific investigation methods before starting the project. The topic should include variables and it should point to the scope of the project rather than leaving it open. One independent variable makes a project fair and it easy for the inexperienced. The project is taken to a conclusion in order to accept or nullify the hypothesis. All the work that has been done, tidy or untidy is reported in a journal. After perfecting the work, using all major scientific steps, neatly arranged work is arranged in a project file (Exposcience, 2012:2; Science Buddies, 2017: 5). Co-researchers had a challenge in coming up with an appropriate topic that would make it easy for them to state a hypothesis and research question. A poor command of the English language influenced the quality of background information of the study as it was irrelevant to the topic, sources were simply transcribed and there was no merging of information from varying sources. Teachers, as co-researchers were in the beginning not in a good space to give direction to the learners as they were also found wanting in the Expo project approach.

#### 4.2.4.1 Insufficient references

The researcher and co-researchers looked at how learners faired in finding references. They realised that learners could not easily find appropriate reference materials based on their chosen topics. Some groups checked information from their grade nine Natural Sciences textbooks only. Unfortunately for many topics chosen, nothing was in those books. Even though the school is from grade R to 12, initially no-one bothered to search information from other grades. The school has a small collection of old textbooks and magazines which learners did not consult at all. The availability of adequate references simplifies information gathering. The opposite stalls progress (cf.2.1.2.3; cf.3.8.2). Boy-Boy and his group chose a very current and interesting topic on the Zika virus.

*A typical challenge was with Boy-Boy during the third meeting. The group was discussing the topics they have chosen and what type of reference materials that would be needed. The following conversation is just part of what was discussed.*

*Boy-Boy: I better choose a topic on Zika Virus. Is there anyone who knows it?*
*Kopano: Ke eng ntho eo? Ke qala ho eutlwa!* (*What is that? Never heard of it!*)
*Boy-Boy: That's what I was telling you about real science. If you were following news before Brazil Soccer World Cup in 2014 you should know about it. But don't worry I will teach you.*
*Myself: Ok Vusi brings as many references such as books, magazine and newspapers in our next meeting to so as to start writing Background research.*
*Ms Setho: Vusi e re re bone information on Zika re bone.(Vusi lets see your information on Zika)*
*Boy-Boy: Miss, kena le piece ena feela ho tswa koranteng. Ha kefumaneniks.(Teacher, I only have a small piece from the newspaper. I cannot find anything)*

*Ms Setho. Boy-Boy how are going to proceed if the is nothing on the table. As I see it may be a challenge for most of us as your topic is even unfamiliar.*

Looking closely at the text, Boy-Boy wanted to choose a stunning topic on the Zika virus. Though he was showing a toned down ego, he still wanted to sound better by going Brazilian. He said it became popular towards 2014 Brazil World Soccer Cup. Boy-Boy wanted to show that he was better than Kopano. He wanted him to feel small because he was not following the news closely. As a challenge, Ms Setho asked him to put down relevant information in his possession. He was able to produce only one cutting from the newspaper and nothing else. It was difficult to even get support from others as they were not familiar with the topic. The project is as good as the reference materials (cf.2.5.11.1).

In Boy-Boy style, he wanted to keep on dominating others. It is true that most learners were hearing about the Zika virus for the first time. He said they chose it because it was a topical issue during a soccer world cup recently held in Brazil. He wanted to feel superior to others by stating that they would learn from him. The injustice faced by him was the lack of the reference materials he wanted (cf.2.5.11.1). As a trend, the farm school had no well-equipped library where he could get books or magazines. The other groups were also frustrated by struggling to get enough relevant information right from the beginning (cf.3.8.2). It made progress slow as learners would jump from topic to topic with no success.

Boy-Boy wanted to maintain his perceived dominance by choosing a very unfamiliar topic to the group. He entrenched social exclusion by his comments that anyone not informed about events in Brazil was automatically irrelevant. Kopano gave him an expected response which made him boastful as the sole knowledge tank. The lack of references brought him back to reality. That made him aware that a lack of references can be an excluding factor as well (cf.2.5.1). He did not consult others to include them in his project. That would have given him a picture of whether the topic could be pursued. Their mentors are as well in handy could also have linked them up with a relevant institution which would be of assistance. They could also support with resources (cf.2.4.3.9). There was no easy access to relevant magazines, books and the Internet after assessing what would be needed (cf.2.1.2.).

There are similarities observed which pointed to the lack of reference materials about what characterise farm schools. Like any young and ambitious person impressing others is inborn. The learners at this site insisted on choosing a so-called impressive topic. They did

not pause to think about whether the chosen topic had adequate references to support the activity.

4.2.4.2 Unavailability and inadequate Materials and Apparatus

“The Declaration of Budapest argues that what distinguishes poor people or countries from rich ones is that not only do they have fewer possessions but also that the large majority remain excluded from the creation and the benefits of scientific knowledge” (Tiang, 2009: 10). It was visible in the approach to projects. In some groups listing materials needed was a headache, while other groups did not struggle that much. However, they could not find all the materials they needed (cf.2.6.2). Some needed to be bought which added to existing problems. They could be guided by factors such as a hypothesis and research question, a list of apparatus or materials needed to answer the question.

For instance, Bonolo wanted to do a project on “*African Jazz music increase growth of pot plants in the house”* which he read about it. She made a table to check material availability

Table: 4.1 Materials collected by Bonolo for the project

| **Material needed** | **Material needed** |
|---|---|
| 1.Music player | X |
| 2. African Jazz music | X |
| 3. Pot plants | P |
| 4. Ruler | P |

Analysing the text from the table 4.1, ‘X’ represents ‘unavailable’, while ‘P’ represents ‘available’. The success of the projects depended on the availability of all items needed (STEM, 2017:1 of 1). However, Bonolo could only have pot plants and a ruler. She had planted pot plants with the hope that by the time they had grown enough to be used, all other materials would be available. Though she had jazz music, it was not African jazz as she wanted. While she could have access to the music player, no one was willing to lend her the music player for two consecutive weeks as need by her project hence marked ‘X’ (cf.2.5.11.1). That meant she could not proceed with the desired project until she had all materials. It is one of the factors that discourages learners from the disadvantaged

communities. Kananelo, a co-researcher who is a regular participant in Expo from an urban school challenged learners to give lists of their needs to their parents who should ask farm owners for assistance (cf.2.5.11.2). He said "*There's a lot of materials lying around at the shed and garages. They can be of good use to you*". Meaning farm owners may have the equipment, books, magazine, scrap metals to mention but few they are no longer using that could be useful to learners (cf.2.5.11.1)

The absence of some of the vital materials excluded Bonolo from doing a project that was in her heart. She also had a small community from which she could seek support. It is this misfortune that can cause farm schools to be dominated forever. It is as the study stated that the epistemology of this study should be to challenge all that has been accepted. It cannot be that farm schools will forever accept a norm to be inferior (cf.2.1.4). The study is about finding ways of fighting for inclusivity with our own strengths.

Learners had to sometimes part with money to buy equipment such as batteries, electrical cords, chemicals and scrap metals for improvisation (Iji, Ogbole & Uka, 2017: 5; cf.2.5.7). They also had to bring them from home which may have been a burden for poor families. The researches as a mentor had advised teachers to assist learners to think about resources before making a final decision about the topic.

As in cf.4.2.4.2, there is a struggle to find all the necessary materials to do a project. The topic might seem simple and interesting but it is a different ball game when all the material needed cannot be found.

4.2.4.3 Absence of free access to the Internet.

Farm schools are characterised by lack of resources especially ICT. At this research site, there was no access to the Internet for information, especially when it is not available in print format on topics like the Zika virus and dress zippers (cf.2.6.4). Only two learners had access to smartphones. They were, however, expensive to use (Singer, Hilton & Schweingruber, 2006: 1). Learners in cities and middle-class families have easy access to the Internet. It is the opposite in poor rural and farm schools. The digital divide disadvantages this farm school community in sourcing the information they need (Kang, 2016: 2). The disadvantage needs to be challenged to achieve emancipation and empowerment (cf. 2.1.2.1; cf.2.1.2.4; cf.2.5.10). Two co-researchers as mentors sacrificed

some data on their smartphones. It caused the principal to spend some of her personal cash to make print-outs in town (cf.2.4.3.3).

*MrsSetho: The biggest challenge here is internet connectivity. These days, the most relevant and quick information is from the internet.*

*Tebello: (a co-researcher who was a former regular Science Expo National gold winner in his school days and now mechanical engineer graduate) "The challenge is not only on accessibility to the internet but the two learners with smartphones struggle to search for the information. Teachers also cannot guide learners to relevant sites. I will avail myself to develop them"*

*Mme Lolo* (Teacher from neighbouring school):*You are right. Even me as a teacher I cannot surf the internet unless guide. By the way le hopolennake le-BBT./By the way, you should remember I was Born Before Technology)*

*Mr Mohale (Also from another neighbouring school):Hape data e tla o qeta, you must be loaded./Again you will have to spend a lot on data. You must be loaded)*

*Dikeledi: Nna ke kgonne ho fumana some information using my cellphone. Hona le data tse cheap tseo o ka ka downlouda information e ngata. E nthusitse./I was able to get some information from my cellphone. There is cheaper data available and you are able to download a lot of information. It has helped me)*

*Kananelo(Regular participant):But in this area, there is poor connectivity. You may have data but not connection. But there is nothing that is not on google.*

Sebabatso exclaimed, "*Does it mean all this time I am carrying the whole world in my palm!"*

In analysing the text, Ms Setho admitted that Internet access could help them to get more information. Its absence results in the opposite. It is not only the absence of Internet facilities which were a challenge as observed by Tebello. He noticed that those with access, two learners and teachers are struggling to surf the internet. Mme Lolo sounded content that she is a BBT, meaning that she is too old to learn how to use internet technology. Her contentment is an addition to the already existing challenge. The process of mentoring is among others things geared to convert the accepted norm (cf.2.1.2.1). The other challenge was brought to the fore by Mr Mohale who lamented the cost of Internet data. One has to remember the economic status of the study community. Any money needed adds to the burden. Dikeledi, however, sounded positive that although a learner she had used her cell-phone to download the relevant information. It was a sign that even in adversity one can strive to achieve self-empowerment (cf.2.1.2.4). The area had multiple obstacles concerning internet accessibility. Kananelo added that there was nothing not in Google. He meant that the Internet has a lot of information more than a human being needs. Google is a popular search engine and most people have given the Internet that name. Sebabatso was astonished at how the Internet could help. She epitomised many people who are ignorant of how big the Internet is (cf.2.4.3.5). The study should be credited for

conscientising the farm school community to use the Internet as a very good tool that can close the gap the farm schools have with regard to their lack of libraries (cf.2.1.2.3).

The mentees were denied power by not having access to the Internet. They could not be on top of projects they were doing. The fact that other schools in urban areas have unlimited access to the Internet is a travesty of justice. All schools belonging to the country should receive the same and fair treatment and accessibility (cf.2.1.2.3). The ICT policy had targeted 2013 as the year by when all teachers in South Africa should be computer literate. The opposite was observed as teachers themselves could not access information as observed by Tebello and so admitted by Mme Lolo. There is a trend that teachers in advanced age have accepted that they have passed the age of learning how to use the latest technology. Empowerment has no age limit. (cf.2.1.2.4).Their experience as teachers is needed in the Science Expo and they should fight against self-created barriers. Farm schools in South Africa should emulate some areas of the USA which have antiquated Internet connections, but there are hotspots at designated areas to respond to the challenge (Dobo, 2017: 2).

The absence of Internet accessibility is an excluding factor for the mentees to prepare for the Science Expo on the same footing as other corners of the country. The absence of training also adds to this factor. One of the teachers who called herself a BBT was resigned to her fate. The second generation of Critical Theory believes that expansion of praxis depends on how one takes control of mastery of technology which emboldens equal participation (cf.2.1.1.2).Critical Theory preaches inclusive development. Some members used ICT language such as surfing, Google and downloading. While there was nothing wrong as it was appropriate, it did, however, make them dominant. It is the challenge that they should accept to uplift other members as well. Mentors need to be forever alert to come in when individual support is needed (cf.2.4.3.5; cf.2.1.1.2).

At this point, there is a struggle as well with Internet availability. While there is so much information on the Internet, it is but a dream to a farm school. They struggle with lack of equipment like computers. Data is expensive. Neglect of the research site has extended even to the communication infrastructure as Internet connectivity is unreliable.

However, there are those who accept the challenge as a few learners were using their cell-phones to connect to the Internet. They have even established that a cheaper data rate can be found. They were able to download information they needed

## 4.3 Tackling of obstacles hindering progress

It has been observed in this study that there are key challenges that hindered smooth progress. Teachers had openly agreed that it was the first time they had become directly engaged with Science Expo. In most cases, teachers are just thrown in the deep end and have to find a way of how learners will come up with acceptable projects. Their informed leadership and mentoring, yield success to learners. (cf: 2.5.4).Thulani Tshefuta, the President of the South African Youth Council, said young people must be supported in whatever innovations in which they are involved (Moodley, 2017: 2). In this study since co-researchers would be supporting learners in between the planned sessions, they needed to be empowered. Having a hands-on short investigation would enable them to work with learners. It is in agreement with what transpired at Science Policy Conferences where Kovacevic (2014: 2) presented that the progress of young people in a science programme should be accompanied by older people in their journey. In this study, it means teachers, the researcher, co-researchers and any specialist could provide that necessary mentoring. Developed teachers would be in good stead to work with learners. They would be able to support learners in choosing appropriate topics. Learners should be able to choose a well-structured topic that for example makes it easy to identify variables and formulate a hypothesis (Nalzaro, 2012:14-19; Science Buddies, 2007: 10). They also have to check the resources at their disposal before finalising the choice of topic. At Youth Participation at the Third UN World Conference on Disaster Risk Reduction, Cumiskey, Hoang, Suzuki, Pettigrew and Herrgard (2015: 157) proclaimed that the benefit of working with young people is their versatility. The researcher has observed that they belong to two worlds as they are able to use both old and modern technologies. They, however, need to check its availability against their choice of topic. For instance, if the project is Internet reliant they will have to check its availability (Davies, 2015: 3). For newcomers to Science Expo local resources would be easier to work with as the learners are familiar with the environment and with what is available.

### *4.3.1 Equipping teachers in starting Science projects*

In cf.4.2.1 Mr Ntshala declared that they needed assistance in how to start a science project. Other teachers cited additional obstacles which many pointed out as challenges. An extra unscheduled whole-day workshop was conducted at their request. They forfeited their midweek public holiday for the activity. Teachers were taken through their paces to initiate a short project and work on it until it is completed. The project was addressed all scientific

methods needed in Science Expo. As mentioned in cf.4.2 and cf.4.3 empowering teachers made it easier to mentor learners while they were also learning (cf.2.4.3.2).

#### 4.3.1.1 Approaching key elements of an Expo project

Teachers were requested to come up with a practice Science project topic they could use for the day. The researcher told them that it should be anything that interested them.

Picture: 4.4. Teachers at the NS project workshop

*In picture4.4, teachers are busy with the project. They first had to work individually before they discussed in a group. Discussions that took place are hereby recorded:*

*Ms Setho: Hai, ha e le nna, I can't come up with a topic.* (*As for me, I can't come up with a topic)*
*Myself: But Ms Setho, can't we mention anything that intrigue or bother us in life? It should not necessarily be a science phenomenon.*
*Mr Ntshala: I am thinking…The topic should be 'Obesity'. Bana ba rona ba overweight, ba ja haholo (I am thinking… The topic should be 'Obesity' (These learners of ours are overweight, they eat too much).*
*Teacher Hloni: As a Maths person, I say the topic should be "Why learners fail Maths". But ha ho thuse, ke nahana re e tlohele. Ke nna feela motho wa Maths mona. Ha lena kgona ho contributa* **(***But it doesn't help, let's forget it. I am the only Maths person in here. You won't be able to contribute).[Making sarcastic gesture].*
*Teacher Thandeka: Le tla ntshwarela, nna ke shebile topic from google.*(*You will pardon me, I copied the* topic from google)*[giggling].*
Myself: *It's good mme. Akere re kgothalletswa ho sebedisa le internet. (It's good mam. By the way we are encouraged to also use the internet).It has hundreds of possible project topics and ideas.*
*Teacher Thandeka: It is "Sunlight causes breadmould on brown bread"*
*Mr Mohale: Ha re nkeng yona(let's take it).Since it comes from google it must be correct.*

*Mme Lolo: Is that so? Is everything from google correct! We need to be careful. There is so much incorrect information out there.*
*Researcher: But Mme Lolo, how can we cautious?*
*Mme Lolo: I guess we should look at the source, like an official website.*
*Ms Setho: Thanks Mme Lolo. I fully agree we take Thandeka's topic for practice. I now realise I don't have to think of difficult deep science staff. I ask myself so many questions daily and they can be used in Science Expo. Look just bread and breadmould, so simple!*
*The Research: There you are lady. We don't box ourselves.*
*Mr Ntshala: Oh, my first step to see light. Let's agree on taking Thandeka's choice, it makes sense and we can all participate unlike Hloni's brain cracking Maths(all laughing)*

When analysing the text Ms Setho quickly proclaimed her inability to come up with a topic. She had resigned herself to never being able to bring any topic to the table. She had come to the workshop to learn from others, not to contribute (cf.2.5.2.2). Mr Ntshala chipped in to suggest a topic. He further supported the relevancy of his choice with the immediate school environment. He claimed the learners at his school are over-eating hence their obesity. Teacher Hloni chose a Mathematics related topic. He however sarcastically pretended to suggest withdrawing the topic. His reason was that the topic was too high for other co-researchers to play a meaningful role due to their lack of Mathematics knowledge. Teacher Thandeka made a reference from the internet and came up with her suggested topic. She apologised for 'copying'. Mr Mohale jumped in to say it must be an agreed topic. As it came from the Internet he felt that it was automatically right. Mme Lolo warned that not everything from the Internet is correct. People can post wrong information. The researcher asked Mme Lolo for advice on users can assess whether information from the Internet is accurate. She responded without committing herself that people need to look at the source of information like an official website. It is true that other websites or blogs are open for anyone to put in information. Some information might be incorrect or perpetuate misconceptions. Ms Setho appreciated Mme Lolo's advice and further movedd that the group should decide on teacher Thandeka's topic. She was supported by Mr Ntshala. He further added that unlike Hloni's 'very difficult topic', for this one they could all actively participate. They all laughed at the repetition of Hloni's earlier sarcasm (cf.2.5.11.1).

It happens as in this group that it takes time for some individuals like Ms Setho to fall into the rhythm and include themselves in an unfamiliar terrain. There is also the tendency among teachers that they will not do something they were not developed on. They feel that someone they regard as dominant and knowledgeable should bring them on board. They want things on a plate. Development needs collective engagement (cf.3.4.1). The FIA

questions actively engage them and assist them to think. She was helped to think by the question, "But Ms Setho, can't we mention anything that intrigues or bothers us in life?" That question assisted her to think of everyday interactions. It was a simpler way to involve her in learning without putting pressure on her but inviting her into the game. DBE (2002:3) states that the teacher plays many roles in their own profession. Besides being leaders and administrators they are researchers and lifelong learners as well. FIA questions allow them to be fully engaged from the start of the learning process (cf.3.16). It also assists them in how they will engage the learners in thinking for themselves. The action was a display of inculcation of critical thinking in them (cf. 2.1.2.5). The positive participation of others persuaded Ms Setho and others to be team members. The FIA question used was not only helpful for one member but even others started to make inputs. The high spirit displayed would augur well for the learners. Learners tend to emulate their teachers. If they see their teachers hustling despite the challenge, they will follow suit. It is one sign of the boomerang effect which continued to build trust and comradeship (cf.24.3.4; Stronge, 2016: 7 of 16).Teacher Hloni quickly sensed that his comments or suggestion would make others feel left out and excluded. Co-researchers as a team have to collaboratively work for each other and build camaraderie amongst them as a principle of PAR. That would rub-off on the learners they were working with (cf.3.4.2). Mr Ntshala had the topic on 'Obesity'. We had a look at the topic as a group.

In order to engage and challenge them, the following thought-provoking questions were asked:

1. How far are we going to research the topic?

2. Are we going to leave out some information about obesity and why? (cf.3.17).After a lengthy discussion, it was realised that the topic was too wide. In order to be as inclusive as possible, all were given space to contribute. There more their inputs were taken, the more the group relaxed. It is unlike an example of traditional mentors in Kenya who wanted to control the proceedings (cf.2.4.3.9). If we continue with the topic, to do justice to it we needed to research EVERYTHING about Obesity. The researcher realised that for people still finding their feet it is easy for them to come up with a one-word topic like Obesity as mentioned. However, it is very challenging for a one-word topic to become a good Science Expo project. Some learners go all over the show with the topic or choose to take only one aspect of it to research, which is an injustice to the topic. It is easy to work on a topic that has the three clear variables, namely dependent, independent and control or constant

(cf.2.5.2.3). The group discussed the three variables to create understanding beyond their definitions.

Co-researchers were tasked to check which of the topics had all variables. That also included the Mathematics topic. They all agreed on the following topic: Sunlight causes breadmould to grow on brown bread. It became a battle however to identify variables. Based on the definition the researcher kept saying “What causes what?”… “What causes what?”…“What causes what?” As he repeated this question the teachers kept giving conflicting responses. The repetition was to ensure that they themselves went through the process. They understood what could be possible answers they would expect from learners. That also assisted them to have ownership of every step of the activity (cf.3.19.1). To allow debate was not a threat as PAR may articulate. Everybody was brought on board step-by-step. Success was ultimately realised when they agreed that ‘Sunlight causes growth of ‘bread-mould’ (cf.3.5.4). Which means sunlight is an independent variable while breadmould is the dependent variable. Brown bread is the constant variable.

The formulation of the research question was also not as easy as they thought. It was easy for Ms Setho to display her English acumen by shouting: “Does sunlight cause breadmould on brown bread?” Things changed when we looked at the characteristic of a research question. The main three questions are:

1. Should not be answered by ‘Yes’ or ‘No’.
2. Should be answered by research.
3. Should be researchable.
4. The researcher added: The question should have all the variables from the topic

Any question formulated was passed through the test. Ms Setho’s research question can be answered by ‘Yes’ or ‘No’. There is no longer a need to continue with an investigation if a researcher knows the outcome.

Hloni said: *‘Will the breadmould grow on bread’?*

The question does not include all variables and was dismissed even though some agreed that it was not far off.

Mr Mohale said: ‘Let me guess. It should be “*How does lack of sunlight affect the growth of breadmould on brown bread?’* After much debate, it was agreed that the research question satisfied the four criteria mentioned earlier. It was this type of critical learning that contributed to the building of consciousness (cf.2.1.2.3).

The next step was on hypothesis formulation. It is done by responding to the scientific question. Co-researchers should pre-empt the answer to the research question. After discussions, the researcher advised them that they should adopt the approach of:

If … (independent variable) … then … (depended variable) … (constant variable) (cf.2.5.11.1; Kinney, 2009: 9).

After deliberation, the team came up with a summarised approach to the hypothesis.

Table 4.2.The approach to hypothesis summarised

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| | independent variable | | dependent variable | constant variable |
| If | Sunlight | then | Breadmould | brown bread |
| | there no sunlight | | breadmould will grow | on brown bread |
| Hypothesis: If there is no sunlight then breadmould will grow on brown bread | | | | |

In Table 4.2:
Column 1: Indicate 'If" which characterises the starting word of hypothesis
Column 2: Independent variable which is 'sunlight' and in a statement will be 'there is no sunlight'.
Column 3: Is 'then" which joins the independent and dependent variables
Column 4: Dependent variable which is bread and in a statement will be 'bread-mould will grow'.
Column 5: Constant variable "brown bread and will be 'on brown bread' in a statement.

The topic might be good but can be excluded if there are no relevant materials. Hence the next step was for the group to list the apparatus to be used. Their initial struggle was to easily list apparatus on such a well-known practical experiment and mirror imaged the struggles on their learners. The researcher realised that those who were brave to speak like Mme Lolo and Hloni were just adding apparatus without thinking about how they would be used or whether they would be used at all. They wanted to be included in every step of the way. What the researcher appreciated, however, was their freedom to speak out. The principle of mentoring was being displayed (cf.2.4.3.5). That propelled a useful debate and

the researcher could realise where the gaps were. It was then suggested that a table should be drawn up which indicated the apparatus and uses for each. It relates to cf.2.4.3.3 where troubles and opportunities are detected before dipping into commitment. Mr Ntshala got excited even before it was drawn up as he said he understood better with drawings, tables and mind maps. A table made things quicker, easier and focused.

Table 4.3: Apparatus and Method Feasibility table

| | | | |
|---|---|---|---|
| Apparatus | After listing apparatus available rate them into below categories | | |
| List all apparatus/ resources | Few/not available | Most available | All available |
| Example topic | Sunlight causes breadmould to grow on brown bread | | |
| APPARATUS | | USES and METHOD | |
| 8x Slices of brown bread ( same brand) | | 1. 4xslices will be placed in the dark<br>2. 4 slices will be placed in direct sunlight | |
| 8x Saucers | | Place slices on saucers | |
| 4x small boxes (e. shoe box) | | 4 slices will be closed in the shoe boxes | |
| 200 ml of water | | Sprinkle a small amount of water on slices to speed up action | |
| | | Estimate the percentage of mould coverage on each slice per day for 5 days | |
| | | Record data on the table | |
| | | Represent data on the bar graph (specify the type of graph to be used) | |

Action in Table 4.3 eliminated the apparatus which would not be used. Teachers realised that if this approach is not used learners will waste time and money in collecting what would be thrown out without being used. Teachers at their workshop were given the opportunity to find a solution instead of being lectured by the researcher. That gave them an opportunity to see all challenges throughout the project. They have learned when and how to intervene. At the end they were proud to own the product as theirs (cf.2.5.4).

Teachers were engaged in the doing of a project from start to finish. Though the exercise was not enough for some, they all appreciated the baptism. Their confidence sky rocketed at the end of the exercise. In Sesotho we say '*Thoto e tielatseleng*', transliterated as 'The load gets tightened along the way'. In the context of this exercise,it loosely means "You

become perfect with practice". The complaint by teachers of not being developed was eliminated with this intense and tailored workshop. It is in fact the purpose of mentoring to support them in their development and skilling (cf. 2.2.1.2). The researcher is a believer in his own philosophy that "You mentor a teacher you mentor generations". All learners who pass through their hands over the next few years will be benefactors. Any teacher development including mentoring should be done so well in order to avoid passing on misconceptions. Good development became evident when they were confident to mingle and mix with learners. This became one manifestation of the fruits of mentoring (cf.2.2.1.2). Using tables in formulating scientific methods and checking whether it is advisable to continue, it ensured avoidance of unnecessary problems.

The study brought a difference by organising a full-day training session for mentees to engage them as peers in how to start a project from scratch. They were taken through every scientific step. Teachers left the workshop with a completed project done by them, the first for farm school teachers in this part of the world. Mentees designed a feasibility table to simplify understanding of the hypothesis. In fact the study has come up with a feasibility table to simplify hypothesis writing. The study introduced a table to thoroughly assess materials that will be needed to complete a project.

#### 4.3.1.2 Ensuring full commitment by co-researchers

The success of the Expo projects seeks the total participation of all involved. Mentees and learners need to be kept encouraged. They need to be assisted to keep their spirits high. Lee (2013: 3) found in the study of adults that they can have benign discouragement which can ultimately kill the programme if not kept in check. Their full positive commitment can, therefore, have a resonance effect. Close monitoring through all the stages of the projects will assist to intervene where there is sluggish progress. Co-researchers and their team should as per agenda and programme agreed, be obliged to give progress reports. Each stage of the project is as important as the final product, hence the continuous reporting (Schneider & Lumpe, 1996: 85). Linking a project with a curriculum is an important push factor. It motivates both learners and teachers to zealously face the big tasks in front of them in chunks while having a supporting hand from a mentor. To eliminate distance and increase progress monitoring, virtual mentoring is a support that is available at any time.

### *4.4.1. Progress reporting*

In order to ensure that each group makes progress, a mechanism of reporting how far each group has come was agreed upon. Each group or individual had to make a brief presentation of how far they are.

Picture 4.7: Progress reporting session

In picture 4.7, the visual text shows Sebabatso presenting her progress with the co-researcher and the researcher flanking her. Sebabatso has completed the background research of the study. She has included a picture indicating dust at the mines. She has also drawn diagrams of the envisaged masks that can used by mineworkers to reduce inhalation of dust. The whole team was following attentively. They were taking notes to ask questions after the presentation or to reinforce their projects. She also enjoyed the support of the mentor and her teacher. After the presentation, the team fired clarity-seeking questions while some gave inputs which were much appreciated (cf.2.1.2.5).

Sebabatso and others who presented felt included as they were given an opportunity to present in front of the group. She accommodated all other mentees as she shared her progress. She included others as she allowed her colleagues to take tips from her work. Her freedom in responding to questions was accommodative of all.

During the process, the critical thinking skills of communicating, reasoning and defending viewpoints were put under scrutiny (cf. 2.1.2.5). The presenting individual or group noted inputs or questions on areas they had to improve on. One of the reasons that made the researcher or any adult co-researcher stand closer to the presenter was to make them feel

supported (Lee, 2013: 5 of 7). However, with time, they had to develop independence and dominate their space. It was explained that any critiquing should not be taken as a dressing down but a developmental activity (cf.2.2.1.3). It assisted them to be able to defend their standpoint and to anticipate what the audience would ask and disagree on. They were given how far they should probably be by the next session (cf.2.5.9). Projects were not all at the same level. Some were delayed by the type of the project or the group itself was grappling with a particular scientific step. Mentoring requires that mentors should allow mentees to have the freedom to approach their activity the way they think will be easier for them. Free souls enjoy what they are doing especially when motivation is continuous (cf. 2.4.3.5). They should support the mentees on their way to achieve objectives unless what they are doing is against the research ethics (cf.2.2.1.2; cf. 2.1.5.).This approach is another input of the study which will make such an impact when correctly and patiently applied.

### *4.4.2 Linking Science Expo projects with curriculum*

The idea of linking the project with curriculum had a positive influence on the scores of learners in the SBA as well. The following conversations alluded to that.

*Mr Ntshala: You know this thing of using the Science Expo project for SBA as well has really pushed me to take it seriously. They say it's killing two birds with one stone.*

*Teacher Thandi: I think you are not listening. I used to give learners just a topic to write a discussion about it and then called in a project. I never gave myself enough time to read how a project for NS should be done. For me, it was something very difficult and impossible.*

*Mr Ntshala: Since we have been hammering this to learners, they as well you have seen they are absorbed into it. Every time they receive the feedback they get motivated to do better.*

*Ms Setho: I am so lucky that I never quit. I am also using the project to give learners SBA marks for my English writing. They have really improved in their writing.*

*Teacher Hloni: In Maths, we do assignments. I want to use marks learners obtained in the graphs for the last assignment of the year.*

*Mr Mohale: Ntate Ntshala you said killing two birds with one stone, it is an understatement. You killed many. Maths, NS and English will benefit in one project.*

*Mme Lolo: This is a real integration OBE was preaching. We used to say it's impossible. Learners are also able to see how a body of knowledge relatestoreal-life situations.*

In the text, Mr Ntshala admitted that it was through involvement with Science Expo that he took doing a NS project seriously at it would benefit him and learners in both ways. It is for Science Expo and for SBA. Teacher Thandi admitted that she was doing the wrong thing as she gave learners a topic, learners would write something lengthy and call it a project for the sake of having to record on. She stated reasons for shoddy work as not devoting enough time to understand project requirements and she took it to be too difficult to be

understood and done. Learners were sweating as observed by Mr Ntshala. He attributed that on their repeated reminders and as well as feedback received on sections completed (cf.2.5.11.1). It was not only NS which was a benefactor but English as well. Ms Setho used the project to check how learners were able to do research writing and were as such credited. Even Hloni did not want to be left behind but ride on the opportunity by planning to use graphs to substitute one of the assignments. Teachers such as Mr Mohale admitted with admiration how three subjects benefited from the same source. It dawned on Mme Lolo that what they were doing was actually the integration which OBE was emphasising. This was not a forced integration.

Justice was done when the project benefited learners. It was used for SBA and Science Expo as alluded explained. It has been mentioned that one of the challenges in doing the project is learners dropping out whenever their interest wanes. The remedy was to link the Expo project with the curriculum. This was not done against the spirit of the ethical clearances signed on behalf of the learners by parents or guardians which gave co-researchers latitude and power to opt-out whenever they are no longer interested. The National Protocol of Assessment (RSA NPA: 2011: 11), states that if a learner does not do one of the formal tasks that learner will not progress to the next grade (cf.3.8.1). The two-fold approach was explained to learners when we started with the projects and was agreed upon. All would be credited marks for SBA (RSA DBE, 2011:89). This is the strength of PAR in the study in the sense that people engage with what will change their lives (cf.3.8.1; cf.2.5.1). Learners were doing the projects for Science Expo while at the same time were satisfying SBA requirements. They knew that a high score increased their chances of progressing to the next grade. It also gave them the chance to be the first ever group to ever represent their school at regional Expo. Teacher Thandeka admitted that previously she felt powerless to lead learners in the doing of the project hence her dubious approach to cheat the system. If the school was not involved in mentoring, this trend would continue unabated. So in they won doubly. Each learner gained good SBA marks and the chance for selection to participate in Science Expo. It became a motivating factor. These pushed learners and teachers on two fronts. Through the eye of Marcuse, it was their reception of transformation that brought joy to them (cf.2.1.1.1).

The usage of wrong work to hide their lack of knowledge was not acceptable to teachers such as Teacher Thandeka. The study through mentoring came in to change the acceptable wrong norm. Mr Ntshala ensured that learners were included by hammering the two-fold benefits. Repetition changes the mindset from old to new. The fact that Ms Setho appreciated that they never quit was an indication of their satisfaction of being included as

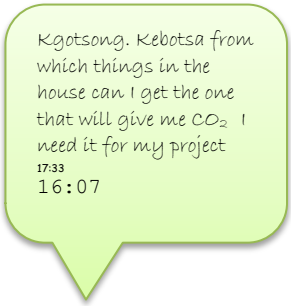
mentees (cf.2.5.2.3). While it was clear that NS would be the main beneficiary, other subjects did not want to be excluded. They too ensured that formal assessments were built from the project.

The study used integration to ensure that NS was not the only one benefiting from doing the project. The study has introduced a model were SBA marks of more than one subject are drawn from one activity. While NS would score the whole project, other subjects such as English and Mathematics used only certain aspects of parts of the study.

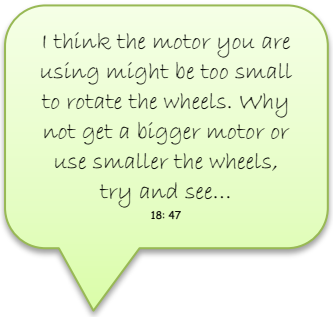
### *4.4.3 The utilisation of virtual mentoring*

The diagrams that follow are some of the WhatsApp messages as an example of the usage of virtual mentoring. The school had no access to the internet anywhere in the vicinity. Lack of ICT is one negative factor characterising farm schools (Dobo, 2015: 2 of 6). Cell-phones became an effective tool used in virtual mentoring, though only two learners had Smartphones. The third one acquired it later. Teachers and other co-researchers had them. A WhatsApp group was established for communication (cf.2.4.1.3).

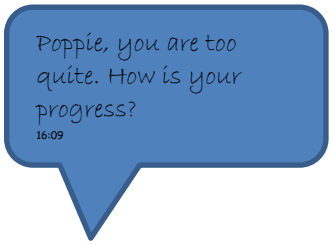
Diagram: Whatsapp bubble conversations




Bubble 4.1




Bubble 4.2




Bubble 4.3

The three bubbles indicate the text that shows the success of the virtual mentoring used to mitigate challenges of communication (cf.2.4.1.3). Bubble 1 is the message received as a group member. Words *'Kgotsong, kebotsa'* means '*Goodday, I am asking…*' From the wording, it shows that the person speaking might be a learner judging from the respectful wording used. This person also does not have adequate knowledge of science vocabulary from the use of 'things in the house' rather than *'household'* as commonly used. In Bubble 2 the learner wanted to know why the motor could not drive or propel the wheels of the project being done. The response received was for this person to try either to increase the size of the motor or reduce the heavy size of the object being propelled. The third bubble

was a question coming from the mentor. He directed the question to Poppie. It was also a way of encouraging all to participate in discussions.

WhatsApp was used to give power to the group which was earlier threatened by poor communication modes. Learners who were timid like Vusi could be fully engaged in communication and gained power as they were able to either ask questions or suggest solutions to other mentees (cf.4.2.2). The trend of non-participation was reduced by asking directed questions to individuals as done with Poppie. Justice was done by opening the usage to all mentees as mentor and mentees were having equal space to exchange ideas (cf.2.7)

All members were included in the conversation. Mentees and co-researchers also felt not excluded despite not meeting as regular in person as they so wished. Asking individuals their views via WhatsApp was also a tactic of including everybody into the conversation. This approach succeeds as those that exclude themselves later became part of regular users. The challenge about the WhatsApp was that not all had cellphones as such they were excluded or individuals would share responses regularly (cf.314.3)

As an agreed ethical policy, all conversation was done via a group. This was to avoid any untoward behaviour. Also, the conversation between two people benefited the whole group at once and they would also contribute to the conversation. Researchers shared information they had as well as the challenges faced by learners. Co-researchers, who are teachers at the research site, were able to share information with other learners. When the whole team met, they a sense of progress (cf.2.2.4.8)

Information was shared through the Internet on smartphones or on one desktop computer at school when it was operational. Whenever there was important information available, it was shared electronically. They could send pictures of projects and receive feedback. Information received was then reflected upon and refining was done (Seabrooks, Kenney & Lamontagne, 2000: 222).This process was useful during the “work to rule” by the biggest teachers’ union in RSA. They had cut communication with the Education Department. They did not allow any departmental official to visit schools, interact with teachers or attend any meeting during that period. The researcher was aware that he had to tread with utmost care (cf.2.4.3.3). He would receive progress reports electronically and could respond. Though progress stalled, there was progress recorded. It is true that while virtual mentoring was one of the valuable instruments, it had a challenge where the mentor could not directly communicate with each mentee as many times as he would have wished. In order to include them, one cellphone user would adopt a few learners nearer to them and would be

allowed to pose questions.The group messages were related to the second person. In few instances, it was not well related to by co-researchers. To mitigate that as a mentor the researcher ensured that he received the correct inquiries and also ensured that co-researchers understood what he explained before transmitting the message to the intended learners (Seabrooks, Kenney & Lamontagne, 2000: 25). He would not wait for inquiries to be made but would constantly ask for progress and how he should intervene as in some instances even co-researchers would run out of data.

At the beginning, progress reporting was stressful. No one would easily volunteer to brief the group on their progress. What added stress was them comparing themselves with others. Some would progress further than others. They were reminded of the OBE which stresses that each one can succeed but in their own time (Burnard, 2005: 38). The collaborative nature of PAR put allowed these farm school teachers to become privy to the challenges of each learner (cf.3.4.2). They had to work on the progress programme agreed upon as a team with co-researchers and the researcher supporting them. They were as such compared with themselves based on the expected progress.

Progress reporting ensured that each individual was recognised, listened to and given recommendations on areas that needed attention. Each one who was struggling was given a further focused mentoring. The group had a chance to reflect and plan the way forward as they employed PAR objectives (cf.3.4.4.) It was more appreciated by both learners and co-researchers as their improvement improved SBA as well. Their understanding and realisation that they are being accompanied on two fronts encouraged them to do more while helping hands were still available. While many did not have means to communicate electronically, the farm spirit of sharing prevailed. Teachers and few learners willingly shared information with others.

A few activities were undertaken to overturn underlying challenges differently. While in other studies progress is monitored, in this study the team added by having a presentation on progress done. Progress reporting without the culture of micro-management from each individual was expected (cf.2.4.3.8) Mentors to groups (mentees) and learners did not want to be left behind after listening to presentations. They were learning from the others on where and how to improve. The other addition of the study was the optimal utilisation of virtual mentoring during adversity. This offered a good alternative strategy that would ensure that only a small hiccup affected the study rather than stalling it. Everybody did not want to be left behind as they made use of the available electronic gadgets to share

information. The method used like WhatsApp was affordable to many with relevant devices. Positive feedback and progress attest to that.

Mentees used the Internet for communicating with the mentor. It is similar to what was mentioned in cf.2.5.11.1 as an example from Madagascar. The mentor kept in touch with the group. He was able to respond to their challenges speedily and could remind them of future meetings. This virtual mentoring strengthened the relationship and ensured that he was up-to-speed. It also assisted in solving problems or responding to questions that could not have waited until a face-to-face meeting.

The difference brought by the study was the intense utilisation of WhatsApp in the study. Unlike the traditional virtual mentoring where it is a one-to-one conversation, the study showed the success of group discussion (cf.2.4.1.3). One message or response would benefit a group. A question asked by one person was responded to by many people, giving an array of ideas which not only the person who asked question benefited from but all (cf.2.4.3). This approach built a strong group unity which is alive daily. It is easy to detect one with a challenge by being quiet for a while. The mentor made a judgement on whether to bring the mentee back to the fold by asking a question as he did with Poppie. Being an experienced mentor he could read or sense if a mentee needed a one-on-one conversation. This allows such a person to open up and express the frustrations being experienced. It was only on a few occasions that mentees felt they wanted to give up or had conflicts (cf.2.1.5). The researcher was fortunate that all challenges could be resolved without a single mentee pulling out of the study.

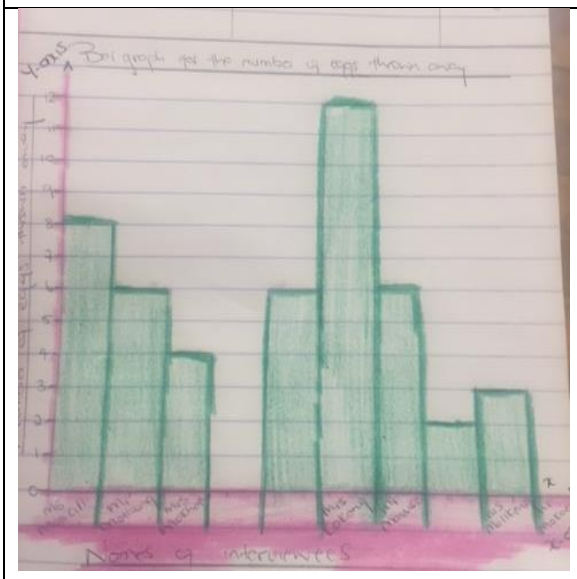
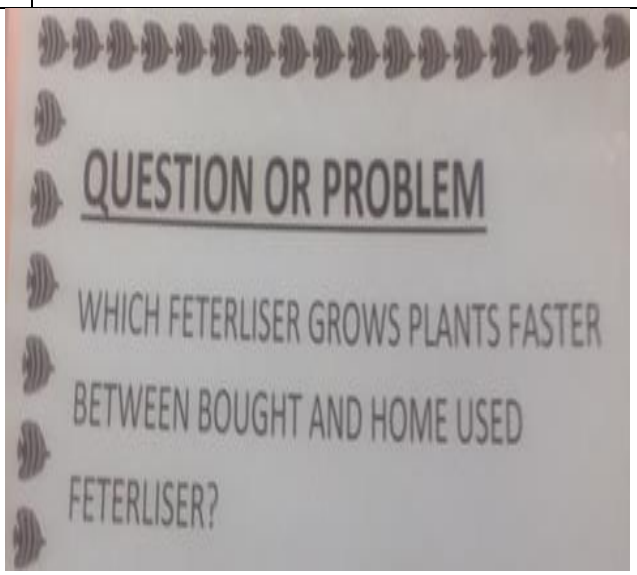
## 4.5 Rewarding successes

It is a human trait to yearn for recognition especially if success was achieved against all odds. It is not only the destination that is important but the journey is equally important as well. When the team is traversing towards the finished product, along the way rewards should be given to appreciate small achievements and to motivate them to strive for more. In the study, recognition was made during progress presentations. That would come from within the team or from people invited during presentations. Presenting a complete project in front of the audience would be the cherry on top.

### *4.5.1 Recognition of progress during presentations*

During the process of doing projects, it was mentioned that presentation of progress was made. Applying the principle of mentoring, those that have made progress received words of encouragement in front of all (cf.2.4.3.5). They were also given the opportunity to encourage others. That gave them oomph in wanting to achieve more the next time around.

Co-researchers who supported them were also given accolades. In the research done in Uganda by Onyango, Raburu & Aloka (2016: 229) they observed that learners who were recognised in front of others got extra motivated. Learners felt so encouraged when given accolades on progress done while others were watching. This motivated others to like-wise want to receive similar or better recognition. They were also elated when given a chance to encourage others. Other observing students were also motivated (cf.2.2.1.2). Teachers were equally elated to receive praise and some were able to notice where learners had to improve. They offered to support learners unaided. These were some of the indications of the success of mentoring.

| Picture 4.8: Representing results on a graph | Picture 4.9:Progress on scientific question |
|---|---|
|  |  |



Pictures 4.8 and 4.9 indicate different stages of the project by different learners. Picture 4.8 indicates a histogram, not bar as indicated. They could have refrained from using names of people but rather numbers 1, 2, 3 etc. to represent different candidates. The x-axis should be more explicit on what is being represented. Instead of 'names of interviews' they should have used 'egg users' for instance. The group could not afford to type their presentation. It was mentioned that one disadvantage of Expo is its class division. It was a challenge to edit all documents as farm school parents could not afford to pay for computer editing (cf. 2.5.5; cf.2.6.4)

Picture 4.9 indicated the improvement of learners in the writing of a scientific question. It indicated a substance that should be compared. Variables were included in the question, with the growth of plants being influenced by different fertilisers. However, they said 'home used' fertiliser instead of 'home-made' fertiliser. It is also advisable to have an independent variable before the dependent variable. Instead of 'bought fertilise'r, they could have used

'factory produced' as 'homemade' can also be packaged and sold. They should have avoided too much repetition of the word 'fertiliser'. It could be phrased as: 'Between factory produced and homemade fertiliser which one can grow plants faster' (cf.2.5.2.2)?

### *4.5.2 Staggered Scoring of projects*

In order to keep momentum going and motivation for the learners, the team designed a score sheet for the whole project. Project sheet 1 is the product of what was designed. Tables were designed in both portrait and landscape orientations. For the discussion, a portrait orientation was used.

Project Scoresheet

| SCORE | PROJECT COMPONENT | LEARNER'S NAMES | | | | |
|---|---|---|---|---|---|---|
| | | 1. | 2. | 3. | 4. | 5. |
| | Project Component | | | | | |
| 2 | Topic | | | | | |
| 4 | Background/ Introduction | | | | | |
| 2 | Aim/Purpose | | | | | |
| 3 | Hypothesis | | | | | |
| 3 | Variables | | | | | |
| 4 | Methods | | | | | |
| 4 | Results | | | | | |
| 5 | Analysis and interpretation of results | | | | | |
| 4 | Discussion of results | | | | | |
| 3 | Written language | | | | | |
| 3 | Conclusion | | | | | |
| 3 | References | | | | | |
| 3 | Acknowledgements | | | | | |
| 3 | Poster | | | | | |
| 3 | Project/ data book | | | | | |
| 50 | Total | | | | | |

The project scoresheet indicates the main components needed in a project such as a title, hypothesis and method. Names of each learner are written. A score has been determined

for each component depending on what is needed in each component. For instance,the score for the title is two marks while for background research it is four marks. Not much energy is used to formulate a topic and writing it down. The topic should, however,include variables as discussed (cf.4.2.3). Background research, however, needs more time to look for information from different sources, put it together and summarise it to have new meaning. More than one scoresheet will be needed depending on the size of the class and the page orientation used. When each component is finished a learner or group is marked and the score is written on the sheet. For instance, if a learner is done with an accurate recording of data, that learner will be given a score out of four marks. Analysis or interpretation of results is given the biggest share of the score as it demands the learner to show understanding of the data collected, analysed and their relation with the study.The teacher should immediately write down the score obtained. The scores of learners will be at different levels depending on the progress. The teacher who is considerate and accomodative may give learners a chance to improve on advice given before giving a final mark. That depends on prior agreement (cf. 2.4.3.3; cf.2.5.8).In the end, a total is obtained is added together for a final mark.The whole project is scored out of 50 marks.

For this study as it was a learning curve for everybody, learners were given a chance to improve on the shortcomings discussed with each learner. It was done to be as inclusive as possible. The Free State Department of Education motto of ‘ No child left behind’ was always ringing in the ears of mentees (cf.2.5.11.1; cf. 2.5.8). The scores became a big motivating factor to both learners and teachers. Both noticed progress. Learners got motivated to see the strides they were making. Learners got motivated to realise how much they were accumulating for SBA. To succeed, the project should be measured constantly. The opposite is a recipe for disaster and failure. Teachers realised that it is such a good idea as they had very few to mark. They avoided the pressure of waiting for the end of the year to start marking voluminous work which is unfortunately also during the end of year examination.For learners who lose their project it would mean either a big chunk of the marks or the whole project have already been recorded. This is one of the contributions of the study.

*4.5.3 School-based Expo.*

An internal mini-science Expo was held at the school where learners were judges on their projects. This was a dress rehearsal for what happens at the regional finals. It was also a process to choose who would represent the school at the finals.

Picture 4.10: School-based judging

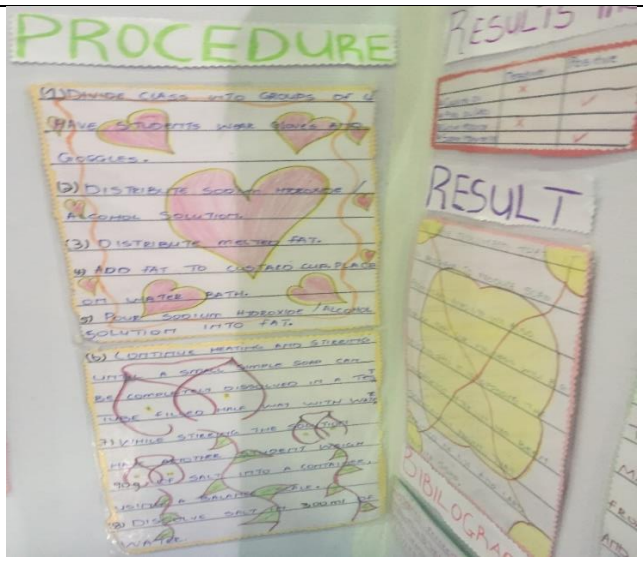
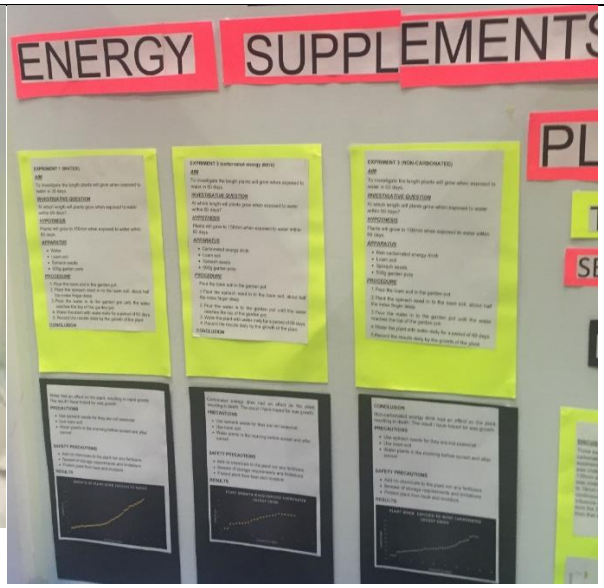
Picture 4.10, a judge who is a university student mentee was busy judging the learner at the research site. The learner had a project file and data file. Immediately after judging, learners are given feedback on areas that they should improve on. A team of co-researchers, Provincial Expo Coordinators, interested teachers from neighbouring schools and teachers from regular participating schools were on hand to support. They were judging, giving one-to-one support to learners or observing. The whole exercise was also a mentoring exercise (cf.2.5.11.1). Critical Theory stresses the transformative nature of the combative approach by many people who have added benefits (cf. 2.1.2.2).

A professor of physics and astronomy at the University of Southern California said. "I believe that the best way to encourage student accomplishment is to recognize it, and recognize it publicly" (Dunne, 2000:1 of 4).That was also the thinking behind school-based Science Expo. When learners had finished the projects, school-based Expo was conducted to choose the best projects to proceed to the finals. Mentor and mentees worked with learners to polish their projects and also prepared them to make a presentation before the judges. The Provincial Science Expo Coordinator led the team of judges (cf.2.3). All projects were scored, including presentation and response to questions. Learners with the best projects were then announced. They had to improve on the limitations highlighted during judging. The exhibition added in generating inner love for science. Though only a certain number was chosen all are winners as all 29 learners scored high SBA marks which they never even came close to in previous years. All were rewarded for the hard work displayed (cf. 2.4.3.7). It became an extra motivation for the eleven that proceeded to the finals.

*4.5.4 Public display of projects*

As in the statement ‘We have arrived’, the completed Expo projects are taken to all custodians of the school and the community. The viewing was done to display to the public what would be taken to the final competitions. The next four photographs are representative of the diversity of projects done.

Projects Displays

<table>
<tr><td>  </td><td> 
</td></tr>
<tr><td>Display 4.1</td><td>Display 4.2</td></tr>
<tr><td>  </td><td> 
</td></tr>
<tr><td>Display 4.3</td><td>Display 4.4</td></tr>
</table>

Display 1 is about water harvesting. Fetsi used a tin as a Jojo (a common name for the movable water tank in rural areas in South Africa). Pieces of scrap metals and cardboard were used to build a house while the soil was used for cleaning harvested water. All materials used were obtained for free from home. In Display 2, Sentle used a pen to write posters. She also used crayons to make it attractive. For Display 3 Unathi used a fan using

solar energy. A discarded fan was reworked to use solar energy. A voltmeter borrowed from the mentor was used to indicate the amount of voltage used. A project file was also on display. In Display 4, Kabelo upped the game as she requested the support of a co-researcher from the university to type and print her posters for her. The poster was colourful and attractive. She also took a risk by doing a project with three hypotheses.

The public display to community is another way of including them in the game-changing activity. Critical theory highlighted that transformation is for the collective which includes the community. That was the reason for displaying the projects publicly. The community was sharing in the development of the mentees (cf.2.1.2.2).Their success is everybody's success. The finalists had an opportunity to explain their projects to the people who visited their display benches. Words of encouragement received from individuals after observing and listening to the abridged presentations had the mentees grinning non-stop. One parent was speechless. She only exclaimed: *"Ra tlara bona dinthotsentle re tsofetse, re bile re di bontshwakebana barona!"(We are only seeing beautiful things in our advanced age, and being introduced to them by our children for that matter!).* It also reduced anxiety for the finals. and prepared them to be able to respond to impromptu questions. Studies done in Ohio district (USA) concluded that participation in Science Expo inculcates self-confidence (Czemiak, 1996: 21). The positive attitude was built at school level. They would be ready for the big occasion which was lying ahead. Davies and McGregor (2017:181) said parents and community add to the raising of the school profile. Mr Ntshala and Teacher Thandeka, the NS teachers, vowed to never let the fire started to go out. Teacher Hloni, the Mathematics teacher was said to have been humbled by the whole mentoring process. Ms Setho was exuberant about acquired confidence, "No one is ever too old to learn. Next year you can leave me alone, I will mentor all these leaners alone"

In her closing remarks, the principal had this to say, "Never underestimate the power of teamwork. I have swallowed my doubts when the study was first introduced. From now onwards I believe everything is possible at this school. I, together with my dedicated team of teachers and learners are thankful for the mentoring done at our school". She also extended her gratitude to all co-researchers (cf.2.5.9).

The mother was surprised to see what learners had achieved. She said they are learning new things each day. She was taken aback that they were seeing new things from their children. The two NS teachers had resolved to continue with what had been started. The Mathematics teacher felt humbled by how much he had learned while the English teacher vowed to go it alone if others pulled out the following year. The principal summed it up by applauding working together as a team and attributed that to mentoring. One parent

acknowledged the positive changes brought by the study. She represented the feeling of the community. They marveled at how young ones changed the face of the school and by extension the community. Learners themselves realised how mentoring had revealed their inner potential. From their reaction, the researcher could see that nothing could stand in their way. Even their teachers attested that the average performance and classroom participation had improved. It had triggered so much confidence in the NS teachers that they committed to never lower their guts (cf.2.4.3.1). They had owned it. Critical Theory and PAR teaches humbleness. It was evident in the Mathematics teacher. His attitude of 'Mr Know-it-all' was no longer the same. He became a convert to empowerment. The principal realised that she should develop confidence in the people around her. With her support and leadership together they can achieve more. The school has besides Expo adopted mentoring as a key approach to all tasks they used to think to be impossible. The achievement can be summed up by the words of the greatest statesman Nelson Mandela, "We are powerful beyond imagination"

The whole group of 29 worked together for months. A deep relationship was developed. All of them had the ambition of ending their journey at Expo finals. There were some disappointments when they realised that only 11 would proceed to regional finals. Though this was mentioned a number of times before, each one had hoped to be the chosen ones (cf.2.4.3.3). The mentor had to calm them and reassure them that they were winners as their names would forever be engraved in the annals of the school and community. All was not lost as they were overjoyed by the SBA scores they received. This, according to the school, was the highest average score on a project ever.

The scoring of projects based on what had been completed at the time was a good motivating factor as learners would see how much they were already accumulating to build up their SBA. No learner left empty-handed as all got a boost in SBA which would definitely go a long way in improving their chances in progressing to the next grade with a better grade level. Each person, more especially young ones and young teachers, want to be labeled as pioneers. Later they will be the legends whenever the school's journey on Science Expo is discussed. The public display adds more to make learners feel important, loved and wanted. The last group chosen to represent the school to the finals had excitement and confidence that would never be easily broken (cf.2.43.1).

Unlike what happens in urban schools, the parents in the research community were not overly assisting their children to the extent of doing projects for them (cf.2.5.6). They gave their children space. The teachers as co-researchers and mentors also did not do projects for the learners but respected their limits. The researcher realised that since it was a new

adventure for them as well they had not much to spoon-feed the learners with even if they so wished. Parents were supportive of the projects rather than seeing them as distractions for learners (cf.2.5.5). Repeated recognition on each step accomplished by the team kept the team in high spirits most of the time. As learners saw how many marks were accruing, their cooperation with the teachers increased.

The study struck similarities with the USA approach as the end results pushed up self-esteem and closeness of young ones to adults. The open friendship makes learners relax and that results in a good learning atmosphere with positive results (cf.2.4.3.9).

Unlike some of the reservations about the Science Expo, the parents in this community showed support. They tried by all means to support their children and the school. They supported the public display of projects despite their poverty, lack of education and travelling long distances. Their supportive and positive comments strengthened the mentees (cf.cf.2.5.5).

### 4.6 Summary of the chapter

The more the teachers have knowledge about Science Expo the more likely it will succeed. Teachers on the research site had not encountered Expo before. Their collaboration with the mentor brought transformation. Their challenges ranged from a choice of appropriate topic, all scientific skills, lack of apparatus, choice of apparatus and lack of access to the Internet. In order to alleviate their fears teachers were trained hands-on how to complete a project. While they would be mentees, they would also be mentors to learners. Both teachers and learners were exposed to keeping a checklist on how to identify the needs of the project. To track the progress it was required that presentations on progress were periodically done. The scoring of the project along the way and linking it to SBA ensured focus. The team was encouraged by holding a mini-expo at school and allowing the community to participate in judging and motivating learners.

### 4.7 Conclusion

Teachers who are co-researchers need proper training through all Science Expo project methods. Learners should be advised on how to choose a good topic that they will be able to carry out to the end. It is always best as a beginner to choose a locally based project or a familiar one where resources are easily available. A feasibility table should be made about the chosen topic. More positive responses are a green light to continue. Progress should be assessed throughout the mentoring process with the score given at an agreed completed level. Where possible, linking Science Expo project with a Curriculum project as needed for SBA gives everybody extra motivation and intent to be fully engaged.

# CHAPTER 5

# FINDINGS, RECOMMENDATIONS AND CONCLUSION

## 5.1. INTRODUCTION

This concluding chapter in the study on *Mentoring Farm school teachers towards Expo for Young Scientists projects* is focused on briefings on the findings made, conclusions drawn and recommendations based on the data analysed in the previous chapter. The objectives of the study are used to sequence presentations. For each objective highlights on findings, challenges and solutions will as far as possible be outlined. Challenges and limitations will be brought to the fore so as to pave the way for future studies. The discussion will indicate how steps of Critical Theory as the framework and PAR as an approach positively influenced the study.

## 5.2. Background

South Africa as influenced by trends around the globe and economic gaps encourages the studies in Science related subjects (STEM). Over four decades Expo for Young Scientists has played a big role in inculcating science affinity in South Africa. Schools in big towns and cities have taken some recognisable strides in participation in the yearly event. These schools have represented the country in worldwide school Science Expos, Science Fairs and Science Festivals. It has launched careers of many teachers in different fields of science as mentors. Farm schools have unfortunately in most cases been left behind.

It has been realised that the gap is on the teachers' side. Teachers have either little or no exposure at all to Science Expo. It is as such advisable to take them along through mentoring. Empowering them means a direct investment into generations of learners who are going to pass through the corridors of such a school. In fast-tracking participation in the Thabo Mofutsanyana District farm schools, this study focused on mentoring teachers at the research site, which is a farm school. They were trained in-service as they learned on the job. Their active engagement with learners ensured that they learned as they practiced as mentees. An array of literature was studied to support the study.

### *5.2.1. Problem statement*

The background of the study gave an idea of the problem statement of the study. The non-participation of farm schools in Expo for young scientists has had the researcher worried as a Science Expo activist. It means learners at farm schools are left at the periphery of the

inculcation of a fondness for Science from an early age. The Free State Education Department's motto is "No child left behind". This to the researcher means every child including farm school learners. My realisation was that non-participation is influenced by teachers who should lead the process. Some of the teachers are not starting Expo at their schools not because they are lazy but because they need support. In responding to this, this study was meant to employ mentoring as a strategy to change the face of farm teachers and learners in their care. Farm school teachers who are in the best spaces lack requisite knowledge and skills to mentor learners. That is why they were taken through hands-on activities in equipping them to have a better idea. Their continued working with learners would help them to gain a better and further experience. It was the duty of the researcher to give them as much support and guidance as possible through mentoring.

### *5.2.2. Research question*

How can mentoring be used as a strategy to assist farm school teachers in developing science projects for participation in Expo for Young Scientists?

### *5.2.3. The aim of the study*

The aim is to employ mentoring as a strategy to support farm school teachers in preparation of science projects for Expo for Young Scientists.

### *5.2.4. The objectives of the study.*

There are five objectives used in the study which responded to the research question that were explored successfully through mentoring as a strategy to expedite a farm school's participation in Expo for Young Scientists. A thorough study of a wide range of literature through Critical Theory as a framework gave convincing arguments on the study. The findings of the study using an approach to PAR, different methods of data collection and analysis have positively responded to these objectives. Objectives of the study are:

- Determination of deterrents for the school's participation.
- Systematic response to detected deterrents.
- The anticipation of hindrances that may arise.
- Ensuring hands-on-deck for all members

Each of the objectives was used as a measuring stick on the progress and the success of the study. Objectives are a pH meter of mentoring as a strategy to help in responding to the question and hypothesis of the study. Achievements of each objective scale-up the success

of the study. A further discussion based on the findings for each of them will follow in this chapter.

## 5.3 Theoretical framework

Critical Theory as a theoretical framework became an appropriate lens that assisted the study to test each objective in achieving the aim of the study. Mentoring rode easily on the objectives of Critical Theory. Teachers empowered through mentoring are able to stand on their own on Expo for young Scientists projects. They were transformed from their dark days as they were supported in their journey to self-emancipation. Their collaboration with the mentor raised their consciousness to challenge the inequalities of their exclusion in participation in Expo for Young Scientists. The community placed empowerment in their own hands by critically creating opportunities for optimizing mentoring as a strategy.

The section first discusses the findings which are followed by a recommendation for each.

## 5.4. Findings and recommendations

### *5.4.1. Determination of deterrents to the school's participation*

Lamentation about the lack of training is compensated for by building self-confidence in the teachers through thorough training.

#### 5.4.1.1 Findings on the determination of deterrents to the school's participation

The study revealed that the perceived knowledge gap hindered teachers to engage with the projects. They had concluded that without prior training or with inadequate so-called micro-wave training, they saw no way forward. Expo for Young Scientists was viewed as for people with a good science background. This attitude was also displayed by those in leadership who should keep everybody invigorated. These made teachers fear the prospect of being embarrassed by learners who might know better than them or be in need for the support they would not be capable to render. Their attitude was robbing them of confidence. Their perception was that their farm had no resources to meaningfully engage in Science Expo.

#### 5.4.1.2. Recommendations on the determination of deterrents to the school's participation

Teachers are life-long learners whom the study urged not to romanticise inefficiency. They have the power to transform their situation through knowledge and skill digging. Through mutual learning which amongst others includes engaging mentors, they should empower

themselves to be at a level of engaging in Science Expo. Any little training received should be used as a headstart. School managers should show commitment to the cause by seeking ways on how to support teachers and inculcate the spirit of teamwork to all members. They need to talk positively about the project as any negative statement kills morale.

A good foundation for starting an Expo project which will quickly be at the level of seasoned campaigners is to arrange a workshop of concerned teachers which should not be less than six hours, the minimum. If there is a problem in finding an open full-day, training can be broken into sessions of two hours which may be in the afternoon or during school vacations. The first two hours should be devoted to a discussion on understanding the meaning of each scientific method. The remaining hours should be hands-on activities. FAI should be carefully used to encourage participation and ensure understanding from the start. Understanding of scientific steps makes it easier to apply them correctly. For an inexperienced person, the topic of the project should display two important roots, which are dependent and independent variables. The presence of the two simplifies hypothesis and research question formations. Before commencing with the project, a table should be drawn to list possible apparatus, resources and references needed and how each will be used. It should also be listed where they will be sourced. This action will tell if it will be possible or difficult to do a chosen project. This is done to avoid wasting time to start a project that will be difficult to complete. The project may as well be changed to suit the apparatus that are available. Time well used to work with teachers is a good investment that will yield a lifetime of returns.

### *5.4.2. Systematic response to detected deterrents.*

The attitude of a farm community about themselves had to be worked on to have a changed new positive perspective. They had to look at their rich ecology.

#### 5.4.2.1. Findings on systematic response to detected deterrents

The learners, like their teachers, laughed at themselves when the issue of a farm related project was mentioned. The people on the farm have a feeling that any project related to the farm cannot be regarded as pure science. They harboured a feeling that a “wow factor” is never related to a farm. The continued working together of teachers and learners developed a state where teachers as adults learned and accepted that they can learn one or two things from learners. They realised that transformation is within the power of the farm community. Learners with a better command of English initially dominated the proceedings.

Participation improved when discussions were open to home language as well. The conditions of the study made it easy for the girl-child to participate. They in fact became the most active. The study as well did not restrict learners but allowed learners to try alternative projects which some later had to abandon for the earlier advice of local choices. Both teachers and learners did not shy away from airing their opinions which contributed positively to the study.

5.4.2.2. Recommendations on systematic response to detected deterrents.

The study recommends that teachers as future mentors should remind learners always to ask themselves what the value their chosen project will have or what new knowledge the project will add to the existing topic. It is in their interest to choose a topic they have some idea about. The study has spoken intensely about a feasibility table. This is one of the contributions of the study. The feasibility table should again be used to check the depth of understanding of the topic. It should be used to check the number of references that will be available when writing the background of the study. Adequate resources help a researcher to have a better understanding of the project ahead. That also helps a reader to understand what the project is all about. The school library, newspapers, magazines, the Internet and the research team are but some of the reference resources. The table is also used to check how many of the apparatus needed is available. If apparatus is not available at all, it should be a no-no. If few are available, the project can be rephrased or the method can also be changed to suit what is at hand. A project that addresses local issues has a chance to succeed as most of the apparatus may be easily available in abundance. The feasibility table bring to light the treasure of information that exists in the farm school. Though the presentation is done in English, it should not be a big factor when working with the group. Everyone should be allowed to use home language if that assists the project. What is important is that the team should use critical thinking on what they will understand and are able to fully participate in the discussion. The adult co-researchers should be good listeners as an objective of mentoring. This action eases the interaction and it also helps teachers to make exact interaction where it is needed. It is at the advantage of the bigger purpose that a team of co-researchers should be made of both sexes. It encourages and attracts active participation of the girl-child. It is what the study had successfully applied and as such contributes to the study. They did not just add to the numbers but fully and actively participated. They observed the composition of co-researchers and mentees.

### *5.4.3 Anticipation of hindrances that may arise.*

One of the anticipated hindrances was a lack of time to complete the study. Compensation for that should be devised to close the gap.

#### 5.4.3.1. Findings on anticipation of hindrances that may arise.

The findings of the study on anticipation of hindrances were intertwined in the study with other objectives. That was an approach to solutions. Some could only be dealt with as we experienced a hindrance. Some were interlinked so that working on one automatically solved the next one. One of the envisaged hindrances as mentioned elsewhere in this chapter was the challenge of not having unlimited time to meet with co-researchers and to visit the research site. Hence the study's utilisation of virtual mentors especially WhatsApp which was not part of the initial planning. The success of this approach cannot be over-emphasised hence the recommendation of its use.

The linking of Science Expo projects with the curriculum pre-empted the lack of interest that that would arise. This act reduced unnecessary stop-and-go in the flow of the study. It gave learners that extrinsic motivation. The inclusion of progress reporting in the programme was to arrest any demotivation even before it reared its head. Recognition of teachers and learners on the positives constantly rejuvenated them. The public display and presenting by learners built self-confidence which would be needed during the competitions.

#### 5.4.3.2. Recommendations on anticipation of hindrances that may arise.

Pre-empting hindrances and mitigating actions to eliminate them is a necessity that will remove as many potholes as possible from the path of doing Expo projects. The common ones appeared as well in the study. The recommendations will help teachers when planning for future Science Expo projects mentoring. Extra effort should be made to exchange notes with the co-researchers between contact sessions. Virtual mentoring was later infused into the plan. An example that worked and is recommended is a WhatsApp group. Its usage keeps lines of communication functional. It is used to exchange information with all members of the group. All are able to contribute and even learn from responses which are not directed to them.

Progress should be tracked through a constant presentation on how far they are. Commendations and recommendations for improvement should be clear. It was mentioned in the study that doing the project is a tedious job. Learners should not toil for fun only but

scores should be utilised to boost their SBA marks. That will attract more teachers and learners as there are more hands that support them.

### 5.4.4. *Ensuring hands-on-deck for all members*

The study came with the means of keeping all on their toes such as progress reporting and awarding of marks.

#### 5.4.4.1. Findings on ensuring hands-on-deck for all members.

The findings are that to ensure full commitment, the mentoring programme should be close and genuine. When the team realises this, they do likewise. It was also found that the process of having a brief presentation on progress each time the team meet pushes each co-researcher to have done something further than the last time. Mentees as well want to be found to have given learners necessary support as much as they could. They try by all means to have an understanding of what they are doing as they have to explain, clarify and defend to the bigger group. In the beginning, it is difficult for learners to stand up and present. Those who presented became irritated when asked questions. A few of those asking questions were in an attacking mood. Defending a project idea and direction built the critical thinking and logical communication as one of the objectives of Critical Theory.

The study also found that to inculcate deeper commitment, the Science Expo project should be linked with the curriculum. In countries like South Africa where the project is compulsory from grade seven, it is very opportune to do so. Everybody involved is a winner. The teacher does not have plead too much. Learners know that a good project will score good SBA marks and a possible slot in the finals of Expo for Young Scientists. A subject teacher like NS enjoys the support of other teachers who are there to support with their expertise.

One of the findings is the successful usage of virtual mentoring. It was not possible to meet the team regularly. Also, there were challenges of accessibility to the research site or with all schools during the lockout by the teachers union. The WhatsApp group became the effective communication tool. Information was shared with all co-researchers while at different places. Unfortunately, some members just disappear; they do not contribute.

5.4.4.2. Recommendation on ensuring hands-on-deck for all members

The study recommends that whenever an Expo project is undertaken, there should be a programme of monitoring progress. Teachers need to allow learners to support what they are doing argumentatively. A programme of how the presentation will be contacted spares time and undue anxiety. Learners need the closer support of an adult with continuous motivation. Learners like any child need constant assurance, hence the need for mentoring.

The other recommendation is that, as much as possible curriculum should benefit during the doing of projects. Scores obtained by learners should benefit them in one way or the other. The score needed to qualify for Science Expo finals should be made known from the beginning. Teachers should give constant feedback of the scores accrued as learners are motivated to see how much they have for SBA and how close they are approaching qualification for Expo finals. The accrual system of scoring projects is the contribution of the study.

Whether the school has access to the Internet or not a WhatsApp group should be one of the tools to be used. The spirit of the team is kept alive as members can share information they have anytime. Questions, queries and frustrations are attended to speedily. It can also be used to share progress. The study has however warned of its disadvantage which should be taken in check. It should never replace face-to-face interaction.

*5.4.5. Acknowledging achievements.*

Every step achieved should be acknowledged through different ways not limited to SBA. Praise should come from different angles as well.

5.4. 5.1. Findings on acknowledging achievements

The study found that with public recognition, encouragement increased efforts made by the activity by co-researchers. People enjoy attention. When praises are sung, it is easy for them to accept any recommendation given without showing signs of disgruntlement. The other reward practiced was awarding marks as per level at which the project was. The hope to succeed and achieve a required score for qualification into the Expo finals and high SBA marks were sustained. A Mini-Expo held at school was a good dress rehearsal for what takes place at finals. Those that did exceptionally well were used as examples. The

exposure of the project to many eyes ensured that mistakes were eliminated as far as possible.

5.4.5.2 Recommendations on acknowledging achievements.

It is the researcher's recommendation that the progress of all involved should constantly receive recognition in public as that creates a jovial mood. Doing projects becomes a time of fun as should all extra-curricular activities. A public display should be included in the programme. Projects can be displayed at school, during parents meetings, inside the school premises, next to a busy street or at a neighbourhood shopping mall. Everything should be well planned and ethics should be strictly adhered to. No one should be deliberately embarrassed. Teachers need to encourage more participation and support during these gatherings. A public display also increases the scope of ownership. It creates happy learners, happy teachers, happy parents and a happy community. In Sesotho we say, 'Letshwele le beta poho', transliterated as saying, 'The crowd wrestles a bull'. An inclusive approach of mentoring in support of PAR and Critical Theory objectives makes a heavy job much easier.

## 5.5. Conclusion and remarks

Mentoring as a strategy is useful in supporting teachers of the farm schools in their desire to have their learners participating in Expo for Young Scientists. Their close working with the mentor gives them chances to learn and understand the requirements of the projects. They learn while at the same time mentoring their learners. Teachers test the strategy by combining theory and practice. That further sharpens their skills. Close implementation of the strategy successfully carries farm school learners to the point of being ready to participate in Expo for Young Scientists.

## 5.6 Recommendations for the improvement of the study

In order to shorten the period of doing the projects, it is better to start with doing a full project with teachers. At least two different types should be done. When a mentor starts to work with the learners, teachers already have a better idea of what is needed. They will immediately start to support or mentor learners in the mentor's absence. During the first few sessions, they wait for the mentor rather than progressing with the learners. Also, the anticipated hindrances that may be identified at the beginning of the study should be addressed for once and for all. It is better to be proactive. Reacting later in the study gives a

sense of being reactive. The action taken should differentiate hindrances to challenges encountered during the study which will be reacted to by then.

The study should in the future focus on a small one-man school and test how this strategy can be tested. Teachers in this type of school do not enjoy the luxury of having colleagues to support. They are far from the next school which makes teamwork a serious challenge.

### 5.7 Constraints and limitations

The study was tested at a farm school having more than one teacher so team-work was built. Not all farm schools enjoy this environment.  Also, only one school was a focus and no replication was done during the same period at another one man school to compare the results of the same study.

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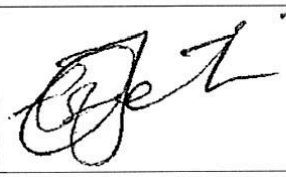
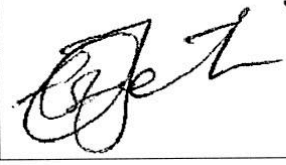
## APPENDIX A

THE UNIVERSITY APPROVAL OF THE STUDY PROPOSAL

**APPROVAL / TOESTEMMING**

- **This proposal has been thoroughly discussed and accepted by the relevant SRT panel.**
  **Please provide the name of the relevant SRT here:**
- **This proposal has been language edited by a professional editor, and evidence to this effect has been submitted.**
- **The involvement of expertise from other disciplines/SRTs has been considered.**

- ***Hierdie voorstel is volledig bespreek en goedgekeur deur die betrokke SNS se paneel.***
  ***Verskaf asseblief die naam van die betrokke SNS hier:***
- ***Hierdie voorstel is taalversorg deur 'n professionele taalversorger, en bewys daartoe is ingehandig.***
- ***Die betrokkenheid van kundigheid van ander dissiplines/SNSe is oorweeg.***

| | |
|---|---|
| **Signature of Supervisor/Promoter**<br>**Handtekening van Studieleier/Promotor** |  |
| **Signature of Co-supervisor/Co-promoter**<br>**andtekening van Medestudieleier/Medepromotor** | |
| **Signature of Head of School / Programme Director**<br>**Handtekening van Hoof van Skool / Programdirekteur** |  |

## APPENDIX B

THE FREE STATEDEPARTMENT OF EDUCATION APPROVAL TO CONDUCT RESEACH AT AN IDENTIFIED SCHOOL

Enquiries: KK Motshumi
Ref: Research Permission: T J Seoke
Tel. 051 404 9283 / 9221 / 079 503 4943
Email: K.Motshumi@fseducation.gov.za

education
Department of Education
FREE STATE PROVINCE

TJ SEOKE
7092 Galane Street
PHUTHADITJHABA, 9866

083 756 3468

Dear Mr Seoke

**APPROVAL TO CONDUCT RESEARCH IN THE FREE STATE DEPARTMENT OF EDUCATION**

1. This letter serves as an acknowledgement of receipt of your request to conduct research in the Free State Department of Education.

   **Topic:** Mentoring Farm school teachers in preparing projects for Expo for Young Scientists participation

   **List of schools involved:** Sibonakaliso Farm School, Thabo Mofutsanyana District.

2. **Target Population:** 29 Grade 9 Natural Science learners aged between 16 and 17 years old and 4 grade 9 teachers responsible for Natural Science, Mathematics and English.

3. **Period of research**: From the date of signature of this letter until 30 September 2018. Please note the department does not allow any research to be conducted during the fourth term (quarter) of the academic year. Should you fall behind your schedule by three months to complete your research project in the approved period, you will need to apply for an extension.

4. The approval is subject to the following conditions:

   4.1 The collection of data should not interfere with the normal tuition time or teaching process.

   4.2 A bound copy of the research document or a CD, should be submitted to the Free State Department of Education, Room 319, 3rd Floor, Old CNA Building, Charlotte Maxeke Street, Bloemfontein.

   4.3 You will be expected, on completion of your research study to make a presentation to the relevant stakeholders in the Department.

   4.4 The attached ethics documents must be adhered to in the discourse of your study in our department.

   Please note that costs relating to all the conditions mentioned above are your own responsibility.

Yours sincerely

DR JEM SEKOLANYANE
CHIEF FINANCIAL OFFICER

DATE: 19/02/2018

**APPENDIX C**

A SAMPLE CONSENT FORM FOR PARTICIPATING MINOR

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV

**CONSENT TO PARTICIPATE IN THIS STUDY**

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet. I have had sufficient opportunity to ask questions and am prepared to participate in the study. I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable). I am aware that the findings of this study will be anonymously processed into a research report, journal publications and/or conference proceedings.

I agree to the recording of the *insert specific data collection method*.

I have received a signed copy of the informed consent agreement.

Full Name of Participant: _____

Signature of Participant: _____ Date: _____

Full Name(s) of Researcher(s): _____

Signature of Researcher: _____ Date: _____

205 Nelson Mandela Drive/Rylaan, Park West/Parkwes, Bloemfontein 9301, South Africa/Suid-Afrika
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